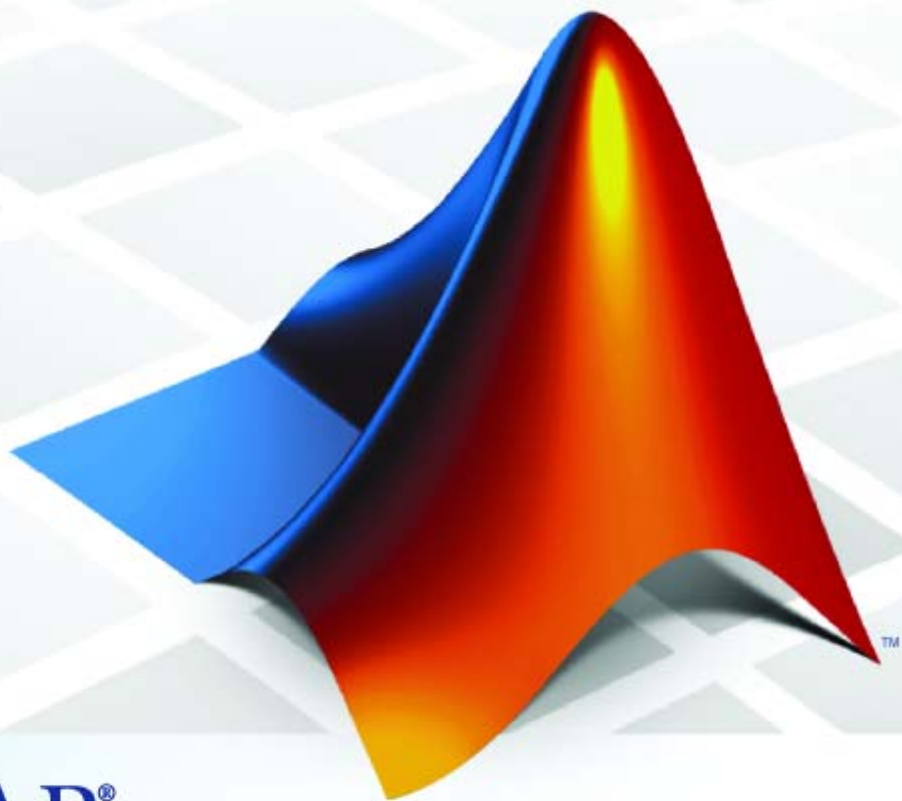


OPC Toolbox™ 2

User's Guide



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OPC Toolbox™ User's Guide

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Introduction

Product Overview (p. 1-2)

Provides an overview of OPC Toolbox™ software.

Getting Command-Line Function Help (p. 1-9)

Describes how to get help on OPC Toolbox functions at the MATLAB® command line.

Preparing to Use OPC Toolbox™ Software (p. 1-10)

Describes how to set up your computer to enable communication with OPC servers.

Exploring Available OPC Servers (p. 1-19)

Describes how to browse your network for OPC servers, and how to browse an OPC server to find server item names.

Connecting to OPC Servers (p. 1-21)

Describes how to create OPC Toolbox client objects and connect to OPC servers.

Troubleshooting (p. 1-28)

Provides some helpful tips on diagnosing problems you might encounter using the toolbox.

Product Overview

In this section...
“About OPC Toolbox™ Software” on page 1-2
“About OPC” on page 1-3
“Understanding OPC Data Access Servers” on page 1-4
“Understanding the OPC Toolbox™ Object Hierarchy” on page 1-6
“How OPC Toolbox™ Objects Relate to OPC Servers” on page 1-7
“System Requirements” on page 1-8

About OPC Toolbox™ Software

OPC Toolbox™ software is a collection of functions that extend the capability of the MATLAB® environment, and blocks that extend the Simulink® simulation environment. Using OPC Toolbox functions and blocks, you can acquire live OPC data directly into MATLAB and Simulink, and write data directly to the OPC server from MATLAB and Simulink.

OPC Toolbox software implements a hierarchical object-oriented approach to communicating with OPC servers using the OPC Data Access Standard. Using toolbox functions, you create an OPC Data Access Client object (opcda client object) that represents the connection between MATLAB and an OPC server. Using properties of the opcda client object you can control various aspects of the communication link, such as time out periods, connection status, and storage of events associated with that client. “Connecting to OPC Servers” on page 1-21 describes how to create opcda objects.

Once you establish a connection to an OPC server, you create Data Access Group objects (dagroup objects) that represent collections of OPC Data Access Items. You then add Data Access Item objects (daiitem objects) to that group, for monitoring server item values from the OPC server and writing values to the OPC server. You can use the dagroup object to perform such actions as determining how often the items in the group must be updated, executing a MATLAB function when the server provides notification of changes in item state, and other tasks related to the group. “Creating OPC Toolbox™

Objects” on page 3-2 describes how to create and configure dagroup objects and add daitem objects to a group.

The OPC Data Access Standard does not provide access to historical data. (While the OPC Foundation has defined the Historical Data Access specification for access to historical data, a significant number of Data Access servers do not support this standard.) Using OPC Toolbox software, you can log records (a list of items that have changed, and their new values) from an OPC Data Access Server to disk or to memory, for later processing. The logging task is controlled by the dagroup object. “Logging OPC Server Data” on page 4-17 describes how to log data using the OPC Toolbox logging mechanism.

To work with the data you acquire, you must bring it into the MATLAB workspace. When the records are acquired, the toolbox stores them in a memory buffer or on disk. The toolbox provides several ways to bring one or more records of data into the workspace where you can analyze or visualize the data. Chapter 5, “Working with OPC Data” describes the different data formats and their application.

You can enhance your OPC application by using event callbacks. The toolbox has defined certain OPC Toolbox software occurrences, such as the start of an acquisition task, as well as OPC server initiated occurrences, such as notification that an item’s state has changed, as events. You can associate the execution of a particular function with a particular event. Chapter 6, “Using Events and Callbacks” describes this process.

When working in the Simulink environment, you can use blocks from the OPC Toolbox block library to use live OPC data as inputs to your model and update the OPC server with your model outputs. The OPC Toolbox block library includes the capability of running Simulink models in pseudo real time, by slowing the simulation to match the system clock. You can prototype control systems, provide plant simulators, and perform optimization and tuning tasks using Simulink and the OPC Toolbox block library. Chapter 7, “Using the OPC Toolbox™ Block Library” describes how to use these blocks in a Simulink model.

About OPC

Open Process Control (OPC), also known as OLE for Process Control, is a series of seven specifications defined by the OPC Foundation

(<http://www.opcfoundation.org>) for supporting open connectivity in industrial automation. OPC uses Microsoft® DCOM technology to provide a communication link between OPC servers and OPC clients. OPC has been designed to provide reliable communication of information in a process plant, such as a petrochemical refinery, an automobile assembly line, or a paper mill.

Before you interact with OPC servers using OPC Toolbox software, you should understand the OPC client-server relationship, how OPC servers organize their server items, and how clients can interact with those server items. “Understanding the OPC Toolbox™ Object Hierarchy” on page 1-6 explains these concepts in detail.

Understanding OPC Data Access Servers

OPC Toolbox software is an OPC Data Access *client* application, capable of connecting to any OPC Data Access compliant *server*. By utilizing the OPC Foundation Data Access standard, the toolbox does not require any knowledge about the internal configuration and operation of the OPC server. Instead, the Data Access Standard provides the common mechanism for the server and client to interact with each other.

An OPC Data Access Server is identified by a unique server ID. The server ID is unique to the computer on which the server is located. A combination of the host name of the server computer, and the server ID of the OPC server, provides a unique identifier for an OPC server on a network of computers.

OPC Server Name Spaces

All OPC servers are required to publish a name space, consisting of an arrangement of the name of every server item (also known as an item ID) associated with that server. The name space provides the internal map of every device and location that the server is able to monitor and/or update.

The following figure shows a portion of the name space on a typical OPC server.

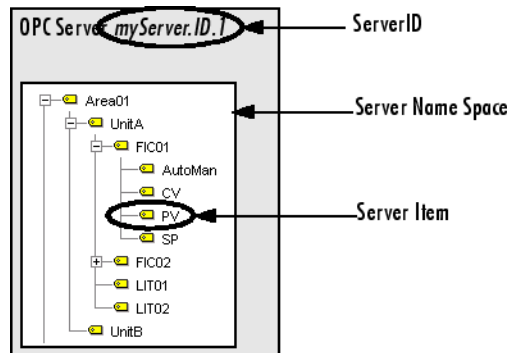


Figure 1-1: Example of OPC Server and Name Space

A *server item* represents a value on the OPC server that a client may be interested in. A server item could represent a physical measurement device (such as a temperature sensor), a particular component of a device (such as the set-point for a controller), or a variable or storage location in a supervisory control and data acquisition (SCADA) system. Each server item is uniquely represented on the server by a fully qualified item ID. The fully qualified item ID is usually made up of the path to that server item in the tree, with each node name separated by a period character. In Figure 1-1, Example of OPC Server and Name Space, the fully qualified item ID for the highlighted server item might be `Area01.UnitA.FIC01.PV`.

Most OPC servers provide a hierarchical name space, where server items are arranged in a tree-like structure. The tree can contain many different categories (called *branch nodes*), each with one or more branches and/or *leaf nodes*. A leaf node contains no other branches, and often represents a specific server Item. The fully qualified item ID of a server item is simply the ‘path’ to that leaf node, with a server-dependent separator.

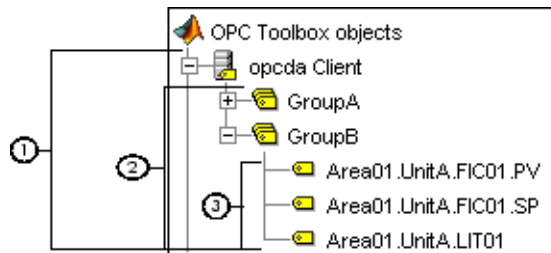
Some OPC servers provide only a flat name space, where server items are all arranged in one single group. You could consider a flat name space as a name space containing only leaf nodes.

It is possible to convert a hierarchical name space into a flat name space. It is not always possible to convert a flat name space into a hierarchical name space.

For information on how to obtain the name space of an OPC server, see “Browsing the OPC Server Name Space” on page 1-23.

Understanding the OPC Toolbox™ Object Hierarchy

OPC Toolbox software is implemented using three basic objects, designed to help you manage connections to servers and collections of server items. The three objects are arranged in a specific hierarchy, shown in the following figure.



OPC Toolbox™ Object Hierarchy

- 1 OPC Data Access Client objects** (opcda client objects) represent a specific OPC client instance that can communicate with only one server. You define the server using the Host and ServerID properties. The Host property defines the computer on which the server is installed. The ServerID property defines the Program ID (*ProgID*) of the server, created when the server was installed on that host. The opcda client object acts as a container for multiple group objects, and manages the connection to the server, communication with the server, and server name space browsing.
- 2 Data Access Group objects** (dagroup objects) represent containers for one or more server items (data points on the server.) A dagroup object manages how often the items in the group must be read, whether historical item information must be stored, and also manages creation and deletion of items. Groups cannot exist without an opcda client object. You create dagroup objects using the addgroup function of an opcda client object.
- 3 Data Access Item objects** (daitem objects) represent server items. Items are defined by an *item ID*, which uniquely defines that server item in the server's name space. A daitem object has a Value, a Quality, and a TimeStamp, representing the information collected by the server from an

instrument or data point in a SCADA system. The Value, Quality, and TimeStamp properties represent the information known to the server when the server was last asked to access information from that instrument.

A dagroup object can only exist “within” an opcda client object. Similarly, a daitem object can only exist within a dagroup object. You create dagroup objects using the addgroup method of an opcda client object. You create daitem objects using the additem method of the dagroup object.

How OPC Toolbox™ Objects Relate to OPC Servers

OPC Toolbox software uses objects to define the server that the client must connect to, and the arrangement of items in groups. The following figure shows the relationship between the OPC Toolbox objects and an OPC server.

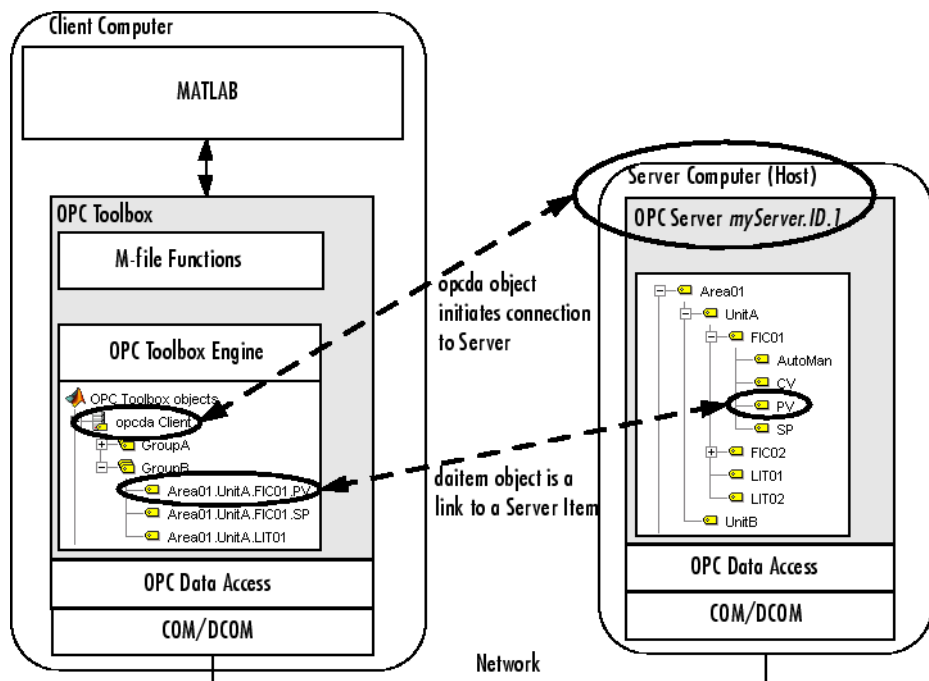


Figure 1-2: Relationship Between OPC Toolbox™ Objects and OPC Server

The `opcda` client object establishes the connection between OPC Toolbox software and the OPC server, using OPC Data Access Specification standards. The standards are based on Microsoft COM/DCOM interoperability standards.

The `daitem` objects represent specific server items. Note that a client typically requires only a subset of the entire name space of a server in order to operate effectively. In Figure 1-2, Relationship Between OPC Toolbox™ Objects and OPC Server only the PV and SP items of FIC01, and the LIT01 item, are required for that particular group. Another group may only contain a single `daitem` object, representing a single server item.

Note The `dagroup` object has no equivalent on the OPC server. However, the server keeps a record of each group that a client has created, and uses that group name to communicate to the client information about the items in that group.

System Requirements

OPC Toolbox software provides the Data Access client capabilities from within MATLAB. To use this toolbox functionality, you need access to an OPC server that supports the Data Access Specification version 2.05. In addition, you will need to ensure that you are able to connect to those OPC servers from the computer on which the toolbox software is installed. For more information on how to configure the client and server computers so that you can connect to an OPC server, see “Preparing to Use OPC Toolbox™ Software” on page 1-10.

Getting Command-Line Function Help

To get command-line function help, you can use the MATLAB® help function. For example, to get help for the `opcserverinfo` function, type

```
help opcserverinfo
```

However, OPC Toolbox™ software provides “overloaded” versions of several MATLAB functions. That is, it provides toolbox-specific implementations of these functions using the same function name.

For example, the toolbox provides an overloaded version of the `isvalid` function. If you type

```
help isvalid
```

you get help for the MATLAB Timer object version of this function. You can determine if a function is overloaded by examining the last section of the help. For `isvalid`, the help contains the following overloaded versions (not all are shown).

```
Overloaded methods
help serial/isvalid.m
help instrument/isvalid.m
.
.
.
help opcroot/isvalid.m
```

To obtain help on the toolbox version of this function, type

```
help opcroot/isvalid
```

To avoid having to specify which overloaded version you want to view, use the `opchelp` function.

```
opchelp isvalid
```

You can also use this function to get help on OPC Toolbox object properties.

For more information on overloaded functions and class directories, refer to MATLAB Programming in the Help browser.

Preparing to Use OPC Toolbox™ Software

In this section...
“Introduction” on page 1-10
“Installing the OPC Foundation Core Components” on page 1-10
“Configuring DCOM” on page 1-11
“Installing the Matrikon™ OPC Simulation Server” on page 1-18

Introduction

Before you can communicate with OPC servers on your network, you need to prepare your workstation (and possibly the OPC server host computer) to use the technologies on which OPC Toolbox™ software is built. These technologies, described in “About OPC” on page 1-3, allow you to browse for and connect to OPC servers on your network, and allow those OPC servers to interact with your MATLAB® session using OPC Toolbox software.

The specific steps are described in the following sections.

Installing the OPC Foundation Core Components

The OPC Foundation has provided a set of tools for browsing other computers on your network for OPC servers, and for communicating with the OPC servers. These tools are called the OPC Foundation Core Components, and are shipped with OPC Toolbox software.

To install the OPC Foundation Core Components, you use the `opcregister` function. You can also use the `opcregister` function to remove or repair the OPC Foundation Core Components installation.

Installing, repairing, and removing the OPC Foundation Core Components follows the same steps:

- 1 If you are repairing or removing the OPC Foundation Core Components, make sure that you do not have any OPC Toolbox objects in memory. Use the `opcreset` function to clear all objects from memory.

```
opcreset;
```

- 2 Run `opcregister` with the action you would like to perform. If you do not supply an option, the function assumes that you want to *install* the components. Otherwise, use `'repair'` to *repair* an installation (reinstall the files), or `'remove'` to *remove* the components.

```
opcregister('install')
```

- 3 You will be prompted to type `Yes` to confirm the action you want to perform. You must type `Yes` exactly as shown, without any quotes. This confirmation question is used to ensure that you acknowledge the action that is about to take place.
- 4 The OPC Foundation Core Components will be installed, repaired, or removed from your system.
- 5 If you receive a warning about having to reboot your computer, you must quit MATLAB and restart your computer for the changes to take effect.

Configuring DCOM

DCOM is a client-server based architecture for enabling communication between two applications running on distributed computers. The OPC Data Access Specification utilizes DCOM for communication between the OPC client (for example, OPC Toolbox software) and the OPC server. To successfully use DCOM, those two computers must share a common security configuration so that the two applications are granted the necessary rights to communicate with each other.

This section describes two typical DCOM configuration options to allow OPC Toolbox software to work. Other DCOM options might provide sufficient permissions for the toolbox to work with an OPC server; the options described here are known to work with tested vendors' OPC servers.

There are two configuration types described in this section:

- “Configuring DCOM to Use Named User Security” on page 1-12 describes how to provide security between the client and server negotiated on a dedicated named user basis. You do not have to be logged in as the named user in order to use this mechanism; all communications between the client and the server are performed using the dedicated named user, independently of the user making the OPC requests. However, the identity

used to run the OPC server must be available on the client machine, and the password of that identity must match on both machines.

- “Configuring DCOM to Use No Security” on page 1-17 describes a configuration that provides no security between the client and server. Use this option only if you are connecting to an OPC server on a dedicated, private network. This configuration option has been known to cause some Microsoft® Windows® services to fail.

You should use the named user configuration, unless your system administrator indicates that no security is required for OPC access.

Caution If your OPC server software comes with DCOM setup guidelines, you should follow the instructions provided by the OPC server vendor. The guidelines provided in this section are generic and may not suit your specific network and security model.

Note The following instructions apply to the Microsoft Windows XP operating system with Service Pack 2. Users of other Microsoft Windows operating systems should be able to adapt these instructions to configure DCOM on their systems.

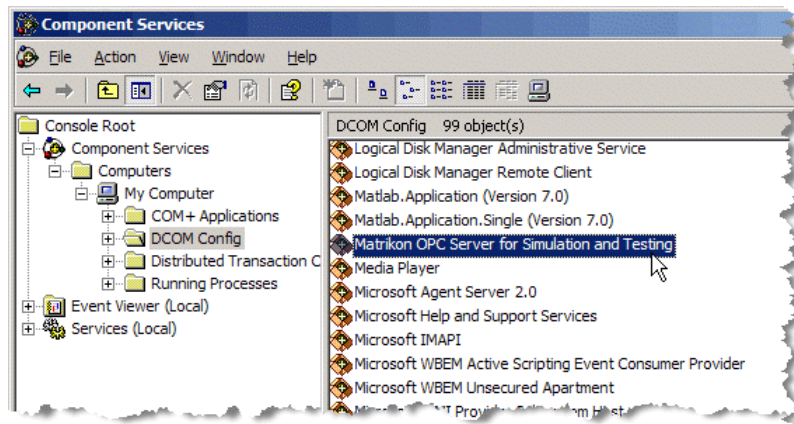
Configuring DCOM to Use Named User Security

To configure DCOM to use named user security, you will have to ensure that both the server machine and client machine have a common user who is granted DCOM access rights on both the server and client machines. You should consult the following sections for information on configuring each machine:

- “OPC Server Machine Configuration” on page 1-13 provides the steps that you must perform on each of the machines providing OPC servers.
- “Client Machine Configuration” on page 1-14 provides the steps that you must perform on the machine that will run MATLAB and OPC Toolbox software.

OPC Server Machine Configuration. On the machines hosting the OPC servers, perform the following steps:

- 1 Create a new local user. (You can also create a domain user if the server and client machines are part of the same domain.) The name used in these instructions is `opc` but you can choose any name, as long as you remain consistent throughout these instructions.
- 2 Select **Start > Settings > Control Panel**. Double-click Administrative Tools and then double-click Component Services. The Component Services dialog appears.
- 3 Browse to Component Services > Computers > My Computer > DCOM Config.
- 4 Locate your OPC server in the DCOM Config list. The example below shows the Matrikon™ OPC Server for Simulation.

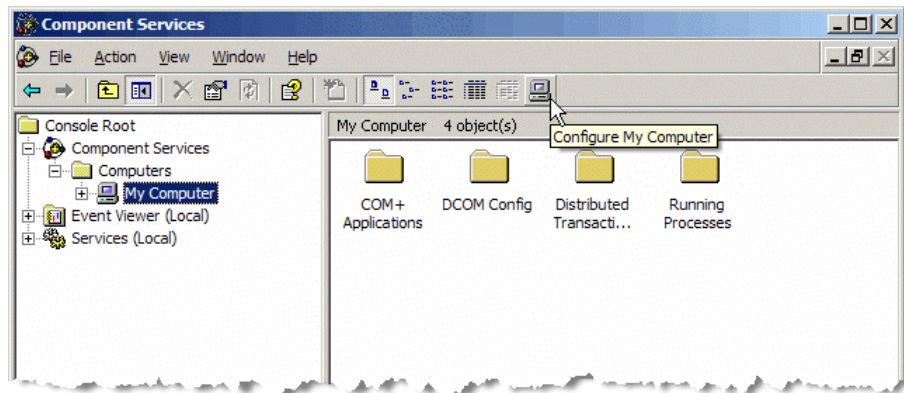


- 5 Right-click the OPC server object, and choose **Properties**.
- 6 In the **General** tab, ensure that the Authentication Level is set to Default.
- 7 In the **Security** tab, choose Customize for the Launch and Activation Permissions, then click **Edit**. Ensure that the `opc` user is granted local Launch and Activation permissions.

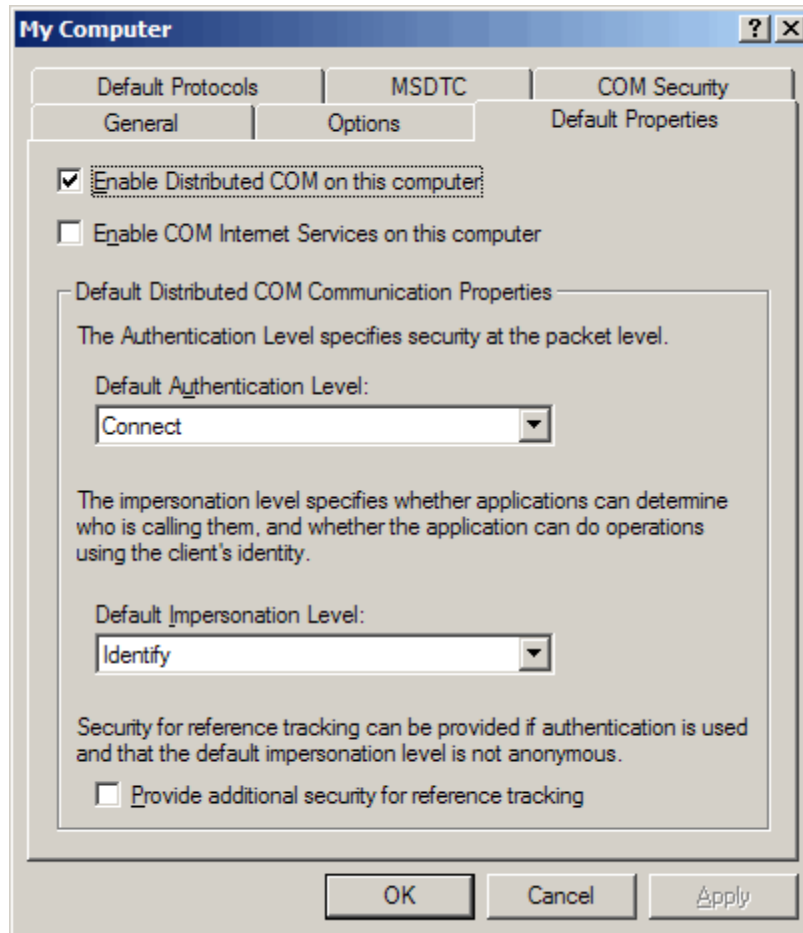
- 8 In the **Security** tab, choose Customize for the Access Permissions, then click **Edit**. Ensure that the opc user is granted local Access permissions.
- 9 In the **Identity** tab, select **This user** and type the name and password for the opc user (created in step 1).
- 10 If the OPC server runs as a service, make sure that the service runs as the opc user (created in step 1) and not as the system account.
- 11 Repeat steps 4 through 10 for each of the servers you want to connect to.

Client Machine Configuration. On the machine(s) that will be running MATLAB and OPC Toolbox software, perform the following steps:

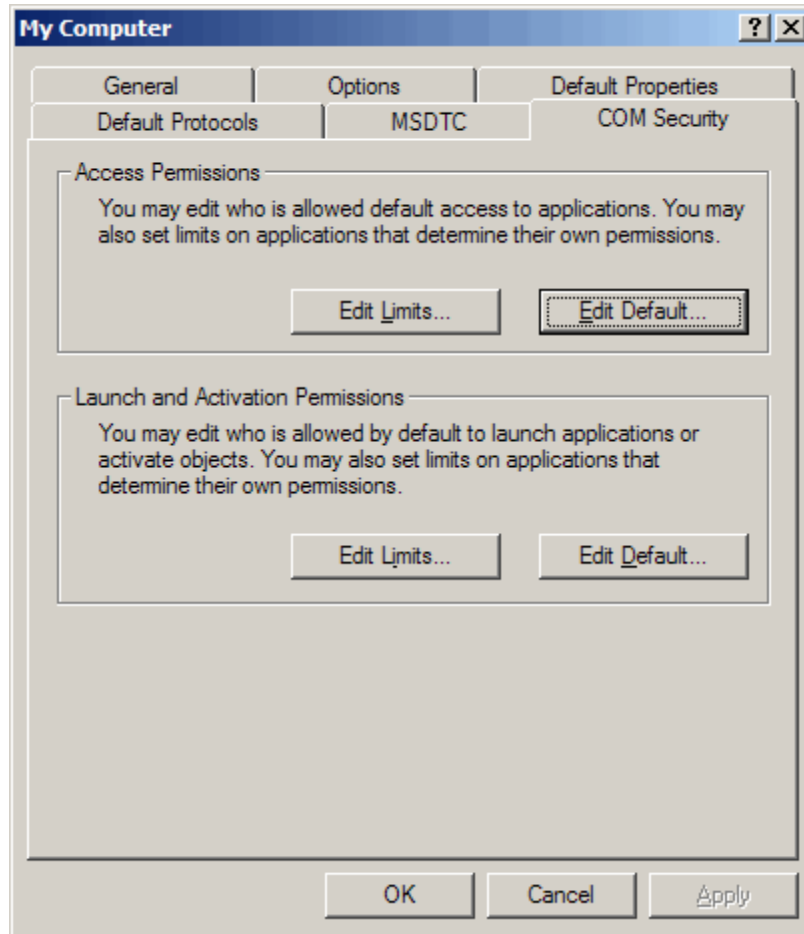
- 1 On the client machine(s), create the identical local user with the same name and password permissions as you set up in step 1 of “OPC Server Machine Configuration” on page 1-13.
- 2 Select **Start > Settings > Control Panel**. Double-click Administrative Tools and then double-click Component Services. The Component Services dialog appears.
- 3 Browse to Component Services > Computers > My Computer. Click Configure My Computer in the Component Services toolbar as shown below.



- 4 Click the **Default Properties** tab, and ensure that Enable Distributed COM is checked, and that the Default Authentication Level is set to Connect and the Default Impersonation Level is set to Identify.



- 5 Click the **COM Security** tab.



- 6 For the Access Permissions, click **Edit Default** and ensure that the opc user is included in the Default Security list, and is granted both Local Access and Remote Access permissions.
- 7 For the Launch and Activation permissions, click **Edit Default** and ensure that the opc user is included in the Default Security list, and is granted all rights (Local Launch, Remote Launch, Local Activation, and Remote Activation).

Your local client machine and server applications are now configured to use the same username when the server attempts to establish a connection back to the client.

Configuring DCOM to Use No Security

Caution You should not use this option if you are not in a completely trusted network. Turning off DCOM security means that any user on the network can launch any COM object on your local machine. Consult with your network administrator before following these instructions.

You must complete the following steps on *both* the client and server machines.

- 1** Select **Start > Settings > Control Panel**. Double-click Administrative Tools and then double-click Component Services. The Component Services dialog appears.
- 2** Browse to **Component Services > Computers > My Computer**. Click the **Configure My Computer** button in the Component Services toolbar.
- 3** In the **Default Properties** tab, make sure that Enable Distributed COM On This Computer is selected. Select None as the Default Authentication Level, and Anonymous as the Default Impersonation Level.
- 4** In the COM Security tab, select Edit Limits from the Access Permissions and ensure that Everyone and ANONYMOUS LOGON are both granted Local Access and Remote Access.
- 5** In the COM Security tab, select Edit Limits from the Launch and Activation Permissions and ensure that Everyone and ANONYMOUS LOGON are both granted Local and Remote permissions (Local Launch, Remote Launch, Local Activation and Remote Activation).

Both the client and the server are now configured so that anybody can access any COM object on either machine.

Caution This configuration is potentially dangerous in terms of security, and is recommended for debugging purposes only.

Installing the Matrikon™ OPC Simulation Server

All examples in this guide and in the OPC Toolbox online help make use of a Matrikon demonstration server that you can download free of charge from:

<http://www.matrikon.com/drivers/opc/simulation.asp>

Note You do not have to install the Matrikon OPC Simulation Server to enable any functionality of OPC Toolbox software. The Simulation Server is used purely for demonstrating the capabilities and syntax of OPC Toolbox commands, and for providing fully working example code.

To install the Matrikon OPC Simulation Server, follow the installation instructions with the software. When prompted for a server ID, use the standard server ID assigned to the Simulation Server ('Matrikon.OPC.Simulation').

Exploring Available OPC Servers

In this section...
“Prerequisites” on page 1-19
“Determining Server IDs for a Host” on page 1-19

Prerequisites

To interact with an OPC server, OPC Toolbox™ software needs two pieces of information:

- The *hostname* of the computer on which the OPC server has been installed. Typically the hostname is a descriptive term (such as 'plantserver') or an IP address (such as 192.168.2.205).
- The *server ID* of the server you want to access on that host. Because a single computer can host more than one OPC server, each OPC server installed on that computer is given a unique ID during the installation process.

Your network administrator will be able to provide you with the hostnames for all computers providing OPC servers on your network. You may also obtain a list of server IDs for each host on your network, or you can use the toolbox function `opcserverinfo` to access server IDs from a host, as described in the following section.

Determining Server IDs for a Host

When an OPC server is installed, a unique server ID must be assigned to that OPC server. The server ID provides a unique name for a particular instance of an OPC server on a host, even if multiple copies of the same server software are installed on the same machine.

To determine the server IDs of OPC servers installed on a host, call the `opcserverinfo` function, specifying the hostname as the only argument. When called with this syntax, `opcserverinfo` returns a structure containing information about all the OPC servers available on that host.

```
info = opcserverinfo('localhost')
```

```
info =  
        Host: 'localhost'  
        ServerID: {1x4 cell}  
        ServerDescription: {1x4 cell}  
        OPCSpecification: {'DA2' 'DA2' 'DA2' 'DA2'}  
        ObjectConstructor: {1x4 cell}
```

The fields in the structure returned by `opcserverinfo` provide the following information.

Server Information Returned by `opcserverinfo`

Field	Description
Host	Text string that identifies the name of the host. Note that no name resolution is performed on an IP address.
ServerID	Cell array containing the server IDs of all OPC servers accessible from that host.
ServerDescription	Cell array containing descriptive text for each server.
OPCSpecification	Cell array containing the OPC Specification that the server provides. Currently, OPC Toolbox software supports only the 'DA2' specification.
ObjectConstructor	Cell array containing default syntax you can use to create an OPC Data Access Client object associated with the server. See “Creating a Client Object” on page 1-21 for more information.

Connecting to OPC Servers

In this section...

“Overview” on page 1-21

“Creating a Client Object” on page 1-21

“Connecting a Client to the Server” on page 1-22

“Browsing the OPC Server Name Space” on page 1-23

Overview

After you get information about your OPC servers, described in “Exploring Available OPC Servers” on page 1-19, you can establish a connection to the server by creating an OPC Data Access Client (opcda) object and connecting that client to the server. These steps are described in the following sections.

Creating a Client Object

To create an opcda object, call the opcda function specifying the hostname, and server ID. You retrieved this information using the opcserverinfo function (described in “Exploring Available OPC Servers” on page 1-19).

This example creates an opcda object to represent the connection to a Matrikon™ OPC Simulation Server (available from <http://www.matrikon.com>). The opcserverinfo function includes the default opcda syntax in the ObjectConstructor field.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation.1');
```

Viewing a Summary of a Client Object

To view a summary of the characteristics of the opcda object you created, enter the variable name you assigned to the object at the command prompt. For example, this is the summary for the object da.

```
da
```

```
da =  
① Summary of OPC Data Access Client Object: localhost/Matrikon.OPC.Simulation.1  
② Server Parameters  
    Host       : localhost  
    ServerID   : Matrikon.OPC.Simulation.1  
    Status     : disconnected  
    Timeout    : 10 seconds  
③ Object Parameters  
    Group      : 0-by-1 dagroup object  
    Event Log  : 0 of 1000 events
```

The items in this list correspond to the numbered elements in the object summary:

- 1** The title of the Summary includes the name of the opcda client object. The default name for a client object is made up of the 'host/serverID'. You can change the name of a client object using the set function, described in “Configuring OPC Toolbox™ Object Properties” on page 3-17.
- 2** The Server Parameters provide information on the OPC server that the client is associated with. The host name, server ID, and connection status are provided in this section. You connect to an OPC server using the connect function, described in “Connecting a Client to the Server” on page 1-22.
- 3** The Object Parameters section contains information on the OPC Data Access Group (dagroup) objects configured on this client. You use group objects to contain collections of items. Creating group objects is described in “Creating Data Access Group Objects” on page 3-2.

Connecting a Client to the Server

You connect a client to the server using the connect function.

```
connect(da);
```

Once you have connected to the server, the Status information in the client summary display will change from 'disconnected' to 'connected'.

If the client could not connect to the server for some reason (for example, if the OPC server is shut down) an error message will be generated. For information on troubleshooting connections to an OPC server, see “Troubleshooting” on page 1-28.

Once you have connected the client to the server, you can perform the following tasks:

- Get diagnostic information about the OPC server, such as the server status, last update time, and supported interfaces. You use the `opcserverinfo` function to obtain this information. See `opcserverinfo` in the function reference for more information.
- Browse the OPC server name space for information on the available server items. See “Browsing the OPC Server Name Space” on page 1-23 for details on browsing the server name space.
- Create group and item objects to interact with OPC server data. See “Creating OPC Toolbox™ Objects” on page 3-2 for information on creating group and item objects.

Browsing the OPC Server Name Space

A connected client object allows you to interact with the OPC server to obtain information about the name space of that server. The server name space provides access to all the data points provided by the OPC server by naming each of the data points with a server item, and then arranging those server items into a name space that provides a unique identifier for each server item.

This section describes how you use a connected client object to browse the name space and find information about each server item. These activities are described in the following sections:

- “Getting the Server Name Space” on page 1-23 describes how to obtain a server name space, or a partial server name space, using the `getnamespace` and `serveritems` functions.
- “Getting Information about a Specific Server Item” on page 1-26 describes how to query the server for the properties of a specific server item.

Getting the Server Name Space

You use the `getnamespace` function to retrieve the name space from an OPC server. You must specify the client object that is connected to the server you are interested in. The name space is returned to you as a structure array containing information about each node in the name space.

The example below retrieves the name space of the Matrikon OPC Simulation Server installed on the local host.

```
da = opcda('localhost','Matrikon.OPC.Simulation.1');
connect(da);
ns = getnamespace(da)

ns =
3x1 struct array with fields:
    Name
    FullyQualifiedID
    NodeType
    Nodes
```

The fields of the structure are described in the following table.

Field	Description
Name	The name of the node, as a string.
FullyQualifiedID	The fully qualified item ID of the node, as a string. The fully qualified item ID is made up of the path to the node, concatenated with '.' characters. You use the fully qualified item ID when creating an item object associated with this node.
NodeType	The type of node. NodeType can be 'branch' (contains other nodes) or 'leaf' (contains no other branches).
Nodes	Child nodes. Nodes is a structure array with the same fields as ns, representing the nodes contained in this branch of the name space.

From the example above, exploring the name space shows.

```
ns(1)

ans =
    Name: 'Simulation Items'
 FullyQualifiedID: 'Simulation Items'
  NodeType: 'branch'
    Nodes: [8x1 struct]
```

```

ns(3)

ans =
    Name: 'Clients'
    FullyQualifiedID: 'Clients'
    NodeType: 'leaf'
    Nodes: []

```

From the information above, the first node is a branch node called 'Simulation Items'. Since it is a branch node, it is most likely not a valid server item. The third node is a leaf node (containing no other nodes) with a fully qualified ID of 'Clients'. Since this node is a leaf node, it is most likely a server item that can be monitored by creating an item object.

To examine the nodes further down the tree, you need to reference the Nodes field of a branch node. For example, the first node contained within the 'Simulation Items' node is obtained as follows.

```

ns(1).Nodes(1)

ans =
    Name: 'Bucket Brigade'
    FullyQualifiedID: 'Bucket Brigade.'
    NodeType: 'branch'
    Nodes: [14x1 struct]

```

The returned result shows that the first node of 'Simulation Items' is a branch node named 'Bucket Brigade', and contains 14 nodes.

```

ns(1).Nodes(1).Nodes(9)

ans =
    Name: 'Real8'
    FullyQualifiedID: 'Bucket Brigade.Real8'
    NodeType: 'leaf'
    Nodes: []

```

The ninth node in 'Bucket Brigade' is named 'Real8' and has a fully qualified ID of 'Bucket Brigade.Real8'. You use the fully qualified ID to

refer to that specific node in the server name space when creating items with OPC Toolbox™ software.

You can use the `flatnamespace` function to flatten a hierarchical name space.

Getting Information about a Specific Server Item

In addition to publishing a name space to all clients, an OPC server provides information about the properties of each of the server items in the name space. These properties provide information on the data format used by the server to store the server item value, a description of the server item, and additional properties configured when the server item was created. The additional properties may include information on the *range* of the server item, the maximum rate at which the server can update that server item value, etc.

You access a property using a defined set of *property IDs*. A property ID is simply a number that defines a specific property of the server item. Property IDs are divided into three categories:

- **OPC Specific Properties (1-99)** that every OPC server must provide. The OPC Specific Properties include the server item's Value, Quality, and Timestamp. See “Understanding OPC Data: Value, Quality, and TimeStamp” on page 5-2 for more information on understanding OPC data.
- **OPC Recommended Properties (100-4999)** that OPC servers can provide. These properties include maximum and minimum values, a description of the server item, and other commonly used properties. See Appendix B, “OPC Server Item Properties” for more information on OPC Recommended Properties.
- **Vendor Specific Properties (5000 and higher)** that an OPC server can define and use. These properties may be different for each OPC server, and provide a space for OPC server manufacturers to define their own properties.

You query a server item's properties using the `serveritemprops` function, specifying the client object, the fully qualified item ID of the server item you are interested in, and an optional vector of property IDs that you wish to retrieve. If you do not specify the property IDs, all properties defined for that server item are returned to you.

Note You obtain the fully qualified item ID from the server using the `getnamespace` function or the `serveritems` function, which simply returns all fully qualified item IDs in a cell array of strings. See the function reference for more information on the `serveritems` function.

The following example queries the Item Description property (ID 101) of the server item 'Bucket Brigade.ArrayOfReal8' from the example in “Getting the Server Name Space” on page 1-23.

```
p = serveritemprops(da, 'Bucket Brigade.ArrayOfReal8', 101)
```

```
p =  
    PropID: 101  
    PropDescription: 'Item Description'  
    PropValue: 'Bucket brigade item.'
```

For a list of OPC Foundation property IDs, see Appendix B, “OPC Server Item Properties”.

Troubleshooting

In this section...

“Introduction” on page 1-28
“Unable to Find an OPC Server” on page 1-28
““Class not registered” Error” on page 1-29
“Unable to Query the Server” on page 1-29
“Unable to Connect to Server” on page 1-29
“Unable to Create a Group” on page 1-29
“Error While Querying Interface” on page 1-29

Introduction

If you are unable to establish a connection to an OPC server, the following sections might help you to identify problems with installation and configuration that could be preventing you from successfully querying and connecting to OPC servers.

Most problems with connecting to an OPC server relate to the DCOM settings on either the host or the client machine. For information on configuring DCOM, see “Configuring DCOM” on page 1-11.

Unable to Find an OPC Server

First, check that you are able to communicate with the host from your client. You can test this by attempting to run a Command Prompt and using the 'ping' command on the host. Alternatively, try to browse to the host using the Network Neighborhood.

If you are able to communicate with the host, but you are unable to find an OPC server (using the `opcserverinfo` command) on that host, then the OPC Foundation Core Components may have to be reinstalled on your workstation. You can run the `opcregister` function to repair your OPC Foundation Core Components installation. For more information see “Installing the OPC Foundation Core Components” on page 1-10.

“Class not registered” Error

If you get this error while attempting to query a server using `opcserverinfo`, or when attempting to add a host in the OPC Tool GUI, the OPC Foundation Core Components have not been installed correctly. Install the OPC Foundation Core Components, as described in “Installing the OPC Foundation Core Components” on page 1-10.

Unable to Query the Server

If you are unable to query the server using `opcserverinfo`, the most common cause is incorrectly configured local DCOM security settings. Review the section on “Configuring DCOM” on page 1-11.

Unable to Connect to Server

An inability to connect to the OPC server usually indicates that the security model on the server is not allowing you to make an initial connection. Check the DCOM configuration on the server, and review the section on “Configuring DCOM” on page 1-11.

Unable to Create a Group

If you are able to connect to the server but cannot create a group, the most common cause is incorrectly configured local DCOM security settings. Review the section on “Configuring DCOM” on page 1-11.

Error While Querying Interface

If you get this error while attempting to add a group to a connected client object,

```
Error occurred while querying interface: IID_IOPCDataCallback
```

your local DCOM security settings are not permitting the OPC server to connect to the OPC Toolbox™ software client on the local machine. Review the section on “Configuring DCOM” on page 1-11.

Quick Start: Using the OPC Tool GUI

The best way to learn about the capabilities of OPC Toolbox™ software is to look at a simple example. This chapter illustrates the basic steps required to log data from an OPC server for analysis and visualization. The example uses OPC Tool, a graphical user interface (GUI) provided in the toolbox, to demonstrate the process, and includes information on how to achieve the same results from the command line.

This chapter contains cross-references to other sections in the documentation that provide more in-depth discussions of the relevant concepts.

Example: Basic OPC Toolbox™
Software Acquisition Procedure
(p. 2-2)

Presents a step-by-step approach to using the toolbox to interact with OPC servers from MATLAB® software.

Example: Basic OPC Toolbox™ Software Acquisition Procedure

In this section...

“Overview” on page 2-2

“Step 1: Launch the OPC Tool GUI” on page 2-3

“Step 2: Locate Your OPC Server” on page 2-4

“Step 3: Create an OPC Data Access Client Object” on page 2-6

“Step 4: Connect to the OPC Server” on page 2-10

“Step 5: Create an OPC Data Access Group Object” on page 2-12

“Step 6: Browse the Server Name Space” on page 2-13

“Step 7: Add OPC Data Access Items to the Group” on page 2-17

“Step 8: View All Item Values” on page 2-21

“Step 9: Configure Group Properties for Logging” on page 2-23

“Step 10: Log OPC Server Data” on page 2-25

“Step 11: Plot the Data” on page 2-26

“Step 12: Clean Up” on page 2-28

Overview

This section illustrates the basic steps required to create an OPC Toolbox™ software application by visualizing the Triangle Wave and Saw-toothed Wave signals provided with the Matrikon™ OPC Simulation Server. The application logs data to memory and plots that data, highlighting uncertain or bad data points. By visualizing the data you can more clearly see the relationships between the signals.

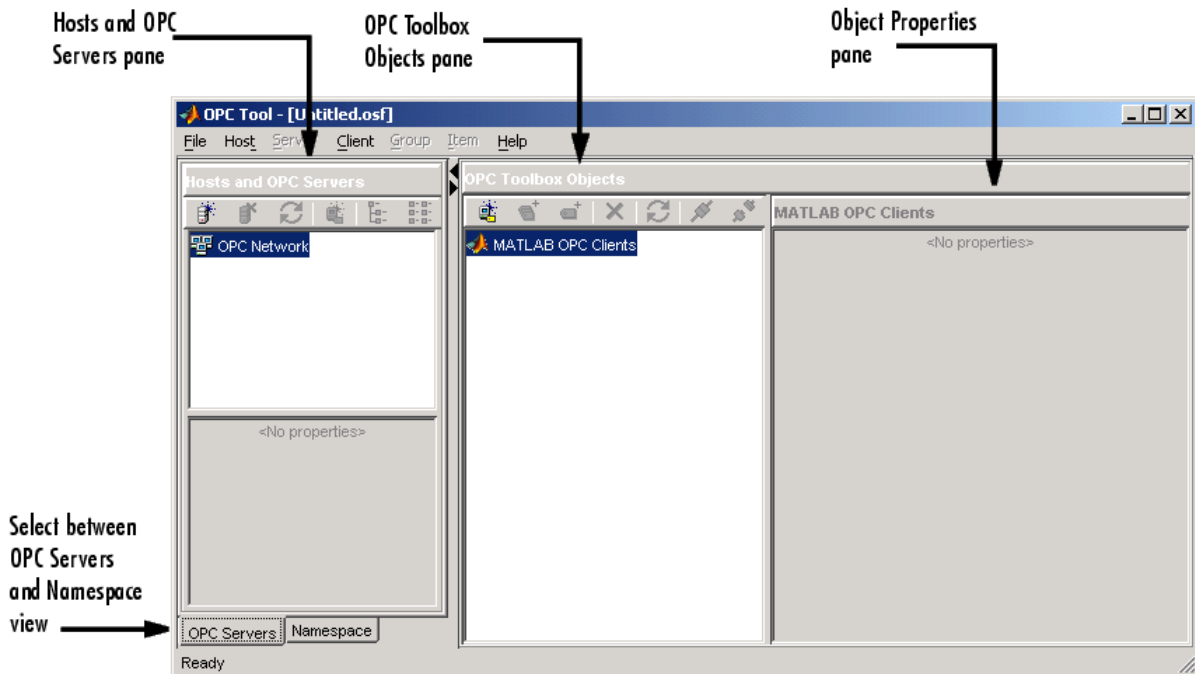
Note To run the sample code in this example, you must have the Matrikon OPC Simulation Server available on your local machine. To download the Matrikon Simulation Server, visit <http://www.matrikon.com>. The code can be used with other servers with only minor changes.

The example in this chapter utilizes the OPC Tool GUI. However, each step contains information on how to complete that step using command-line code. The entire example is contained in the demonstration file `opcdemo_quickstart`.

Step 1: Launch the OPC Tool GUI

To launch the OPC Tool GUI, type `opctool` at the MATLAB® prompt.

The GUI is displayed with no hosts, servers, or toolbox objects created. The following figure shows the main components of the OPC Tool GUI.



OPC Tool Graphical User Interface

In the following steps, you will fill each of the panes with information required to log data, and you will log the data, by creating and interacting with OPC Toolbox objects.

Command-Line Equivalent

Since this step simply launches the OPC Tool GUI, there is no equivalent function when using the command line.

Step 2: Locate Your OPC Server

In this step, you obtain two pieces of information that the toolbox needs to uniquely identify the OPC server that you want to access. You use this information when you create an OPC Data Access Client object (opcda client object), described in “Step 3: Create an OPC Data Access Client Object” on page 2-6.

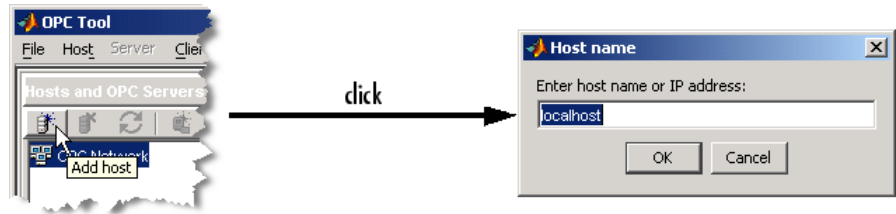
The first piece of information that you require is the hostname of the server computer. The hostname (a descriptive name like "PlantServer" or an IP Address such as 192.168.16.32) qualifies that computer on the network, and is used by the OPC Data Access protocols to determine the available OPC servers on that computer, and to communicate with the computer to establish a connection to the server. In any OPC Toolbox software application, you must know the name of the OPC server's host, so that a connection with that host can be established. Your network administrator will be able to provide you with a list of hostnames that provide OPC servers on your network. In this example, we will use localhost as the hostname, because we will connect to the OPC server on the same machine as the client.

The second piece of information that you require is the OPC server's *server ID*. Each OPC server on a particular host is identified by a unique server ID (also called the Program ID or ProgID), which is allocated to that server on installation. The server ID is a text string, usually containing periods.

Although your network administrator will be able to provide you with a list of server IDs for a particular host, you can query the host for all available OPC servers. “Exploring Available OPC Servers” on page 1-19 discusses how to query hosts from the command line.

Using the OPC Tool GUI you can browse a host using the following steps:

- 1 In the **Hosts and OPC Servers** pane, click the **Add host** icon to bring up the Host name dialog, shown below.

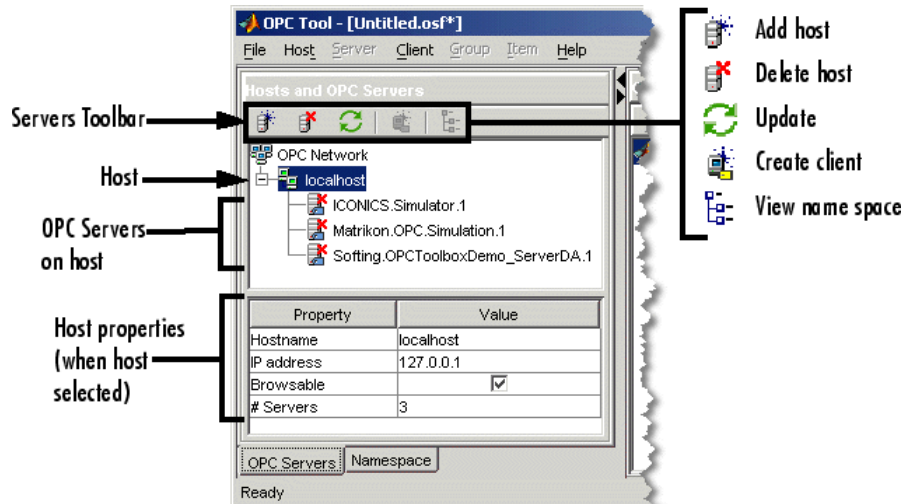


Add Host Button and Resulting Host Name Dialog

- In the Host name dialog, enter the name of the host. In this case, we can use the "localhost" alias.

localhost

Click **OK**. The hostname will be added to the **OPC Network** tree view, and the OPC servers installed on that host will automatically be found and added to the tree view. Your **Hosts and OPC Servers** pane should look similar to the one shown below.



Example of Hosts and OPC Servers Pane

Note that the local host in this example provides three OPC servers. The Server ID for this example is 'Matrikon.OPC.Simulation.1'.

Command-Line Equivalent

The command-line equivalent for this step uses the function `opcserverinfo`.

```
hostInfo = opcserverinfo('localhost')

hostInfo =
    Host: 'localhost'
    ServerID: {1x3 cell}
    ServerDescription: {1x3 cell}
    OPCSpecification: {'DA2' 'DA2' 'DA2'}
    ObjectConstructor: {1x3 cell}
```

Examining the returned structure in more detail provides the server IDs of each OPC server.

```
allServers = hostInfo.ServerID'

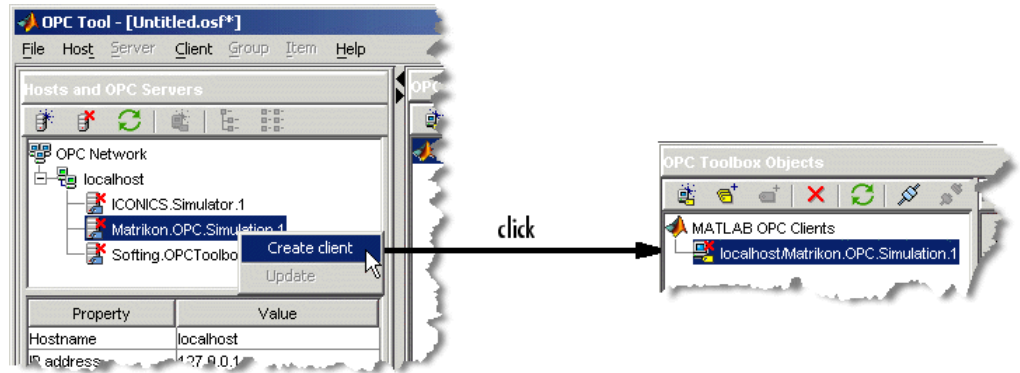
allServers =
    'Matrikon.OPC.Simulation.1'
    'ICONICS.Simulator.1'
    'Softing.OPCToolboxDemo_ServerDA.1'
```

Step 3: Create an OPC Data Access Client Object

Once you have determined the hostname and server ID of the OPC server you want to connect to, you can create an `opcda` client object. The client controls the connection status to the server, and stores any events that take place from that server (such as notification of data changing state, which is called a *data change event*) in the event log. The `opcda` client object also contains any Data Access Group objects that you create on the client. For more information on the OPC Toolbox object hierarchy, see “Understanding the OPC Toolbox™ Object Hierarchy” on page 1-6.

With the OPC Tool GUI, you can create a client directly from the **Hosts and OPC Servers** pane.

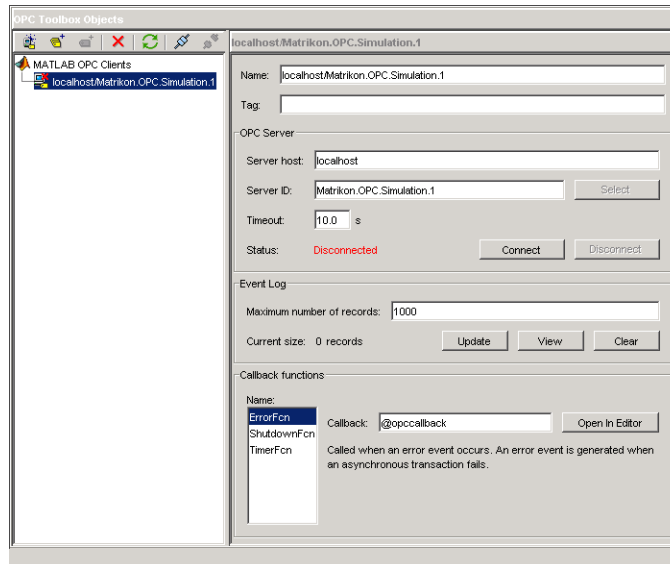
Right-click the Matrikon server node and choose **Create client**. A client will be created in the **OPC Toolbox Objects** pane, as shown in the following figure.



Server Context Menu and Client Node

The name of the client (displayed in the **OPC Toolbox Objects** pane) is *Host/ServerID*, where *Host* is the hostname and *ServerID* is the Server ID associated with that client. In this example, the client's name is 'localhost/Matrikon.OPC.Simulation.1'

Once you have created the client, you can view the properties of the client object in the **Object Properties** pane, as shown in the next figure.



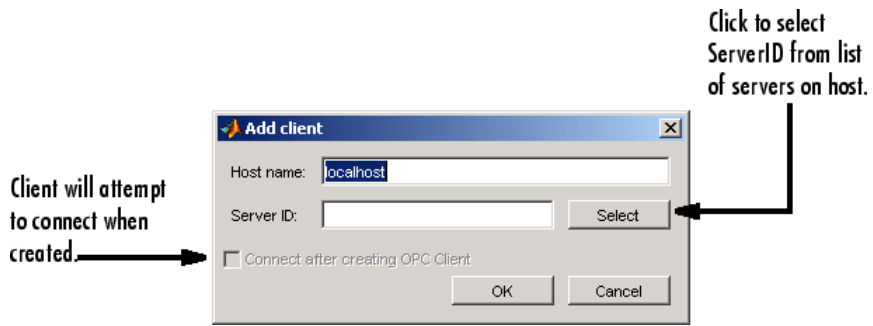
Example of OPC Toolbox Objects Pane, Showing Client Properties

Alternative Methods for Creating Clients

You can also create a client in the OPC Tool GUI by using one of the following methods:

- Select the **MATLAB OPC Clients** node in the **OPC Toolbox Objects** pane and click **Add Client** in the **OPC Toolbox Objects** toolbar.
- Choose **Add** from the **Client** menu.
- Right-click the **MATLAB OPC Clients** node in the **OPC Toolbox Objects** tree and select **Create Client**.

If you select one of the methods described above, a dialog appears requesting the hostname and server ID.



Add Client Dialog

When you supply a hostname, you will be able to select the Server ID from a list, by clicking **Select**. Using the Add client dialog, you can also automatically attempt to connect to the server when the client is created, by checking **Connect after creating OPC Client** before clicking **OK**.

Command-Line Equivalent

The command-line equivalent of this step involves using the `opcda` function, specifying the hostname and Server ID arguments.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation.1')

da =
  OPC Data Access Object: localhost/Matrikon.OPC.Simulation.1
  Server Parameters
    Host:          localhost
    ServerID:      Matrikon.OPC.Simulation.1
    Status:        disconnected
  Object Parameters
    Group:         0-by-1 dagroup object
```

For more information on creating clients, see “Creating a Client Object” on page 1-21.

Step 4: Connect to the OPC Server

OPC Data Access Client objects are not automatically connected to the server when they are created. This allows you to fully configure an OPC Toolbox object hierarchy (a client with groups and items) prior to connecting to the server, or without a server even being present.

Note The Add Client dialog described in “Alternative Methods for Creating Clients” on page 2-8 can connect the client to the server after creating the client object.

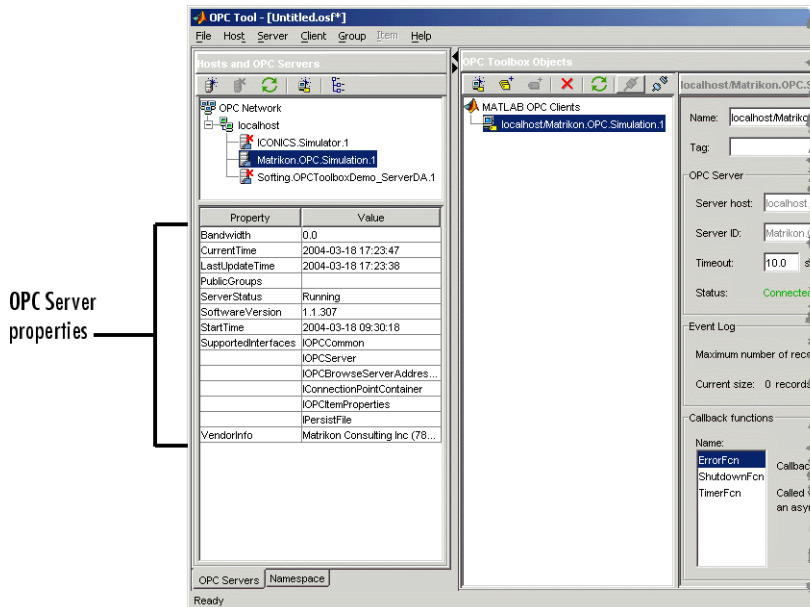
To connect the client to the server, you can use the **OPC Toolbox Objects** toolbar, shown in the following figure.



OPC Toolbox Objects Toolbar

Click **Connect** in the **OPC Toolbox Objects** toolbar. If the client is able to connect to the server, the icon for that client in the **OPC Toolbox Objects** tree will change to show that the client is connected. If the client could not connect to the server, an error dialog will show any error message returned. See “Troubleshooting” on page 1-28 for information on why a client may not be able to connect to a server.

When you connect an opcdac client object to the server associated with that client, the server node in the **Hosts and OPC Servers** pane also updates to show that the server has a connection to a client in the GUI. With that connection, the properties of the server are displayed in the **Hosts and OPC Servers** pane. For this example, a typical view of the GUI after connecting to a client is shown in the next figure.



Example of Connected Client and OPC Server Properties

The OPC server properties include diagnostic information, such as the supported OPC Data Access interfaces, the time the server was started, and the current server status.

Command-Line Equivalent

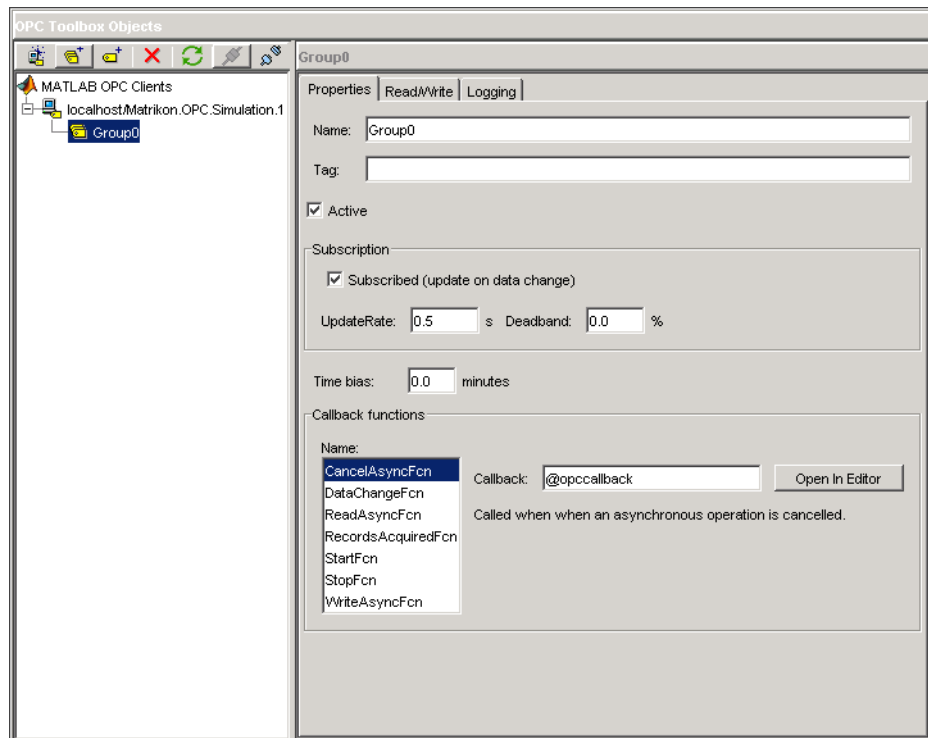
You use the connect function to connect an opcdac client object to the server at the command line.

```
connect(da)
```

Step 5: Create an OPC Data Access Group Object

You create Data Access Group objects (dagroup objects) to control and contain a collection of Data Access Item objects (daitem objects). A dagroup object controls how often the server must notify you of any changes in the item values, control the activation status of the items in that group, and define, start, and stop logging tasks.

To create a dagroup object, click **Add group** in the **OPC Toolbox Objects** toolbar. A group is created and automatically named, either by the OPC server or by OPC Toolbox software.



Example of OPC Data Access Group Properties Pane

On their own, dagroup objects are not useful. Once you add items to a group, you can control those items, read values from the server for all the items in a group, and log data for those items, using the dagroup object. In Step 6 you

browse the OPC server for available tags. Step 7 involves adding the items associated with those tags to the dagroup object.

Command-Line Equivalent

To create dagroup objects from the command line, you use the `addgroup` function. This example adds a group to the `opcda` client object already created.

```
grp = addgroup(da)

grp =
  OPC Group Object: Group0
  Object Parameters
    GroupType:      private
    Item:           0-by-1 daitem object
    Parent:         localhost/Matrikon.OPC.Simulation.1
    UpdateRate:    0.5
    DeadbandPercent: 0
  Object Status
    Active:         on
    Subscription:  on
    Logging:        off
    LoggingMode:   memory
```

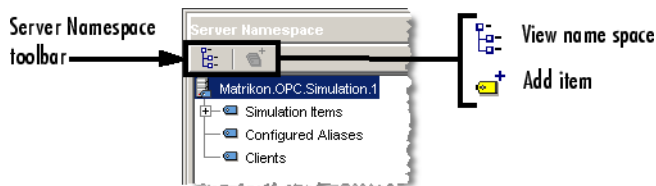
See “Creating Data Access Group Objects” on page 3-2 for more information on creating group objects from the command line.

Step 6: Browse the Server Name Space

All OPC servers provide access to server items via a server name space. The name space is an ordered list of the server items, usually arranged in a hierarchical format for easy access. A server item (also known as a *tag*) is a measurement or data point on a server, providing information from a device (such as a pressure sensor) or from another software package that supplies data through OPC Data Access (such as a SCADA package).

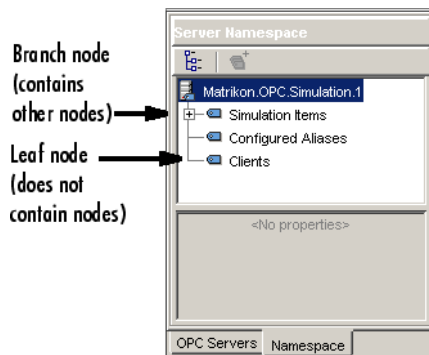
Note If you know the item IDs of the server items you are interested in, you can skip this section and proceed to “Step 7: Add OPC Data Access Items to the Group” on page 2-17. In this example, we assume that we do not know the exact item IDs, although we do know that we want to log information from the Saw-toothed Waves and Triangular Waves provided by the Matrikon Simulation Server.

The **Namespace** tab of the **Hosts and Servers** pane allows you to graphically browse a server’s name space. Because most OPC servers contain thousands of server items, retrieving a name space can be time consuming. When you connect to a server for the first time, the name space is not automatically retrieved. You have to request the name space using one of the **View** buttons in the **Server Namespace** toolbar, as shown in the following figure.



Namespace Toolbar Showing View Buttons

Click *View hierarchical namespace* to retrieve the hierarchical name space for the Matrikon OPC Server. A tree view containing the Matrikon name space is shown in the pane. Your pane should look similar to the following figure.



Example of Populated Namespace Tree

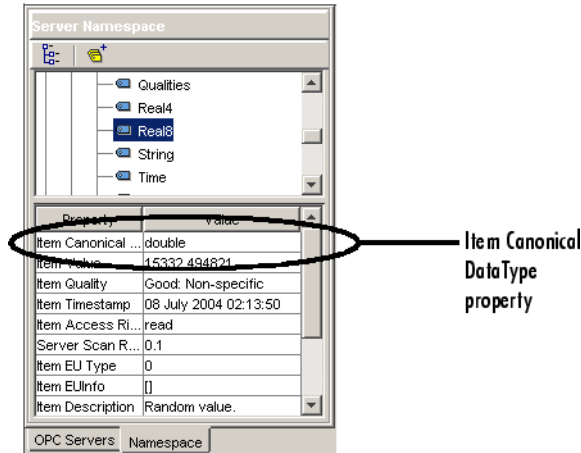
Note If you choose to view the name space as flat, you get a single list of all server items in the name space, expanded to their fully qualified names. A fully qualified name can be used to create a `daitem` object.

Browsing the name space using the GUI also provides some property information for each server item. The properties include the published OPC Item properties such as Value, Quality, and Timestamp, plus additional properties published by the OPC server that may provide more information on that particular server item. For a list of standard OPC properties and an explanation of their use, consult Appendix B, “OPC Server Item Properties”.

In this example, you need to locate the Saw-toothed Waves and Triangle Waves signals in the Matrikon Simulation Server. You can achieve this using the following steps:

- 1** Ensure that you are viewing the hierarchical name space.
- 2** Expand the **Simulation items** node. You will see all the signal types that the Matrikon Server simulates.
- 3** Expand the **Saw-toothed Waves** node. A number of *leaf* nodes appear. A leaf node contains no other nodes, and usually signifies a tag on an OPC server.

- 4 Select the Real8 leaf node. You will see the properties of the server item in the properties table below the name space tree, as shown in the following figure.



Example of Server Tag Properties

Note the Item Canonical Data Type property, which is double. The Canonical Data Type is the data type that the server uses to store the server item's value.

- 5 Select the UInt2 leaf node. You will notice that the properties update, and the Item Canonical Data Type property for this server item is uint16. (MATLAB denotes integers with the number of bits in the integer, such as uint16; the Matrikon Server uses the COM Variant convention denoting the number of bytes, such as UInt2.)

You can continue browsing the server name space using the **Server Namespace** pane in the GUI. One unique characteristic of the Matrikon Simulation Server is that you can view the connected clients through the name space, by selecting the **Clients** node in the root of the name space.

In Step 7, you will add three items to your newly created group object, using the **Server Namespace** pane.

Command-Line Equivalent

From the command line, you can “browse” the server name space using the `serveritems` function. You need to supply a connected `opcda` client object to the `serveritems` function, and an optional string to limit the returned results. The string can contain wildcard characters (*). An example of using `serveritems` is as follows.

```
sawtoothItems = serveritems(da, '*Saw*')

sawtoothItems =
    'Saw-toothed Waves.'
    'Saw-toothed Waves.Int1'
    'Saw-toothed Waves.Int2'
    'Saw-toothed Waves.Int4'
    'Saw-toothed Waves.Money'
    'Saw-toothed Waves.Real4'
    'Saw-toothed Waves.Real8'
    'Saw-toothed Waves.UInt1'
    'Saw-toothed Waves.UInt2'
    'Saw-toothed Waves.UInt4'
```

The command-line equivalent for obtaining the server item properties is `serveritemprops`. See the `serveritemprops` reference page for more information on using the function.

Step 7: Add OPC Data Access Items to the Group

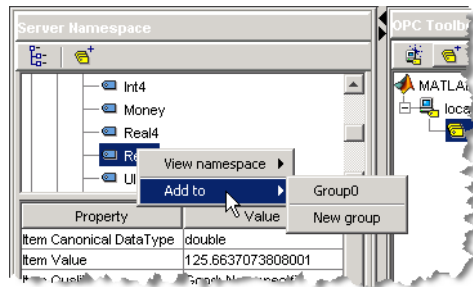
Now that you have found the server items in the name space, you can add Data Access Item objects (`daitem` object) for those tags to the `dagroup` object you created in Step 5. A `daitem` object is a link to a tag in the name space, providing the tag value, and additional information on that item, such as the Canonical Data Type.

Using the GUI, you create items directly from the name space tree, using a context menu on each node in the tree.

Browse to **Simulated Items > Saw-toothed Waves > Real8**, and right-click that node to bring up the context menu. Selecting **Add to** from the context menu provides you with a list of created groups for the item associated with

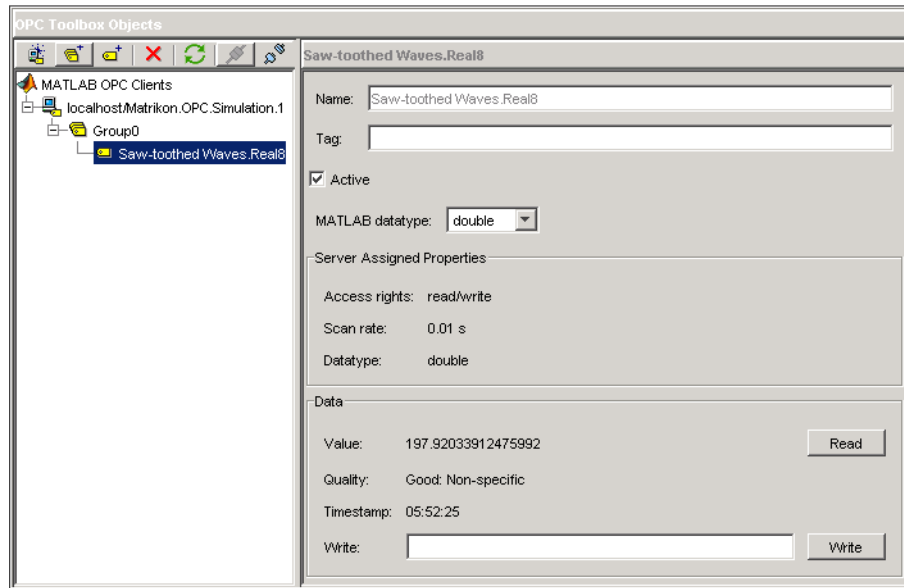
that server, and a menu item to create a **New group** (and add the item to that group).

The menu displayed for this example is shown in the following figure.



Example of Context Menu for Namespace Node

Click **Group0** to add the item to the already existing group that you created in Step 5. A daitem object is created in the **OPC Toolbox Objects** pane. The following figure shows the newly created item highlighted, with the properties of the item shown in the **Properties** pane.



Example of Data Access Item Object and Properties

Reading a Value from the Server

A daitem object initially contains no information about the server item that it represents. The daitem object only updates when the server notifies the client of a change in status for that item (the notification is called a data change event) or the client specifically reads a value from the server. Using the GUI, you can force a read of the item by clicking **Read** in the **Properties** pane of the required item.

Click **Read**. The **Value**, **Quality**, and **Timestamp** fields in the GUI will update. **Value** contains the last value that the server read from that particular item. **Quality** provides a measure of how meaningful **Value** is. If **Quality** is Good, then the **Value** can be trusted to be the same as the device or object to which the item refers, but only at the time provided by the **Timestamp** field. If **Quality** is anything other than Good, then the **Value** of the item is questionable.

Each time you read or obtain data from the server through a data change event, the server will provide you with updated Value, Quality, and Timestamp values.

Adding More Items to the Group

Using the **Namespace** pane, expand the **Triangle Waves** node and add items for the **Real8** and **UInt2** server items. You will then have three items associated with your dagroup object. In Step 8, you configure a logging session for that group. You then log data in Step 9 from the three items you just created, and visualize the data in Step 10.

Command-Line Equivalent

You use the `additem` function to add items to a dagroup object. You need to pass the dagroup object to which the items will be added, and the fully qualified item ID as a string. The item IDs were found using the `serveritems` function in Step 6.

```
itm1 = additem(grp, 'Saw-toothed Waves.Real8')

itm1 =
  OPC Item Object: Saw-toothed Waves.Real8
  Object Parameters
    Parent:          Group0
    AccessRights:    read/write
    DataType:        double
  Object Status
    Active:          on
  Data:
    Value:
    Quality:
    Timestamp:
```

You can add multiple items to the group in one `additem` call, by specifying multiple `ItemID` values in a cell array.

```
itms = additem(grp, {'Triangle Waves.Real8', ...
  'Triangle Waves.UInt2'})

itms =
```

OPC Item Object Array:

Index:	DataType:	Active:	ItemID:
1	double	on	Triangle Waves.Real8
2	uint16	on	Triangle Waves.UInt2

For more information on adding items to groups, see “Creating Data Access Item Objects” on page 3-5.

Step 8: View All Item Values

You can view the Value, Quality, and Timestamp for each item using the item’s properties pane. However, that view only provides access to one item at a time. The group object is designed to allow you to read and write values from all items in the group, and to log data to memory and/or disk. You use the **Group Read/Write** pane to view the values of the items you created in Step 7 to determine the approximate range of values that each item’s value varies over. The information from this pane will help you to verify that the data is updating, and whether you can plot the data in one set of axes or in subplots.

Click **Group0** in the **OPC Toolbox Objects** pane. Select the **Read/Write** tab in the top of the **Group properties** pane. The **OPC Toolbox Objects** pane should now look similar to the one shown in the following figure.

The screenshot shows the OPC Tool GUI with the following components:

- Tree View:** MATLAB OPC Clients > localhost/Matikon.OPC.Simulation.1 > Group0
 - Saw-toothed Waves.Real8
 - Triangle Waves.Real8
 - Triangle Waves.UInt2
- Properties Tab:**
 - Active
 - Subscription:
 - Subscribed (update on data change)
 - UpdateRate: 0.5 s Deadband: 0.0 %
- Item data Table:**

Item ID	Active	Value	Quality	Timestamp	Write Value
Saw-toothed Wave...	<input checked="" type="checkbox"/>	78.5398171...	Good: Non-specific	04:23:06	
Triangle Waves.Real8	<input checked="" type="checkbox"/>	160.221226...	Good: Non-specific	04:23:06	
Triangle Waves.UInt2	<input checked="" type="checkbox"/>	110	Good: Non-specific	04:23:06	

Annotations on the right side of the image:

- Control how often group receives updated values. (points to Subscription controls)
- Group value, quality, and timestamp shown. (points to Item data table)
- Enter value to write. (points to Write Value column)
- Select items to be updated and written. (points to Active checkboxes)

Example of Group Read/Write Pane

The **Value**, **Quality**, and **Timestamp** values in the table of items will continually update as long as you have **Subscription** enabled. Subscription controls whether *data change events* are sent by the OPC server to the toolbox, for items whose values change. UpdateRate and DeadbandPercent define how often the items must be queried for a new value, and whether all value changes or only changes of a specified magnitude are sent to the toolbox. For more information on Subscription, see “Data Change Events and Subscription” on page 4-12.

By observing the data for a while, you will see that the three signals appear to have similar ranges. This indicates that you can visualize the data in the same axes when you plot it in Step 11.

You can also use the **Group Read/Write** pane for writing values to many items simultaneously. Specify a value in the **Write** column of the **Item data** table for each item you want to write to, and click **Write**, to be able to write to those items.

In Step 10 you will configure a logging task and log data for the three items.

Command-Line Equivalent

You can use the read function with a group object as the first parameter to read values from all items in a group. The read function is discussed in more detail in “Reading and Writing Data” on page 4-2.

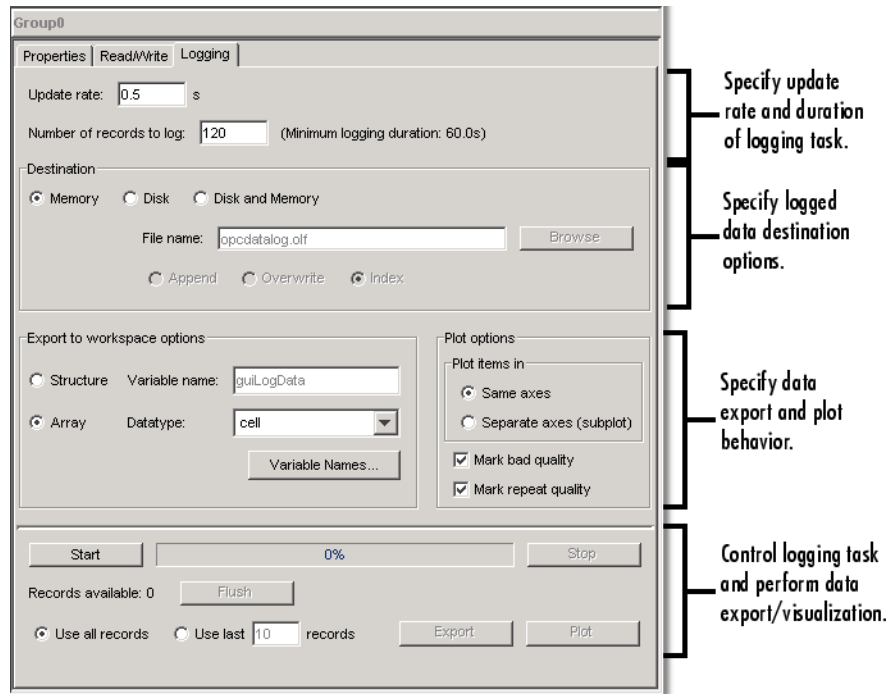
Step 9: Configure Group Properties for Logging

Now that your dagroup object contains items, you can use the group to control the interaction of those items with the server. In this step, you configure the group to log data from those items for 2 minutes at 0.2-second intervals. You will use the logged data in Step 11 to visualize the signals produced by the Matrikon Simulation Server.

OPC Data Access Servers provide access only to "live" data (the last known value of each server item in their name space). In many cases, a single value of a signal is not useful, and a time series containing the signal value over a period of time is helpful in analyzing that signal or signal set. OPC Toolbox software allows you to log all items in a group to disk or memory, and to retrieve that data for analysis in MATLAB.

You configure a logging session using the dagroup object. By modifying the properties associated with logging, you control how often the data must be sent from the server to the client, how many records the group must log, and where to log the data. This information is summarized in the **Logging** pane of the dagroup object properties in the GUI.

Select the **Logging** tab in the **Properties** pane. The following figure shows the **Logging** pane for the dagroup object created in this example.



Example of Logging Pane for Data Access Group Objects

Using the **Logging** pane, configure the logging session using the following steps:

- 1 Set **Update rate** to 0.2.
- 2 Set **Number of records to log** to 600. Because you want to log for 2 minutes (120 seconds) at 0.2-second update rates, you need 600 (i.e., $120/0.2$) records.

You can leave the rest of the logging properties at their default values, because this example uses data logged to memory.

In Step 10 you log the data. In Step 11 you will visualize the data.

Command-Line Equivalent

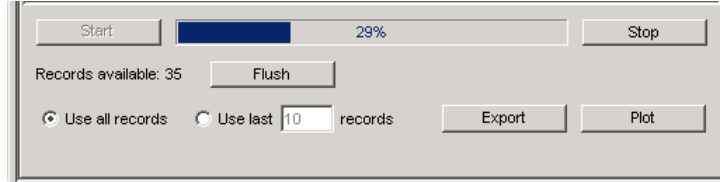
You use the `set` function to set OPC Toolbox object properties. From the MATLAB command line, you can calculate the number of records required for the logging task.

```
logDuration = 2*60;
logRate = 0.2;
numRecords = ceil(logDuration./logRate)
set(grp, 'UpdateRate',logRate,'RecordsToAcquire',numRecords);
```

Step 10: Log OPC Server Data

In Step 9 you configured the `dagroup` object's logging properties. Your object is now ready to log the required amount of data to memory.

Click **Start** in the **Logging** tab. The logging task will begin, and the OPC Toolbox software engine will receive and store the data from the OPC server. The progress bar indicates the status of the logging task, as shown in the following figure.



Example of Logging Task in Progress

Note The logging task occurs in the background. You can continue working in MATLAB while a logging task is in operation. The logging task is not affected by any other computation taking place in MATLAB, and MATLAB is not blocked from processing by the logging task.

Wait for the task to complete before continuing with Step 11.

Command-Line Equivalent

You use the `start` function with the required `dagroup` object to start a logging task.

```
start(grp)
```

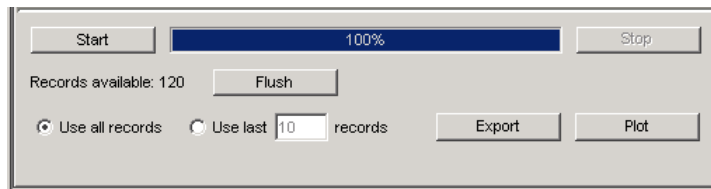
Although the logging operation takes place in the background, you can instruct MATLAB to wait for the logging task to complete, using the wait function.

```
wait(grp)
```

Step 11: Plot the Data

In this introductory example, you use the GUI to visualize the data logged in Step 10. In a more complex task, you would export the logged data to the workspace and use MATLAB functions to analyze and interpret the logged data.

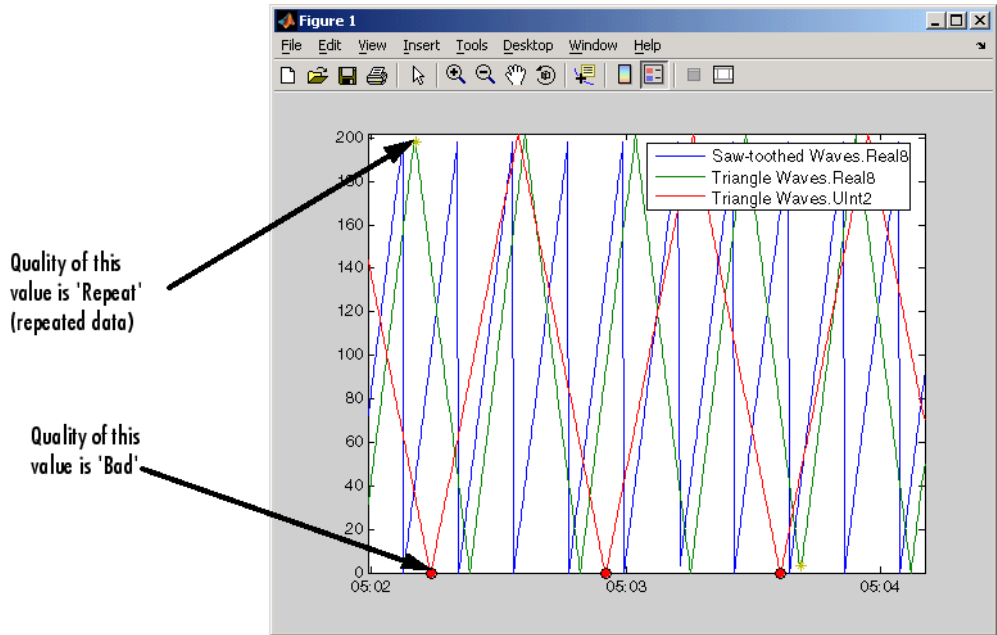
When the logging task stops, the **Logging** pane will update to show that the task is complete. An example of the logging status portion of the **Logging** pane after a completed task is shown in the following figure.



Example of Logging Pane After Logging has Completed

To view the data from the GUI, click **Plot**. The logged data will be retrieved from the toolbox engine and displayed in a MATLAB figure window. The format of the displayed data and annotation options are controlled by settings in the **Plot** options frame of the **Logging** pane. By default, the plot will be annotated with any data points that have a Quality other than Good. Values whose Quality is Bad are annotated with a large red circle with a black border, and Values with Quality of Repeat are annotated with a yellow star. You should always view the Quality returned with the Value of an item to determine if the Value is meaningful or not. The relationship between the Value and Quality of an item is discussed in “Understanding OPC Data: Value, Quality, and TimeStamp” on page 5-2.

An example of the plotted data is shown in the next figure.



Example of Data Plot from a Logging Task

Note Your plotted data will almost certainly not look like the one shown here, because the logging task was executed at a different time.

Notice how the three signals seem almost completely unrelated, except for the period of the two **Real8** signals. The peak values for each signal are different, as are the periods for the two **Triangle Waves** signals. By visualizing the data, we have gained some insight into the way the Matrikon OPC Simulation Server simulates each tag. In this case, we know for certain that **Real8** and **UInt2** signals have a different period.

Command-Line Equivalent

When your logging task has completed you transfer data from the toolbox engine to the MATLAB workspace using the `getdata` function, which provides

two types of output, depending on the 'datatype' argument. For more information see `getdata` in the reference pages. In this case you retrieve the data into separate arrays, and plot the data.

The example below reproduces the figure display that you get when you click **Plot**.

```
[logIDs, logVal, logQual, logTime, logEvtTime] = ...
    getdata(grp, 'double');
plot(logTime, logVal);
axis tight
datetick('x', 'keeplimits')
legend(logIDs)
```

Step 12: Clean Up

When you are finished with an OPC task, you should remove the task objects from memory and clear the MATLAB workspace of the variables associated with these objects. The OPC Tool GUI will automatically delete all objects that it creates from the toolbox engine. If you work only in the OPC Tool GUI, you do not need to perform any further cleanup other than to close the GUI. You close the GUI by using the **Exit** option in the **File** menu, or by using the **Close** button in the title bar. You will be prompted to save the OPC Tool session. You can choose to save the session to an OPC Session File (.osf file) for later use, or exit without saving.

Command-Line Equivalent

When you use OPC Toolbox objects from the MATLAB command line, or from your own functions, you must remove them from the OPC Toolbox software engine using the `delete` function. Note that when you delete a toolbox object, the children of that object are automatically removed from the toolbox engine. In the following example, there is no need to delete `grp` and `itm`, as they are children of `da`.

```
disconnect(da)
delete(da)
clear da grp itm
close(gcf)
```

OPC Toolbox object management is discussed in more detail in “Deleting Objects” on page 3-23.

Using OPC Toolbox™ Objects

To interact with an OPC server, you need to create toolbox objects. You create an OPC Data Access Client (opcda client) object to provide a connection to a particular OPC server. You then create one or more Data Access Groups (dagroup objects) to control sets of Data Access Items (daitem objects), which represent links to server items. OPC Toolbox™ objects are described in more detail in “Understanding the OPC Toolbox™ Object Hierarchy” on page 1-6.

This chapter describes how to create and configure toolbox objects to interact with an OPC server. Chapter 4, “Reading, Writing, and Logging OPC Data” provides information on how to use the OPC Toolbox objects to exchange data with an OPC server.

Creating OPC Toolbox™ Objects (p. 3-2)	Describes how to create toolbox objects.
Configuring OPC Toolbox™ Object Properties (p. 3-17)	Describes how to configure toolbox object properties.
Deleting Objects (p. 3-23)	Describes how to remove toolbox objects.
Saving and Loading Objects (p. 3-25)	Describes how to save and load OPC Toolbox objects.

Creating OPC Toolbox™ Objects

In this section...

“Overview” on page 3-2

“Creating Data Access Group Objects” on page 3-2

“Creating Data Access Item Objects” on page 3-5

“Building an Object Hierarchy with a Disconnected Client” on page 3-8

“Creating OPC Toolbox™ Object Vectors” on page 3-9

“Working with Public Groups” on page 3-12

Overview

The first step in interacting with an OPC server from MATLAB® software is to establish a connection between the server and OPC Toolbox™ software. You create `opcda` client objects to control the connection between an OPC server and the toolbox. Then you create `dagroup` objects to manage sets of `daitem` objects, and then you create the `daitem` objects themselves, which represent server items. A server item corresponds to a physical device or to a storage location in a SCADA system or DCS.

You must create the toolbox objects in the order described above. “Connecting to OPC Servers” on page 1-21 describes how to create an `opcda` client object. This section discusses how to create and configure `dagroup` and `daitem` objects.

Creating Data Access Group Objects

Once you have created an `opcda` client object, you can add groups to the client. A `dagroup` object manages multiple `daitem` objects. Using a `dagroup` object, you can read data from all items in that group in one action, write data to the items in the group, define actions to take when any of the items in that group change value, or log data for all the items in that group for analysis and processing.

To create a `dagroup` object, you use the `addgroup` function, specifying the `opcda` client object that you want to add the group to, and an optional group

name. See “Specifying a Group Name” on page 3-3 for rules on defining your own group name.

The example below creates an `opcda` client object, connects that object to the server, and adds two groups to the client. The first group is automatically named by the server, and the second group is given a specified name.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation.1');  
connect(da);  
grp1 = addgroup(da);  
grp2 = addgroup(da, 'MyGroup');
```

Specifying a Group Name

Every OPC server requires that each group created by the client has a unique name. This allows the OPC server to uniquely identify the group when a client makes a server request using that group. The name can be any nonempty string.

You do not need to specify a group name for each group that you add to a client. If you do not specify a name, the OPC server will automatically assign a group name for you. Each OPC server defines different rules for automatic naming of groups.

If you attempt to create a group with the same name as a group already created for that client, an error will be generated.

See “Deleting Objects” on page 3-23 for information about how groups are automatically named when you create groups with a disconnected client.

Viewing a Summary of a Group Object

To view a summary of the characteristics of the `dagroup` object you created, enter the variable name you assigned to the object at the command prompt. For example, this is the summary for the object `grp1`.

```
grp1
```

```
grp1 =  
① Summary of OPC Data Access Group Object: Group0  
② Object Parameters  
   Group Type   : private  
   Item         : 0-by-1 daitem object  
   Parent       : localhost/Matrikon.OPC.Simulation.1  
   Update Rate  : 0.5  
   Deadband     : 0%  
③ Object Status  
   Active       : on  
   Subscription : on  
   Logging      : off  
④ Logging Parameters  
   Records      : 120  
   Duration     : at least 60 seconds  
   Logging to   : memory  
   Status       : Waiting for START.  
                0 records available for GETDATA/PEEKDATA
```

The items in this list correspond to the numbered elements in the object summary:

- 1 The title of the Summary includes the name of the dagroup object. In the example, this is the server-assigned name Group0.
- 2 The Object Parameters section lists the values of key dagroup object properties. These properties describe the type of group, the daitem objects associated with the group, the name of the group's parent opcda client object, and properties that control how the server updates item information for this group. In the example, any items created in this group will be updated at half-second intervals, with a deadband of 0%. For information on how the server updates item information, see “Data Change Events and Subscription” on page 4-12.
- 3 The Object Status section lists the current state of the object. A dagroup object can be in one of several states:
 - The Active state defines whether any operation on the group applies to the item.
 - The Subscription state defines whether changes in the item's value or quality will produce a data change event. See “Data Change Events and Subscription” on page 4-12 for more information about the Subscription property.

- The Logging state describes whether the group is logging or not. See “Logging OPC Server Data” on page 4-17 for information on how to log data.
- 4** The Logging Parameters section describes the values of the logging properties for that group. Logging properties control how the dagroup object logs data, including the duration of the logging task and the destination of logged data. See “Logging OPC Server Data” on page 4-17 for information on logging data using dagroup objects.

Using a Group Object

A dagroup object with no items does not perform any useful functions. Once you have added items to a group, you can use the group to

- Read data from, and write data to, the OPC server. See “Reading and Writing Data” on page 4-2 for more information.
- Control how an OPC server notifies MATLAB about changes in any item associated with a dagroup object. See “Data Change Events and Subscription” on page 4-12 for more information.
- Log data from all items in that group, for later processing and analysis. “Logging OPC Server Data” on page 4-17 describes how to control logging.

Creating Data Access Item Objects

A dagroup object provides a container for collecting one or more daitem objects. A daitem object provides a link to a specific server item. The daitem object defines how you want to retrieve and store the client-side value of the server item, and also stores the last data retrieved from the server for that server item. You can use a daitem object to read data from the server for that server item, or to write values to that server item on the server.

You create a daitem object using the additem function, specifying the dagroup object to which the item must be added and the fully qualified item ID of the server item. You can obtain a list of the fully qualified item IDs for all server items using the serveritems function.

The example below builds on the example in “Creating Data Access Group Objects” on page 3-2 by adding a daitem object to the first group created

in that example. The server item associated with this item is called 'Random.Real8'.

```
itm1 = additem(grp1, 'Random.Real8');
```

Specifying a Local Data Type for the Item

When you create a `daitem` object, you create an object that stores the value of the server item locally on the client. You can specify that the local storage data type be different from the server storage data type. For example, you can specify that a value stored on the server as an integer be stored in MATLAB as a double-precision floating-point value, because you know that you will be performing double-precision calculations with that item's value.

Although it is possible to modify the data type of the item after it is created, you can also create an item with a specific data type by specifying the data type as the third parameter to the `additem` function. The data type specification must be a string describing that data type. Valid OPC data types are any MATLAB numeric data type, plus 'char', and 'logical'. See “Working with Different Data Types” on page 5-18 for more information on supported data types.

The example below adds another item to the group `grp1` created by the example in “Creating Data Access Group Objects” on page 3-2. The item ID is 'Random.UInt2', which is stored on the server as an unsigned 16-bit integer. By specifying the data type as 'double', the value will be returned to MATLAB and stored locally as a double-precision floating-point number.

```
itm2 = additem(grp1, 'Random.UInt2', 'double');
```

Note The conversion process from the server's data type to the item's data type is performed by the server, using Microsoft® COM Variant conversion rules. If you attempt to convert a value to a data type that does not have that value's range, the OPC server will return an error when attempting to update the value of that item. You should then change the data type to one that has the same or larger range than the server item's data type. See “Working with Different Data Types” on page 5-18 for more information.

Specifying the Active Status of an Item Object

You can optionally specify the Active status of an `daitem` object by passing a string as the fourth parameter to the `additem` function. The Active status can be 'on' or 'off'. An item with an Active status of 'off' behaves as if the item was never created: No server updates of the item's value will take place, and a read or write with that item will fail. You use the Active status to temporarily disable an item without deleting that item from MATLAB. For more information on the Active status, see the reference page for the Active property.

Viewing a Summary of the Item Object

To view a summary of the characteristics of the `daitem` object you created, enter the variable name you assigned to the object at the command prompt. For example, this is the summary for the object `itm1`.

```
itm1

itm1 =
  ① Summary of OPC Data Access Item Object: Random.Real8
  ② Object Parameters
      Parent      : Group0
      Access Rights : read
  ③ Object Status
      Active      : on
  ④ Data Parameters
      Data Type   : double
      Value       : 0
      Quality     : Bad: Out of Service
      Timestamp   : 08-Mar-2004 10:32:23
```

The items in this list correspond to the numbered elements in the object summary:

- 1 The title of the Summary includes the fully qualified item ID of the item. In the example, the item is associated with the 'Random.Real8' server item.
- 2 The Object Parameters section lists the values of key `daitem` object properties. These properties describe the name of the item's Parent group, and the Access Rights advertised by the server.

- 3 The `Object Status` section lists the Active state of the object. The Active state defines whether any operation on the parent group applies to the item, and whether you want to be notified of any changes in the item's value.
- 4 The `Data Parameters` section lists the Data Type used by the `daitem` object to store the value, and the Value, Quality, and TimeStamp of the last value obtained from the server for this item. For more information on the Value, Quality, and TimeStamp of an item, see “Understanding OPC Data: Value, Quality, and TimeStamp” on page 5-2.

Using an Item Object

You create a `daitem` object to query the value of the associated server item, or to write values to that server item. You can write values to a single item, and read values from a single item, using the `daitem` object. For more information on reading and writing values, see “Reading and Writing Data” on page 4-2.

You can also use the parent `dagroup` object to read and write values for all of the `daitem` objects contained in that group, or to log changes in the item's value for a period of time. See “Logging OPC Server Data” on page 4-17 for information on logging data.

Building an Object Hierarchy with a Disconnected Client

When you create objects with a connected client, OPC Toolbox software validates those objects with the OPC server before creating them on the client. For example, when adding a group to the client using the `addgroup` function, the validation process ensures that no other group with the same name exists on the server, and that the server will accept the group. When adding an item, the item ID is verified to be a valid server item.

Occasionally you may wish to build up a toolbox object hierarchy without connecting to the server. For example, you may be off site and wish to configure a logging task for use on the following day, rather than wait to configure the objects for that task when you are on site.

OPC Toolbox software allows you to configure an entire toolbox object hierarchy without connecting to the server. However, without a connection to the server, the toolbox cannot validate the created objects with that server.

Instead, OPC Toolbox software will perform some basic validation on the objects you create, and revalidate those objects with the server when you connect to the server.

When you create toolbox objects with a disconnected client, the following validation is performed:

- When adding a group using the `addgroup` function, if you do not specify a name, OPC Toolbox software automatically assigns a unique name 'group N ', where N is the lowest integer that ensures that the group name is unique. For example, the first group created will be 'group1', then 'group2', and so on.
- When you specify a group name when using the `addgroup` function, an error will be generated if a group with the same name already exists.
- When adding an item to a group using the `additem` function, an error will be generated only if an item with the same name already exists in that group. No other checking is performed on the item.
- When adding an item to a group, if you do not specify a data type for that item, the data type is set to 'unknown'. When you connect to the server, the data type will be changed to the server item's `CanonicalDataType`.

Despite all of the checks described above, the server may not accept all objects created on a disconnected client when that client is connected to the server using the `connect` function. For example, an item's item ID may not be valid for that server, or a group name may not be valid for that server. When you connect a client to the server using `connect`, any objects that the server rejects will be deleted from the object hierarchy, and a warning will be generated. In this way, all objects on a connected client are guaranteed to have been accepted by the server.

Creating OPC Toolbox™ Object Vectors

OPC Toolbox software supports the use of *object vectors*. An object vector is a single variable in the MATLAB workspace containing a reference to more than one object. For example, all the groups added to an `opcda` client object are stored in the client's `Group` property. The `Group` property contains a `dagroup` object vector that represents all groups in that client. Similarly,

a `dagroup` object has an `Item` property that contains a reference to every `daitem` object created in the group.

You can construct vectors using any of the standard concatenation techniques available in MATLAB. However, OPC Toolbox software imposes some limitations on the construction of object vectors:

- Objects must be the same class. For example, you can concatenate two `dagroup` objects, but you cannot concatenate a `dagroup` object with a `daitem` object.
- Group and item objects must have the same parent.
- One of the dimensions of the resulting array must be scalar. You can create a column vector (m -by-1 objects) or a row vector (1-by- n objects), but not an m -by- n matrix.
- OPC Toolbox software does not fill in missing elements in a vector. Instead, an error is generated. For example, you cannot assign a scalar object at the 4th index to a scalar object.

The following sections discuss how to create and use toolbox object vectors:

- “Constructing Object Vectors” on page 3-10 describes how to create object vectors.
- “Displaying a Summary of Object Vectors” on page 3-11 describes how object vectors are displayed at the command line.
- “Using Object Vectors” on page 3-12 describes how you can use object vectors with OPC Toolbox software.

Constructing Object Vectors

You can construct an object vector using any of the following techniques:

- Using concatenation of lists of individual object variables
- Using indexed assignment
- Using object properties to retrieve object vectors

Creating object vectors using concatenation. To construct an OPC Toolbox object vector using concatenation, you use the normal MATLAB syntax for concatenation. Create a list of all objects you want to create, and surround that list with square brackets ([]). Separate each element of the object vector by either a comma (,) to create a row vector, or a semicolon (;) to create a column vector.

The following example creates three fictitious opcda client objects, and concatenates them into a row vector.

```
da1 = opcda('Host1', 'Dummy.Server.1');
da2 = opcda('Host2', 'Dummy.Server.2');
da3 = opcda('Host3', 'Dummy.Server.3');
dav = [da1, da2, da3];
```

Creating object vectors using indexed assignment. Indexed assignment refers to creating vectors by assigning elements to specific indices in the vector. The following example constructs the same three-element opcda client object vector as in the previous example, using indexed assignment.

```
dav(1) = opcda('Host1', 'Dummy.Server.1');
dav(2) = opcda('Host2', 'Dummy.Server.2');
dav(3) = opcda('Host3', 'Dummy.Server.3');
```

Creating object vector using object properties. You may obtain an object vector if you assign the Group property of a opcda client object, or the Item property of a dagroup object, to a variable. If the client has more than one group, or the group has more than one item, the resulting property is an object vector.

For information on obtaining object properties, see “Viewing the Value of a Particular Property” on page 3-19.

Displaying a Summary of Object Vectors

To view a summary of an object vector, type the name of the object vector at the command prompt. For example, this is the summary of the client vector dav.

```
dav =
```

```
OPC Data Access Object Array:
```

Index:	Status:	Name:
1	disconnected	Host1/Dummy.Server.1
2	disconnected	Host2/Dummy.Server.2
3	disconnected	Host3/Dummy.Server.3

The summary information for each OPC Toolbox object class is different. However, the basic display is similar.

Using Object Vectors

You use object vectors just as you would a normal object variable. The function you call with the object vector simply gets applied to all objects in the vector. For example, passing the client vector `dav` to the `connect` function connects each object in the vector to its OPC server.

Note Some OPC Toolbox functions do not accept object vectors as arguments. If you attempt to use an object vector with a function that does not accept object vectors, an error will be generated. Consult the relevant function reference page for information on whether a function supports object vectors.

If you need to extract elements of an object vector, use standard MATLAB indexing notation. For example, the following example extracts the second element from the client vector `dav`.

```
dax = dav(2);
```

Working with Public Groups

The OPC Data Access Specification provides a mechanism for sharing group configuration amongst many clients. Normally, a client has *private* access to a group; no other client connected to the same server can see that group, and the items configured in that group. However, a client can define a group as *public*, allowing other clients connected to the same server to gain access to that group.

Note The OPC Data Access Specification defines the support for public groups as optional. Consequently, some OPC servers will not support public groups.

A public group differs from a private group in the following ways:

- Once a group is defined as public, you cannot add items to that group, nor remove items from the group. This restriction ensures that every client using that public group has access to the same items, and does not need to worry about items being added or removed from that group. You should ensure that a group's items are correct before making that group public.
- Each client that accesses the public group is able to set its own group properties, such as the UpdateRate, DeadbandPercent, Active, and Subscription properties. For example, one client can define an UpdateRate of 10 seconds for a public group, while another client specifies the UpdateRate as 2 seconds.
- Each public group defined on a server must have a unique name. If you attempt to create a public group with a name that is the same as a public group on the server, an error is generated.
- A single client cannot have a public group and a private group with the same name. For example, you cannot connect to a public group named 'LogGroup' and then create a private group called 'LogGroup'.

Using OPC Toolbox software, you can define and publish your own public groups or connect to existing public groups. You can also request that public groups be removed from an OPC server. The following sections illustrate how you can work with public groups using OPC Toolbox software:

- “Defining a New Public Group” on page 3-14 describes how you can create new public groups.
- “Connecting to an Existing Public Group” on page 3-14 describes how you can utilise a public group that is already defined on the server.
- “Removing Public Groups from the Server” on page 3-16 describes how you can remove public groups from an OPC server.

Defining a New Public Group

You define a new public group by creating a private group in the normal way (described in “Creating Data Access Group Objects” on page 3-2) and then converting that private group into a public group.

You use the `makepublic` function to convert a private group into a public group. The only argument to the `makepublic` function is the group object that you want to convert to a public group.

The following example creates a private group, with specific items in that group. The group is then converted into a public group.

```
da = opcda('localhost', 'My.Server.1');  
grp = addgroup(da, 'PublicGrpExample');  
itms = additem(grp, {'Item.ID.1', 'Item.ID.2'});  
makepublic(grp);
```

You can check the group type using the `GroupType` property.

```
get(grp, 'GroupType')  
  
ans =  
  
public
```

Connecting to an Existing Public Group

In addition to creating new public groups, you can also create a connection to an existing public group on the server. To obtain a list of available public groups on a server, you use the `opcserverinfo` function, passing the client object that is connected to the server as the argument. The returned structure includes a field called `'PublicGroups'`, containing a cell array of public groups defined on that server. If the `'PublicGroups'` field is empty, then you should check the `'SupportedInterfaces'` field to ensure that the server supports public groups. A server that supports public groups will implement the `IOPCServerPublicGroups` interface.

Once you have a list of available public groups, you can create a connection to that group using the `addgroup` function, passing it the client that is connected to the server containing the public group, the name of the public group, and the `'public'` group type specifier.

Note You cannot create a connection to an existing public group if your client object is disconnected from the server.

The following example connects to a public group named 'PublicTrends' on the server with program ID 'My.Server.1'.

```
da = opcda('localhost', 'My.Server.1');
connect(da);
pubGrp = addgroup(da, 'PublicTrends', 'public');
```

When you connect to a public group, the items in that group are automatically created for you.

```
itm = get(pubGrp, 'Items');
```

```
itm =
```

OPC Item Object Array:

Index:	DataType:	Active:	ItemID:
1	double	on	item.id.1
2	uint16	on	item.id.2
3	double	on	item.id.3

You cannot add items to or remove items from a public group. However, you can still modify the update rate of the group, the dead band percent, and the active and subscription status of the group, and you can use the group to read, write, or log data as you would for a private group.

When you have finished using a public group, you can use the `delete` function to remove that group from your client object. Deleting the group from the client does not remove the public group from the server; other clients might require that group after you have finished with it. Instead, deleting the group from the client indicates to the server that you are no longer interested in the group.

Removing Public Groups from the Server

You can request that a public group be removed from a server using the `removepublicgroup` function, passing the client object that is connected to the server and the name of the public group to remove.

Caution The OPC Data Access Specification does not provide any security mechanism for removing public groups; any client can request that a public group be removed. You should use this function with extreme caution!

If any clients are currently connected to that group, the server will issue a warning stating that the group will be removed when all clients have finished using the group.

Configuring OPC Toolbox™ Object Properties

In this section...

“Purpose of Object Properties” on page 3-17

“Viewing the Values of Object Properties” on page 3-18

“Viewing the Value of a Particular Property” on page 3-19

“Getting Information About Object Properties” on page 3-19

“Setting the Value of an Object Property” on page 3-20

“Viewing a List of All Settable Object Properties” on page 3-21

Purpose of Object Properties

All OPC Toolbox™ objects support properties that enable you to control characteristics of the object:

- The `opcda` client object properties control aspects of the connection to the OPC server, and event information obtained from the server. For example, you can use the `Timeout` property to define how long to wait for the server to respond to a request from the client.
- The `dagroup` object properties control aspects of the collection of items contained within that group, including all logging properties. For example, the `UpdateRate` property defines how often the items in the group must be checked for value changes, as well as the rate at which data will be sent from the server during a logging session.
- The `daitem` object properties control aspects of a single server item. For example, you use the `DataType` property to define the data type that the server must use to send values of that server item to the OPC Toolbox software.

For all three toolbox objects, you can use the same toolbox functions to

- View a list of all the properties supported by the object, with their current values
- View the value of a particular property

- Get information about a property
- Set the value of a property

Viewing the Values of Object Properties

To view all the properties of an OPC Toolbox object, with their current values, use the `get` function.

If you do not specify a return value, the `get` function displays the object properties in categories that group similar properties together. You use the display form of the `get` function to view the value of all properties for the toolbox object.

This example uses the `get` function to display a list of all the properties of the OPC dagroup object `grp`.

```
get(grp)
```

General Settings:

```
DeadbandPercent = 0  
GroupType = private  
Item = []  
Name = group1  
Parent = [1x1 opcda]  
Tag =  
TimeBias = 0  
Type = dagroup  
UpdateRate = 0.5000  
UserData = []
```

Callback Function Settings:

```
CancelAsyncFcn = @opccallback  
DataChangeFcn = []  
ReadAsyncFcn = @opccallback  
RecordsAcquiredFcn = []  
RecordsAcquiredFcnCount = 20  
StartFcn = []  
StopFcn = []  
WriteAsyncFcn = @opccallback
```

Subscription and Logging Settings:

```
Active = on
LogFileName = opcdata\log.olf
Logging = off
LoggingMode = memory
LogToDiskMode = index
RecordsAcquired = 0
RecordsAvailable = 0
RecordsToAcquire = 120
Subscription = on
```

Viewing the Value of a Particular Property

To view the value of a particular property of an OPC Toolbox object, use the `get` function, specifying the name of the property as an argument. You can also access the value of the property as you would a field in a MATLAB® structure.

This example uses the `get` function to retrieve the value of the `Subscription` property for the `dagroup` object.

```
get(grp,'Subscription')
```

```
ans =
```

```
on
```

This example illustrates how to access the same property by referencing the object as if it were a MATLAB structure.

```
grp.Subscription
```

```
ans =
```

```
on
```

Getting Information About Object Properties

To get information about a particular property, you can view the reference page for the property in Chapter 9, “Functions — Alphabetical List”. You can also get information about a particular property at the command line by using the `propinfo` or `opchelp` functions.

The `propinfo` function returns a structure that contains information about the property, such as its data type, default value, and a list of all possible values if the property supports such a list. This example uses `propinfo` to get information about the `LoggingMode` property.

```
propinfo(grp, 'LoggingMode')  
  
ans =  
  
           Type: 'string'  
      Constraint: 'enum'  
ConstraintValue: {'memory' 'disk' 'disk&memory'}  
      DefaultValue: 'memory'  
           ReadOnly: 'whileLogging'
```

The `opchelp` function returns reference information about the property with a complete description. This example uses `opchelp` to get information about the `LoggingMode` property.

```
opchelp(grp, 'LoggingMode')
```

Setting the Value of an Object Property

To set the value of a particular property of an OPC Toolbox object, use the `set` function, specifying the name of the property as an argument. You can also assign the value to the property as you would a field in a MATLAB structure.

Note Because some properties are read-only, only a subset of the toolbox object properties can be set. Use the property reference pages or the `propinfo` function to determine if a property is read-only.

This example uses the `set` function to set the value of the `LoggingMode` property.

```
set(grp, 'LoggingMode', 'disk&memory')
```

To verify the new value of the property, use the `get` function.

```
get(grp, 'LoggingMode')
```

```
ans =
```

```
disk&memory
```

This example sets the value of a property by assigning the value to the object as if it were a MATLAB structure.

```
grp.LoggingMode = 'disk';
grp.LoggingMode
```

```
ans =
```

```
disk
```

Viewing a List of All Settable Object Properties

To view a list of all the properties of a toolbox object that can be set, use the `set` function.

```
set(grp)
  General Settings:
  DeadbandPercent
  Name
  Tag
  TimeBias
  UpdateRate
  UserData

  Callback Function Settings:
  CancelAsyncFcn: string -or- function handle -or- cell array
  DataChangeFcn: string -or- function handle -or- cell array
  ReadAsyncFcn: string -or- function handle -or- cell array
  RecordsAcquiredFcn: string -or- function handle -or- cell array
  RecordsAcquiredFcnCount
  StartFcn: string -or- function handle -or- cell array
  StopFcn: string -or- function handle -or- cell array
  WriteAsyncFcn: string -or- function handle -or- cell array

  Subscription and Logging Settings:
  Active: [ {on} | off ]
  LogFileName
```

```
LoggingMode: [ {memory} | disk | disk&memory ]
LogToDiskMode: [ {index} | append | overwrite ]
RecordsToAcquire
Subscription: [ {on} | off ]
```

When using the set function to display a list of settable properties, all properties that have a predefined set of available values will have those values shown after the property. The default value for these properties will be enclosed in curly brackets ({}). For example, from the display shown above, you can set the Subscription property for a dagroup object to 'on' or 'off', with the default value being 'on'. You can set the LogFileName property to any value.

Special Read-Only Modes

Some OPC Toolbox object properties change their read-only status, depending on the state of an object (defined by another property of that object, or the parent of that object). The toolbox uses two special read-only modes:

- 'whileConnected': These properties cannot be changed while the client is connected to the OPC server. For example, the client's Host property is read-only while connected.
- 'whileLogging': These properties cannot be changed while the dagroup object is logging. For example, the LoggingMode property is read-only while logging. For more information on logging, see “Logging OPC Server Data” on page 4-17.
- 'whilePublic': These properties cannot be changed because the group is a public group. For more information on public groups, see “Working with Public Groups” on page 3-12.

Note Properties that modify their read-only state are always displayed when using set to display settable properties, even when they cannot be changed because of the state of the object.

To determine if a property has a modifiable read-only state, use the propinfo function.

Deleting Objects

When you finish using your OPC Toolbox™ objects, use the `delete` function to remove them from memory. After deleting them, clear the variables that reference the objects from the MATLAB® workspace by using the `clear` function.

Note When you delete an `opcda` client object, all the group and item objects associated with the `opcda` client object are also deleted. Similarly, when you delete a `dagroup` object, all `daitem` objects associated with that `dagroup` object are deleted.

To illustrate the deletion process, this example creates several `opcda` client objects and then deletes them.

Step 1: Create several clients

This example creates several `opcda` client objects using fictitious host and server ID properties.

```
da1 = opcda('Host1', 'Dummy.Server.1');  
da2 = opcda('Host2', 'Dummy.Server.2');  
da3 = opcda('Host3', 'Dummy.Server.3');
```

Step 2: Delete clients

Always remove toolbox objects from memory, and the variables that reference them, when you no longer need them.

You can delete toolbox objects using the `delete` function.

```
delete(da1)  
delete(da2)  
delete(da3)
```

Note that the variables associated with the objects remain in the workspace.

```
whos
```

Name	Size	Bytes	Class
da1	1x1	636	opcda object
da2	1x1	636	opcda object
da3	1x1	636	opcda object

These variables are not valid OPC Toolbox objects.

```
invalid(da1)
```

```
ans =  
    0
```

To remove these variables from the workspace, use the `clear` command.

Note You can delete toolbox object vectors using the `delete` function. You can also delete individual elements of a toolbox object vector.

Saving and Loading Objects

Using the `save` command, you can save an OPC Toolbox™ object to a MAT-file, just as you would any workspace variable. This example saves the `dagroup` object to the MAT-file `myopc.mat`.

```
save myopc grp
```

When you save a toolbox object, all the toolbox objects in that object hierarchy are also saved. For example, if you save a `dagroup` object, the client, all groups associated with that client and all items created in those groups are saved along with the `dagroup` object. However, only those objects you elect to save will be created in the MATLAB® workspace. Other objects will be created with no reference to them in the workspace. To obtain a reference to an existing OPC Toolbox object, use the `opcfind` function.

To load a toolbox object that was saved to a MAT-file into the MATLAB workspace, use the `load` command. For example, to load `grp` from MAT-file `myopc.mat`, use

```
load myopc
```

Note The values of read-only properties are not saved. When you load a toolbox object into the MATLAB workspace, read-only properties revert back to their default values. To determine if a property is read-only, use the `propinfo` function or see Chapter 11, “Properties — Alphabetical List”.

Reading, Writing, and Logging OPC Data

The core of any OPC Toolbox™ software application is the exchange of data between the MATLAB® workspace and one or more OPC servers. You create and configure toolbox objects to support the reading, writing, and data logging functions that you require for your application.

Using OPC Toolbox software you can exchange data with an OPC server in a number of ways. You can read and write data from the MATLAB command line or other MATLAB functions. You can configure toolbox objects to automatically run MATLAB code when the server notifies the objects that data has changed on the server. You can also log changes in OPC server data to a disk file or to memory, for further analysis.

This chapter provides information on how to exchange data with an OPC server.

Reading and Writing Data (p. 4-2)	Describes how to use group and item objects to read and write data synchronously and asynchronously.
Data Change Events and Subscription (p. 4-12)	Describes how OPC servers generate data change events, and how you can control data change event notification.
Logging OPC Server Data (p. 4-17)	Describes how to log data from an OPC server for later analysis and/or visualization.

Reading and Writing Data

In this section...
“Introduction” on page 4-2
“Reading Data from an Item” on page 4-2
“Writing Data to an Item” on page 4-6
“Reading and Writing Multiple Values” on page 4-8

Introduction

Using OPC Toolbox™ software, you can exchange data with the OPC server using individual items, or using the `dagroup` object to perform the operation on multiple items. The reading and writing operation can be performed *synchronously*, so that your MATLAB® session will wait for the operation to complete, or *asynchronously*, allowing your MATLAB session to continue processing while the operation takes place in the background.

Reading Data from an Item

You can read data from any item that is associated with a connected client. When you perform the read operation on an item, the server will return information about the server item associated with that item ID. The read operation can be performed synchronously or asynchronously:

- “Using Synchronous Read Operations” on page 4-2 describes how to perform synchronous read operations. Synchronous read operations can request data from the server’s cache, or directly from the device.
- “Using Asynchronous Read Operations” on page 4-5 describes how to perform asynchronous read operations.

Using Synchronous Read Operations

A *synchronous* read operation means that MATLAB will wait for the server to return data from a read request before continuing processing. The data returned by the server can come from the server’s cache, or you can request that the server read values from the device that the server item refers to.

You use the read function to perform synchronous read operations, passing the daitem object associated with the server item you want to read. If the read operation is successful, the data is returned in a structure containing information about the read operation, including the value of the server item, the quality of that value, and the time that the server obtained that value. The item's Value, Quality and Timestamp properties are also updated to reflect the values obtained from the read operation.

The following example creates an opcda client object and configures a group with one item, 'Random.Real8'. A synchronous read operation is then performed on the item.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation.1');
connect(da);
grp = addgroup(da);
itm1 = additem(grp, 'Random.Real8');
r = read(itm1)
```

```
r =
```

```
    ItemID: 'Random.Real8'
    Value: 4.3252e+003
    Quality: 'Good: Non-specific'
    Timestamp: [2004 3 2 9 50 26.6710]
    Error: ''
```

Specifying the Source of the Read Operation. By default, a synchronous read operation will return data from the OPC server's cache. By reading from the cache, you do not have to wait for a possibly slow device to provide data to the server. You can specify the source of the synchronous read operation as the second parameter to the read function. If the source is specified as 'device', the server will read a value from the device, and return that value to you (as well as updating the server cache with that value).

Note Reading from the device may be slow. If the read operation generates a time-out error, you may need to increase the value of the Timeout property of the opcda client object associated with the group or item in order to support synchronous reads from the device.

The following example reads data from the device associated with itm1.

```
r = read(itm1, 'device')

r =

    ItemID: 'Random.Real8'
    Value: 9.1297e+003
    Quality: 'Good: Non-specific'
    TimeStamp: [2004 3 2 10 8 20.2650]
    Error: ''
```

Reading from the Cache with Inactive Items. In order to reduce communication traffic and speed up data access, OPC servers do not store all server item values in their cache. Only those server items that are *active* will be stored in the server cache. Therefore, synchronous read operations from the cache on an inactive item will return data that may not correspond to the current device value. If you attempt to read data from an inactive item using the read function, and do not specify 'device' as the source, the Quality will be set to 'Bad: Out of Service'.

You control the active status of an item using the Active property.

The following example sets the Active property of the item to 'off' and attempts to read from the cache.

```
itm1.Active = 'off';
r = read(itm1)

Warning: One or more items is inactive.
(Type "warning off opc:read:iteminactive" to suppress this
warning.)

r =

    ItemID: 'Random.Real8'
    Value: 8.4278e+003
    Quality: 'Bad: Out of Service'
    TimeStamp: [2004 3 2 10 17 19.9370]
    Error: ''
```

Using Asynchronous Read Operations

An *asynchronous* read operation creates a request to read data, and then sends that request to the server. Once the request has been accepted, MATLAB continues processing the next instruction without waiting to receive any values from the server. When the data is ready to be returned, the server sends the data back to MATLAB by generating a *read async event*. MATLAB will handle that event as soon as it is able to perform that task.

Asynchronous read operations always return data from the device.

By using an asynchronous read operation, you can continue performing tasks in MATLAB while the value is being read from the device, and then process the returned value when the server is able to provide it back to MATLAB.

You perform asynchronous read operations using the `readasync` function, passing the `daitem` object that you want to read from. If successful, the function will return a *transaction ID*, a unique identifier for that asynchronous transaction. You can use that transaction ID to identify the read operation when it is returned through the `read async` event.

When an asynchronous read operation is processed in MATLAB, the item's `Value`, `Quality` and `Timestamp` properties are also updated to reflect the values obtained from the asynchronous read operation.

The following example of using an asynchronous read operation uses the default callback for a `read async` event. The default callback is set to the `opccallback` function, which displays information about the event in the command line.

```
tid = readasync(itm1)
```

```
tid =
```

```
3
```

The transaction ID for this operation is 3. A little while later, the default callback function displays the following information at the command line.

```
OPC ReadAsync event occurred at local time 10:44:49  
Transaction ID: 3
```

```
Group Name: Group0
1 items read.
```

You can change the read async event callback function by setting the `ReadAsyncFcn` property of the `dagroup` object. For more information on callbacks and events, see Chapter 6, “Using Events and Callbacks”.

Writing Data to an Item

You can write data to individual items, or to groups of items. This section describes how to write data to individual items. See “Reading and Writing Multiple Values” on page 4-8 for information on using `dagroup` objects to write data to multiple items.

You can write data to an OPC server using a synchronous write operation, in which case MATLAB will wait for the server to acknowledge that the write operation succeeds, or using an asynchronous write operation, in which case MATLAB is free to continue performing other tasks while the write operation takes place. Because write operations always apply directly to the device, a synchronous write operation may take a significant amount of time, particularly if the device that you are writing to has a slow connection to the OPC server.

Using Synchronous Write Operations

You use the `write` function to perform synchronous write operations. The first argument is the `daitem` object that represents the server item you want to write to. The second argument is the value that you want to write to that server item. The `write` function does not return any results, but will generate an error if the write operation is not successful.

The following example creates an item with item ID 'Bucket Brigade.Real8' and writes the value 10.34 to the item. The value is then read using a synchronous read operation.

```
itm2 = additem(grp, 'Bucket Brigade.Real8');
write(itm2, 10.34)
r = read(itm2, 'device')
```

You do not need to ensure that the data type of the value you are writing, and the data type of the `daitem` object, are the same. OPC Toolbox software

relies on the server to perform the conversion from the data type you provide, to the data type required for that server item. For information on how the toolbox handles different data types, see “Working with Different Data Types” on page 5-18.

Using Asynchronous Write Operations

An asynchronous write operation creates a request to write data, and then sends that request to the server. Once the request has been accepted, MATLAB continues processing the next instruction without waiting for the data to be written. When the write operation completes on the server, the server notifies MATLAB that the operation completed by generating a *write async event* containing information on whether the write operation succeeded, and an error message if applicable. MATLAB will handle that event as soon as it is able to perform that task.

You use the `writesync` function to write values to the server asynchronously. The first argument is the `daitem` object that represents the server item you want to write to. The second argument is the value you want to write to that server item. The return value is the *transaction ID* of the operation. You can use the transaction ID to identify the write operation when it is returned through the write async event.

The following example uses asynchronous operations to write the value 57.8 to the item 'Bucket Brigade.Real8' created earlier.

```
tid = writesync(itm2, 57.8)

tid =

    4
```

A while later, the standard callback (`opccallback`) will display the results of the write operation to the command line.

```
OPC WriteAsync event occurred at local time 11:15:27
Transaction ID: 4
Group Name: Group0
1 items written.
```

You can change the write async event callback function by setting the `WriteAsyncFcn` property of the `dagroup` object. For more information on events and callbacks, see Chapter 6, “Using Events and Callbacks”.

Reading and Writing Multiple Values

When you use the read and write operation on a single `daitem` object, you read or write a single value per transaction. OPC Toolbox software allows you to perform one operation to read multiple item values, or to write multiple values. You can also use a `dagroup` object to read and write values using all items in the group, or you can perform read and write operations on item object vectors.

A `daitem` object vector is a single variable in the MATLAB workspace containing more than one `daitem` object. You can construct item vectors using any of the standard concatenation techniques available in MATLAB. See “Creating OPC Toolbox™ Object Vectors” on page 3-9 for information on creating and working with toolbox object vectors.

When you perform any read or write operation on a `dagroup` object, it is the equivalent of performing the operation on the `Item` property of that group, which is a `daitem` object vector representing all items that are contained within the `dagroup` object.

The following sections describe how to perform read and write operations on multiple items:

- “Reading Multiple Values” on page 4-8 describes how to read multiple values from an item vector or `dagroup` object.
- “Writing Multiple Values” on page 4-10 describes how to write multiple values to an item vector or `dagroup` object.
- “Error Handling for Multiple Item Read and Write Operations” on page 4-10 explains how OPC Toolbox software deals with errors when performing read and write operations on multiple objects.

Reading Multiple Values

The following sections describe how synchronous read operations and asynchronous read operations behave for multiple items.

Synchronous Read Operations. When you read multiple values using the read function, the returned value will be a structure array. Each element of the structure will contain the same fields. One of the fields is the item ID that the information in that element of the structure refers to.

The following example performs a synchronous read operation on the dagroup object created in the previous examples in this section.

```
r = read(grp)

r =

2x1 struct array with fields:
    ItemID
    Value
    Quality
    TimeStamp
    Error
```

To display the first record in the structure array, use indexing into the structure.

```
r(1)

ans =

    ItemID: 'Random.Real8'
    Value: 3.7068e+003
    Quality: 'Good: Non-specific'
    TimeStamp: [2004 3 2 11 49 52.5460]
    Error: ''
```

To display all values of a particular field, you can use the list generation syntax in MATLAB. Enclosing that list in a cell array groups the values into one variable.

```
{r.Value}

ans =

    {3.7068e+003    10}
```

Asynchronous Read Operations. When you read multiple values using the `readasync` function, the return value is still a single transaction ID. The multiple values will be returned in the read async event structure passed to the `ReadAsyncFcn` callback. For information on the structure of the read async event, see “Event Types” on page 6-5.

Writing Multiple Values

When you perform a write operation on multiple items you need to specify multiple values, one for each item you are writing to. OPC Toolbox software requires these multiple values to be in a *cell array*, since the data types for each value may be different. For information on constructing cell arrays, see MATLAB Programming.

Note Even if you are using the same data type for every value being written to the `dagroup` object or `daitem` object vector, you must still use a cell array to specify the individual values. Use the `num2cell` function to convert numeric arrays to cell arrays.

The following example writes values to a `dagroup` object containing two items.

```
write(grp, {1.234, 5.43})
```

Error Handling for Multiple Item Read and Write Operations

When reading and writing with multiple items, an error generated by performing the operation on one item will not automatically generate an error in MATLAB. The following rules apply to reading and writing with multiple items:

- If all items fail the operation, an error will be generated. The error message will contain specific information for each item about why the item failed.
- If some items fail but some succeed, the operation does not error, but generates a warning, listing which items failed and the reason for failure.

Note that for asynchronous read and write operations, items may fail early (during the request for the operation) or late (when the information

is returned from the server). If any items fail late, an error event will be generated in addition to the read async event or write async event.

Data Change Events and Subscription

In this section...

“Introduction” on page 4-12

“Configuring OPC Toolbox™ Objects for Data Change Events” on page 4-12

“How OPC Toolbox™ Software Processes Data Change Events” on page 4-15

“How to Customize the Data Change Event Response” on page 4-15

Introduction

Using the `read` and `readasync` functions described in “Reading Data from an Item” on page 4-2, you can obtain information about OPC server item values upon request. The OPC Data Access specification provides another mechanism for clients to get information on server item values. This mechanism allows the OPC server to notify a client when a server item’s value or quality has updated. This mechanism is called a *data change event*. OPC Toolbox™ software supports data change event notification by executing a MATLAB® function when a data change event is received from a connected OPC server. This section describes how to use the data change event notification.

Configuring OPC Toolbox™ Objects for Data Change Events

A data change event occurs at the `dagroup` object level. Using `dagroup` object properties, you can control whether a data change event is generated for a particular group, the minimum time between successive events, and the MATLAB function to run when the event notification is received and processed by OPC Toolbox software. You can also control which items in a particular group should be monitored for data changes. In this way, you can control the number and frequency of data change events that MATLAB has to process. On a busy OPC server, you can also turn off data change notification for groups that you are not currently interested in.

The following sections describe how to control data change notification.

- “Controlling Data Change Notification for a Group” on page 4-13 describes how to turn off data change notification for a `dagroup` object.

- “Temporarily Disabling Items in a Group” on page 4-14 describes how to control which items in a group must be monitored for data changes.
- “How to Customize the Data Change Event Response” on page 4-15 provided information on how to configure the MATLAB function to run when a data change event occurs.

Controlling Data Change Notification for a Group

The following properties of a dagroup object control whether a server notifies the group of data changes on items in that group:

- **UpdateRate:** The UpdateRate property defines the rate at which an OPC server must monitor server item values and generate data change events. Even if a server item’s value changes more frequently than the update rate, the OPC server will only generate a data change at the interval specified by the update rate.
- **Subscription:** The Subscription property defines whether the OPC server will generate a data change event for the group. When you create a dagroup object, the Subscription property is set to 'on'. When you set the Subscription property to 'off', you tell the OPC server not to generate data change events for that group.
- **Active:** The Active property must be 'on' for data change events to be generated. When you create a dagroup object, the Active property is set to 'on'. When you set the Active property to 'off', you remove any ability to read data from the group, whether through read operations or data change events.

A summary of group read, write, and data change behavior for the Active and Subscription properties is given in the following table.

Active	Subscription	Read	Write	Data Change
'on'	'on'	Yes	Yes	Yes
'on'	'off'	Yes	Yes	No
'off'	'on'	No	No	No
'off'	'off'	No	No	No

Temporarily Disabling Items in a Group

You can temporarily disable items in a group without deleting the item from the group. When you disable a `daitem` object, the OPC server no longer monitors changes in the associated server item's value, and will therefore not generate data change events when the value of that server item changes.

You can disable a `daitem` object by setting that object's Active property to 'off'. You can reenable the `daitem` object by setting the Active property to 'on'.

Forcing a Data Change Event

You can force an OPC server to generate a data change event for all active items in a group by using the `refresh` function with the `dagroup` object as the first argument. The OPC server will generate a data change event containing information for every active item in the group.

You can pass an optional second argument to the `refresh` function to instruct the OPC server where to source the data values that are sent back in the data change event. By specifying a source of 'device', you instruct the OPC server to update the values from the device. By specifying a source of 'cache' (the default) you instruct the OPC server to return values from the OPC server's cache.

How OPC Toolbox™ Software Processes Data Change Events

OPC Toolbox software uses data change events for a number of tasks. The following activities take place when a data change event occurs:

- 1** The Value, Quality, and TimeStamp properties of the daitem object are automatically updated. For more information on these properties, see “Understanding OPC Data: Value, Quality, and TimeStamp” on page 5-2.
- 2** If the dagroup object is logging, the data change event is logged to memory and/or disk as a *record*. For information on logging, see “Logging OPC Server Data” on page 4-17.
- 3** If the dagroup object’s DataChangeFcn property is not empty, that function is called with the data change event information. By default, this property is empty, since data change events occur frequently. You can customize the behavior of the toolbox by setting this property to call a function that you choose. For information on the data change event, see the reference page for the DataChangeFcn property.

Note If you disable data change events by setting the Subscription property to 'off' or the Active property to 'off', none of the activities listed above can take place. You cannot change the Active or Subscription properties while a dagroup object is logging, otherwise the logging task may never complete.

How to Customize the Data Change Event Response

One of the activities that occurs when OPC Toolbox software receives a data change event from the OPC server is the running of the function defined in the DataChangeFcn property. By setting this property to a the name of a function that you have written, you can fully customize the data change event behavior of the toolbox. For example, you may configure a dagroup object to monitor a server item that is updated from an operator interface. By pushing a button on the operator interface, the server item value will change, initiating a data change event on that group. By configuring the DataChangeFcn property to run a MATLAB function that performs control loop optimization, you can

allow an operator to initiate a control loop performance test on all critical control loops in the plant.

Logging OPC Server Data

In this section...

“How OPC Toolbox™ Software Logs Data” on page 4-17

“Configuring a Logging Session” on page 4-20

“Executing a Logging Task” on page 4-24

“Getting Logged Data into the MATLAB® Workspace” on page 4-26

How OPC Toolbox™ Software Logs Data

The OPC Data Access Specification, which OPC Toolbox™ software implements, provides access to current values of data on an OPC server. Often, for analysis, troubleshooting, and prototyping purposes, you will want to know how OPC server data has changed over a period of time. For example, you can use time series data to perform control loop optimization or system identification on a portion of your plant. OPC Toolbox software provides a logging mechanism that stores a history of data that changed over a period of time. This section discusses how to configure and execute a logging task using the toolbox.

Note The OPC Toolbox software logging mechanism is not designed to replace a data historian or database application that logs data for an extended period. Rather, the logging mechanism allows you to quickly configure a task to log data on an occasional basis, where modifications to the plant-wide data historian may be unfeasible.

OPC Toolbox software uses the data change event to log data. Each data change event that is logged is called a *record*. The record contains information about the time the client logged the record, and details about each item in the data change event. Data change events are discussed in detail in “Data Change Events and Subscription” on page 4-12.

The use of a data change event for logging means that you should consider the following points when planning a logging session:

- **Logging takes place at the group level** — When planning a logging task, configure the group with only the items you need to log. Including more items than you need to will only increase memory and/or disk usage, and using that data may be more difficult due to unnecessary items in the data set.
- **Inactive items in a group will not be logged** — You must ensure that the items you need to log are active when you start a logging session. You control the active state of a daitem object using the Active property of the daitem object.
- **Data change events (records) may not include all items** — A data change event contains only the items in the group that have changed their value and/or quality state since the last update. Hence, a record is not guaranteed to contain every data item. You need to consider this when planning your logging session.
- **OPC logging tasks are not guaranteed to complete** — Because data change events only happen when an item in the group changes state on the server, it is possible to start a logging task that will never finish. For example, if the items in a group never change, a data change event will never be generated for that group. Hence, no records will be logged.
- **Logged data is not guaranteed to be regularly sampled** — It is possible to force a data change event at any time (see “Forcing a Data Change Event” on page 4-14). If you do this during a logging task, the data change events may occur at irregular sample times. Also, a data change event may not contain information for every item in the group. Consequently, logged OPC server data may not occur at regular sample times.

An overview of the logging task, and a representation of how the above points impact the logging session, is provided in the following section.

Example: An Overview of a Logging Task

To illustrate a typical logging task, the following example logs to disk and memory six records of data from two items provided by the Matrikon™ OPC Simulation Server. During the logging task, data is retrieved from memory. When the task stops, the remaining records are retrieved.

Step 1: Create the OPC Toolbox object hierarchy. This example creates a hierarchy of OPC Toolbox objects for two items provided by the Matrikon Simulation Server. To run this example on your system, you must have the Matrikon Simulation Server installed. Alternatively, you can replace the values used in the creation of the objects with values for a server you can access.

```
da = opcda('localhost','Matrikon.OPC.Simulation.1');
connect(da);
grp = addgroup(da,'CallbackTest');
itm1 = additem(grp,'Triangle Waves.Real8');
itm2 = additem(grp,'Saw-Toothed Waves.Boolean');
```

Step 2: Configure the logging duration. This example sets the UpdateRate value to 1 second, and the RecordsToAcquire property to 6. See “Controlling the Duration of a Logging Session” on page 4-21 for more information on this step.

```
set(grp,'UpdateRate',1);
set(grp,'RecordsToAcquire',6);
```

Step 3: Configure the logging destination. In this example, data is logged to disk and memory. The disk filename is set to LoggingExample.olf. The LogToDiskMode property is set to 'overwrite', so that if the filename exists, the toolbox engine must overwrite the file. See “Controlling the Logged Data Destination” on page 4-22 for more information on this step.

```
set(grp,'LoggingMode', 'disk&memory');
set(grp,'LogFileName', 'LoggingExample.olf');
set(grp,'LogToDiskMode','overwrite');
```

Step 4: Start the logging task. Start the dagroup object. The logging task is started, and the group summary updates to reflect the logging status. See “Starting a Logging Task” on page 4-24 for more information on this step.

```
start(grp)
grp
```

Step 5: Monitor the Logging Progress. After about 3 seconds, retrieve and show the last acquired value. After another second, obtain the first two records during the logging task. Then wait for the logging task to complete. See “Monitoring the Progress of a Logging Task” on page 4-24 for more information on this step.

```
pause(3.5)
sPeek = peekdata(grp, 1);
% Display the local event time, item IDs and values
disp(sPeek.LocalEventTime);
disp({sPeek.Items.ItemID;sPeek.Items.Value});
pause(1)
sGet = getdata(grp, 2);
wait(grp)
```

Step 6: Retrieve the data. This example retrieves the balance of the records into a structure array. See “Retrieving Data from Memory” on page 4-27 for more information on this step.

```
sFinished = getdata(grp, grp.RecordsAvailable);
```

Step 7: Clean up. When you no longer need them, always remove from memory any toolbox objects and the variables that reference them. Deleting the `opcda` client object also deletes the group and `daitem` objects.

```
disconnect(da)
delete(da)
clear da grp itm1 itm2
```

Configuring a Logging Session

A logging session is associated with a `dagroup` object. Before you start a logging session, you will need to ensure that the logging session is correctly configured. This section explains how you can control

- The duration of a logging session (see “Controlling the Duration of a Logging Session” on page 4-21). By default, a group will log approximately one minute of data at half second intervals.
- The destination of logged data (see “Controlling the Logged Data Destination” on page 4-22). By default, a group will log data to memory.

- The response to events that take place during a logging session (see “Configuring Logging Callbacks” on page 4-23). By default, a logging session takes no action in response to events that take place during a logging session.

Controlling the Duration of a Logging Session

While you cannot guarantee that a logging session will take a specific amount of time (see “How OPC Toolbox™ Software Logs Data” on page 4-17), you can control the rate at which the server will update the items and how many records the logging task should store before automatically stopping the logging task. You control these aspects of a logging task by using the following properties of the `dagroup` object:

- `UpdateRate`: The `UpdateRate` property defines how often the item values are inspected.
- `RecordsToAcquire`: The `RecordsToAcquire` property defines how many records OPC Toolbox software must log before automatically stopping a logging session. A logging task can also be stopped manually, using the `stop` function.
- `DeadbandPercent`: The `DeadbandPercent` property does not control the duration of a logging task directly, but has a significant influence over how often a data change event is generated for *analog items* (an item whose value is not confined to discrete values). By setting the `DeadbandPercent` property to 0, you can ensure that a data change event occurs each time a value changes. For more information on `DeadbandPercent`, consult the property reference page.

You can use the `UpdateRate` and `RecordsToAcquire` properties to define the minimum duration of a logging task. The duration of a logging task is at least

$$\text{UpdateRate} * \text{RecordsToAcquire}$$

For example, if the `UpdateRate` property is 10 (seconds) and the `RecordsToAcquire` property is 360, then provided that a data change event is generated each time the server queries the item values, the logging task will take 3600 seconds, or one hour, to complete.

Controlling the Logged Data Destination

OPC Toolbox software allows you to log data to memory, to a disk file, or both memory and a disk file. When logging data to memory, you can log only as much data as will fit into available memory. Also, if you delete the dagroup object that logged the data without extracting that data to the MATLAB® workspace, the data will be lost. The advantage of logging data to memory is that logging to memory is faster than using a disk file.

Logging data to a disk file usually means that you can log more data, and the data is not lost if you quit MATLAB or delete the dagroup object that logged the data. However, reading data from a disk file is slower than reading data from memory.

The `LoggingMode` property of a dagroup object controls where logged data is stored. You can specify `'memory'` (the default value), or `'disk'`, or `'disk&memory'` as the value for `LoggingMode`.

The following properties control how OPC Toolbox software logs data to disk. You must set the `LoggingMode` property to `'disk'` or `'disk&memory'` for these properties to take effect:

- `LogFileName`: The `LogFileName` property is a string that specifies the name of the disk file that is used to store logged data. If the file does not exist, data will be logged to that filename. If the file does exist, the `LogToDiskMode` property defines how the toolbox behaves.
- `LogToDiskMode`: The `LogToDiskMode` property controls how OPC Toolbox software handles disk logging when the file specified by `LogFileName` already exists. Each time a logging task is started, if the `LoggingMode` is set to `'disk'` or `'disk&memory'`, the toolbox checks to see if a file with the name specified by the `LogFileName` property exists. If the file exists, the toolbox will take the following action, based on the `LogToDiskMode` property:
 - `'append'`: When `LogToDiskMode` is set to `'append'`, logged data will be added to the existing data in the file.
 - `'overwrite'`: When `LogToDiskMode` is set to `'overwrite'`, all existing data in the file will be removed without warning, and new data will be logged to the file.

- 'index': When LogToDiskMode is set to 'index', OPC Toolbox software automatically changes the log filename, according to the following algorithm:

The first log filename attempted is specified by the initial value of LogFileName.

If the attempted filename exists, LogFileName is modified by adding a numeric identifier. For example, if LogFileName is initially specified as 'groupRlog.olf', then groupRlog.olf is the first attempted filename, groupRlog01.olf is the second filename, and so on. If LogFileName already contains numeric characters, they are used to determine the next sequence in the modifier. For example, if the LogFileName is initially specified as 'groupRlog010.olf', and groupRlog010.olf exists, the next attempted file is groupRlog011.olf, and so on.

The actual filename used is the first filename that does not exist. In this way, each consecutive logging operation is written to a different file, and no previous data is lost.

Configuring Logging Callbacks

You can configure the dagroup object so that MATLAB will automatically execute a function when the logging task starts, when the logging task stops, and each time a specified number of records is acquired during a logging task. The dagroup object has three *callback properties* that are used during a logging session. Each callback property defines the action to take when a particular logging event occurs:

- **Start event:** A start event is generated when a logging task starts.
- **Records acquired event:** A records acquired event is generated each time a logging task acquires a set number of records.
- **Stop event:** A stop event is generated when a logging task stops, either automatically, or by the user calling the stop function.

For more information on configuring callbacks, see Chapter 6, “Using Events and Callbacks” For an example of using callbacks in a logging task, see “Example: Viewing Recently Logged Data” on page 6-20.

Executing a Logging Task

Once you have configured your logging task you can execute the task. Executing a logging task involves starting the logging task, monitoring the task progress, and stopping the logging task.

Starting a Logging Task

You start a logging task by calling the start function, passing the dagroup object that you want to start logging. The following example starts a logging task for the dagroup object grp.

```
start(grp);
```

When you start a logging task, certain group and item properties become read-only, as modifying these properties during a logging task would corrupt the logging process. Also, the dagroup object performs the following operations:

- 1 Generates a start event and executes the StartFcn callback.
- 2 If Subscription is 'off', sets Subscription to 'on' and issues a warning.
- 3 Removes all records associated with the object from the OPC Toolbox software engine.
- 4 Sets RecordsAcquired and RecordsAvailable to 0.
- 5 Sets the Logging property to 'on'.

For more information on callbacks and events, see Chapter 6, “Using Events and Callbacks”

Monitoring the Progress of a Logging Task

During a logging task, you can monitor the progress of the task by examining the following properties of the dagroup object:

- Logging: The Logging property is set to 'on' at the start of a logging task, and set to 'off' when the logging task stops.
- RecordsAcquired: The RecordsAcquired property contains the number of records that have been logged to the destination specified by the

LoggingMode property. When a start function is called, RecordsAcquired is set to 0. When RecordsAcquired reaches RecordsToAcquire, the logging task stops automatically.

- RecordsAvailable: The RecordsAvailable property contains the number of records that have been stored in the OPC Toolbox software engine for this logging task. Data is only logged to memory if the LoggingMode is set to 'memory' or 'disk&memory'. You extract data from the toolbox engine using the getdata function. See “Getting Logged Data into the MATLAB® Workspace” on page 4-26 for more information on using getdata.

You can monitor these properties in the summary display of a dagroup object, by typing the name of the dagroup object at the command line.

```
grp

grp =
Summary of OPC Data Access Group Object: group1
  Object Parameters
    Group Type      : private
    Item            : 1-by-1 daitem object
    Parent          : localhost/Matrikon.OPC.Simulation.1
    Update Rate     : 0.5
    Deadband        : 0%
  Object Status
    Active          : on
    Subscription    : on
    Logging         : on
  Logging Parameters
    Records         : 120
    Duration        : at least 60 seconds
    Logging to     : disk
    Log File        : group1log.olf ('index' mode)
    Status          : 5 records acquired since starting.
                   0 records available for GETDATA/PEEKDATA
```

Stopping a Logging Task

A logging task stops when one of the following conditions is met:

- The number of records logged reaches the value defined by the `RecordsToAcquire` property.
- You manually stop the logging task by using the stop function.

The following example manually stops the logging task for dagroup object `grp`.

```
stop(grp);
```

When a logging task stops, the `Logging` property is set to `'off'`, a stop event is generated, and the `StopFcn` callback is executed. For more information on callbacks and events, see Chapter 6, “Using Events and Callbacks”.

Getting Logged Data into the MATLAB® Workspace

OPC Toolbox software does not log data directly to the MATLAB workspace. When logging to memory, the data is buffered in the toolbox engine in a storage-efficient way. When logging to disk, the data is logged in ASCII format. To analyze your data, you need to extract the data from the toolbox engine or from a disk file into MATLAB for processing. This section describes how to get your logged data into the MATLAB workspace. The following sections describe this process:

- “Retrieving Data from Memory” on page 4-27, discusses how to retrieve data from the toolbox engine into MATLAB.
- “Retrieving Data from Disk” on page 4-28, discusses how to retrieve data from a disk file into MATLAB.

Whether you log data to memory or to disk, you can retrieve that logged data in one of two formats:

- **Structure format:** This format stores each data change event in a structure. Data from a logging task is simply an array of such structures.
- **Array format:** To visualize and analyze your data, you will need to work with the time series of each of the items in the group. The array format is the logged structure data, “unpacked” into separate arrays for the `Value`, `Quality`, and `TimeStamp`.

These formats are discussed in more detail in Chapter 5, “Working with OPC Data”.

Retrieving Data from Memory

You retrieve data from memory using the `getdata` function, passing the `dagroup` object as the first argument, and the number of records you want to retrieve as the second argument. The data is returned as a structure containing data from each data change event in the logging task. For example, to retrieve 20 records for the `dagroup` object `grp`:

```
s = getdata(grp, 20);
```

If you do not supply a second argument, `getdata` will try to retrieve the number of records specified by the `RecordsToAcquire` property of the `dagroup` object. If the OPC Toolbox software engine contains fewer records for the group than the number requested, a warning is generated and all of the available records will be retrieved.

To retrieve data in array format, you must indicate the data type of the returned values. You pass a string defining that data type as an additional argument to the `getdata` function. Valid data types are any MATLAB numeric data type (for example, `'double'` or `'uint32'`) plus `'cell'` to denote the MATLAB cell array data type.

When you specify a numeric data type or cell array as the data type for `getdata`, the logged data is returned in separate arrays for the item IDs logged, the value, quality, time stamp, and the local event time of each data change event logged. You must therefore specify up to five output arguments for the `getdata` function when retrieving data in array format.

For example, to retrieve 20 records of logged data in double array format from `dagroup` object `grp`.

```
[itmID, val, qual, tStamp, evtTime] = getdata(grp, 20, 'double');
```

Once you have retrieved data to the MATLAB workspace using `getdata`, the records are removed from the toolbox engine to free up memory for additional logged records. If you specify a smaller number of records than those available in memory, `getdata` will retrieve the oldest records. You can use the `RecordsAvailable` property of the `dagroup` object to determine how many records the toolbox engine has stored for that group.

During a logging task, you can examine the most recently acquired records using the `peekdata` function, passing the `dagroup` object as the first argument, and the number of records to retrieve as the second argument. Data is returned in a structure. You cannot return data into separate arrays using `peekdata`. You can convert the structure returned by `peekdata` into separate arrays using the `opcstruct2array` function. Data retrieved using `peekdata` is not removed from the toolbox engine.

For an example of using `getdata` and `peekdata` during a logging task, see “Example: An Overview of a Logging Task” on page 4-18.

When you delete a `dagroup` object, the data stored in the toolbox engine for that object is also deleted.

Retrieving Data from Disk

You can retrieve data from a disk file into the MATLAB workspace using the `opcread` function. You pass the name of the file containing the logged OPC data as the first argument. The data stored in the log file is returned as a structure array, in the same format as the structure returned by `getdata`. Records retrieved from a log file into the MATLAB workspace are not removed from the log file.

You can specify a number of additional arguments to the `opcread` function, that control the records that are retrieved from the file. The additional arguments must be specified by an option name and the option value. The following options are available.

Option Name	Option Value Description
'items'	Specify a cell array of item IDs that you want returned. Items not in this list will not be read.
'dates'	Specify a date range for the event times. The range must be [startDt endDt] where startDt and endDt are MATLAB date numbers.

Option Name	Option Value Description
'records'	Specify the index of records to retrieve as [startRec endRec]. Records outside these indices will not be read.
'datatype'	Specify the data type, as a string, that should be used for the returned values. Valid data type strings are the same as for getdata. If you specify a numeric data type or 'cell', the output will be returned in separate arrays. If you specify a numeric array data type such as 'double' or 'uint32', and the logged data contains arrays or strings, an error will be generated and no data will be returned.

The following example retrieves the data logged during the example on page “Example: An Overview of a Logging Task” on page 4-18, first into a structure array, and then records 3 to 6 are retrieved into separate arrays for Value, Quality, and TimeStamp.

```

sDisk = opcread('LoggingExample.olf')

sDisk =
40x1 struct array with fields:
    LocalEventTime
    Items

[i,v,q,t,e] = opcread('LoggingExample.olf', ...
    'records',[3,6], 'datatype','double')
i =
    'Random.Real8'      'Random.UInt2'      'Random.Real14'
v =
    1.0e+004 *
    0.7819    3.0712    1.4771
    1.5599    2.7792    2.2051
    1.4682    0.4055    0.5315
    0.0235    2.4473    1.5456
q =
    'Good: Non-specific' 'Good: Non-specific' 'Good: Non-specific'
    'Good: Non-specific' 'Good: Non-specific' 'Good: Non-specific'
    'Good: Non-specific' 'Good: Non-specific' 'Good: Non-specific'
    'Good: Non-specific' 'Good: Non-specific' 'Good: Non-specific'

```

```
t =
  1.0e+005 *
    7.3202    7.3202    7.3202
    7.3202    7.3202    7.3202
    7.3202    7.3202    7.3202
    7.3202    7.3202    7.3202
e =
  1.0e+005 *
    7.3202
    7.3202
    7.3202
    7.3202
```

Note For a record to be returned by `opcread`, it must satisfy all the options passed to `opcread`.

Working with OPC Data

When an OPC server returns data from a read or logging operation, three pieces of information make up the data. The Value, Quality, and Timestamp all contribute information about the data point that is returned. As a result, you need to understand how to deal with this information together, because one aspect of the data in isolation will not provide a complete picture of the data returned by a read operation, data change event, read async event, or toolbox logging task.

This chapter describes how OPC Toolbox™ software handles data returned by an OPC server.

Understanding OPC Data: Value, Quality, and TimeStamp (p. 5-2)

Describes the Value, Quality, and TimeStamp elements that make up OPC data.

Working with Structure Formatted Data (p. 5-8)

Describes how OPC Toolbox software arranges data in structure formats.

Understanding Array Formatted Data (p. 5-15)

Describes how you can use array formats returned by OPC Toolbox software.

Working with Different Data Types (p. 5-18)

Describes how OPC Toolbox software deals with MATLAB® data types and OPC server data types.

Understanding OPC Data: Value, Quality, and TimeStamp

In this section...

“Introduction” on page 5-2

“The Relationship Between Value, Quality, and TimeStamp” on page 5-2

“How Value, Quality, and TimeStamp Are Obtained” on page 5-3

Introduction

OPC servers provide access to many server items. To reduce network traffic between the server and the “device” associated with each server item (a field instrument, or a memory location in a PLC, SCADA, or DCS system) the OPC server stores information about each server item in the server’s “cache,” updating that information only as frequently as required to satisfy the requests of all clients connected to that server. Because this process results in data in the cache that may not reflect the actual value of the device, the OPC server provides the client with additional information about that value.

This section describes the OPC Value, Quality, and TimeStamp properties, and how they should be used together to assess the information provided by an OPC server.

The Relationship Between Value, Quality, and TimeStamp

Every server item on an OPC server has three properties that describe the status of the device or memory location associated with that server item:

- **Value** — The Value of the server item is the last value that the OPC server stored for that particular item. The value in the cache is updated whenever the server reads from the device. The server reads values from the device at the update rate specified by the dagroup object’s UpdateRate property, and only when the item and group are both active. You control the active status of an item or group using that object’s Active property.

In addition, for analog type data (data with the additional OPC Foundation Recommended Properties 'High EU' and 'Low EU') the percentage change between the cached value and the device value must exceed the

DeadbandPercent property specified for that item in order for the cached value to be updated.

- **Quality** — The Quality of the server item is a string that represents information about how well the cache value matches the device value. The Quality is made up of two parts: a major quality, which can be 'Good', 'Bad', or 'Uncertain', and a minor quality, which describes the reason for the major quality. For more information on the Quality string, see Appendix A, “OPC Quality Strings”.

The Quality of the server item can change without the Value changing. For instance, if the OPC server attempts to obtain a Value from the device but that operation fails, the Quality will be set to 'Bad'. Also, when you change the client's Active property, the Quality will change.

You must always examine the Quality of an item before using the Value property of that item.

- **TimeStamp** — The TimeStamp of a server item represents the most recent time that the server assessed that the device set the Value and Quality properties of that server item. The TimeStamp can change without the Value changing. For example, if the OPC server obtains a value from the device that is the same as the current Value, the TimeStamp property will still be updated, even if the Value property is not.

OPC Toolbox™ software provides access to the Value, Quality, and TimeStamp properties of a server item through properties of the daitem object associated with that server item.

How Value, Quality, and TimeStamp Are Obtained

OPC Toolbox software provides all three OPC Data Access Standard mechanisms for reading data from an OPC server. The toolbox uses these three mechanisms in various ways to return data from those functions, to provide event information, to update properties of toolbox objects, and to log data to memory and disk.

The way OPC Toolbox software uses the three OPC Data Access mechanisms is described in the following sections:

- “OPC Data Returned from Synchronous Read Operations” on page 5-4 describes the synchronous read mechanism used by the read function.

- “OPC Data Returned in Asynchronous Read Operations” on page 5-4 describes the asynchronous read mechanism used by the `readasync` function.
- “OPC Data Returned from a Data Change Event” on page 5-5 describes the data change event notification mechanism used with subscribed, active groups, with the `refresh` function, and by the toolbox logging process.

OPC Data Returned from Synchronous Read Operations

You initiate a synchronous read operation by using the `read` function. When you read from a `dagroup` object, all items in that group are read in one instruction.

You can specify the source of a synchronous read operation as `'cache'` or `'device'`. If you read from the cache, the server simply returns the value in the cache. If you read from the device, the server will get the value from the device and update the cache before sending the `Value`, `Quality`, and `TimeStamp` information back as part of the read operation.

OPC Toolbox software returns the data in the output structure from the read operation. Each element of the structure array contains information about one of the items read.

Whenever you read values using the `read` function, the toolbox updates the `daitem` object's `Value`, `Quality`, and `TimeStamp` properties with the values read from the server.

OPC Data Returned in Asynchronous Read Operations

You initiate an asynchronous read operation by using the `readasync` function. When you read from a `dagroup` object, all items in that group are read in one instruction.

Asynchronous read operations always use the device as the source of the read. Whenever you send an asynchronous read request, the server will read values from the devices connected to the items. The server will then update that server item's `Value`, `Quality`, and `TimeStamp` in the cache before sending an asynchronous read event back to the toolbox.

OPC Toolbox software returns information from an asynchronous read operation via the read async event structure. This event structure is stored in the `opcda` client object's event log, which you can access using the `EventLog` property of the client. The event structure is also passed to the callback function defined in the `ReadAsyncFcn` property of the `dagroup` object that initiated the asynchronous read operation. For more information on the format of the event structures, see "Event Structures" on page 6-10.

When an asynchronous read operation succeeds, in addition to returning data via the event structures, the toolbox also updates the `Value`, `Quality`, and `TimeStamp` properties of the associated `daitem` object.

OPC Data Returned from a Data Change Event

The third mechanism for getting data from an OPC server involves the data change event. The OPC server generates a data change event for a group at the period specified by the `UpdateRate` property when the `Value` or `Quality` of an item in the group changes. You do not have to specifically request a data change event, because the OPC server will automatically generate a data change event. However, you can force a data change event at any time using the `refresh` function.

An OPC server will generate a data change event only for an active, subscribed group containing active items. You control the active status of `dagroup` objects and `daitem` objects by setting their `Active` property. You control the subscribed status of a `dagroup` object by setting the `Subscription` property of the `dagroup` object.

The following points describe how an OPC server generates a data change event:

- When you configure a group, you define the rate at which the server must scan items in that group. This rate is controlled by the `UpdateRate` property for a `dagroup` object. The server updates the `Value`, `Quality`, and `TimeStamp` values in the cache for the items in that group at the required update rate. Note that if a device cannot provide a value in that time, the server may reduce the rate at which it updates the value in the server cache for that item.

- If you set an item's Active property to 'off', the server will stop scanning that item. You must set the Active property to 'on' for the server to scan the item again.
- If you set the Active property of a dagroup object to 'off', the server will stop scanning all items in that group. You can still perform asynchronous read operations, and synchronous read operations from the 'device', but no operations involving the server cache can be performed. You must set the Active property to 'on' to enable operations involving the server cache.
- If the Subscription property for a dagroup object is set to 'on', then every time the server updates cache values for the items in that group, the server will send a data change event for that group, to the client object. The data change event contains information about every item whose Value, Quality, or TimeStamp updated.
- If you set the Subscription property to 'off', then the OPC server will not generate data change events. However, as long as the group is still active, the OPC server will continue to scan all active items for that group, at the rate specified by the UpdateRate property.

When the OPC server generates a data change event, OPC Toolbox software performs the following tasks:

- 1** The daitem object Value, Quality, and TimeStamp properties are updated for each item that is included in the data change event.
- 2** The callback function defined by the DataChangeFcn property of the dagroup object is called. For more information on callbacks, see “Creating and Executing Callback Functions” on page 6-16.
- 3** If the group is logging data, the data change event is stored in memory and/or on disk. For more information on logging, see “Logging OPC Server Data” on page 4-17.
- 4** If the group is logging, and the number of records acquired is a multiple of the RecordsAcquiredFcnCount property of the dagroup object, then the callback function defined by the RecordsAcquiredFcn property of the dagroup object is called. For more information on callbacks, see “Creating and Executing Callback Functions” on page 6-16.

For more information on the structure of a data change event, see “Data Fields for Cancel Async, Data Change, Error, Read Async, and Write Async Events” on page 6-11.

Working with Structure Formatted Data

In this section...
“When Structures Are Used” on page 5-8
“Example: Performing a Read Operation on Multiple Items” on page 5-8
“Interpreting Structure Formatted Data” on page 5-10
“When to Use Structure Formatted Data” on page 5-13
“Converting Structure Formatted Data to Array Format” on page 5-13

When Structures Are Used

OPC Toolbox™ software uses structures to return data from an OPC server, for the following operations:

- Synchronous read operations, executed using the read function.
- Asynchronous read operations, executed using the readasync function.
- Data change events generated by the OPC server for all active, subscribed groups or through a refresh function call.
- Retrieving logged data in structure format from memory using the getdata or peekdata functions.

In all cases, the structure of the returned data is the same. This section describes that structure, and how you can use the structure data to understand OPC operations.

Example: Performing a Read Operation on Multiple Items

To demonstrate how to use structure formatted data, the following example reads values from three items on the Matrikon™ OPC Simulation Server.

Step 1: Create OPC Toolbox™ Group Objects

This example creates a hierarchy of OPC Toolbox objects for the Matrikon Simulation Server. To run this example on your system, you must have the

Matrikon Simulation Server installed. Alternatively, you can replace the values used in the creation of the objects with values for a server you can access.

```
da = opcda('localhost','Matrikon.OPC.Simulation.1');
connect(da);
grp = addgroup(da,'StructExample');
itm1 = additem(grp,'Random.Real18');
itm2 = additem(grp,'Saw-toothed Waves.UInt2');
itm3 = additem(grp,'Random.Boolean');
```

Step 2: Read Data

This example reads values first from the device and then from the server cache. The data is returned in structure format.

```
r1 = read(grp, 'device');
r2 = read(grp);
```

Step 3: Interpret the Data

The data is returned in structure format. To interpret the data, you must extract the relevant information from the structures. In this example, you compare the Value, Quality, and TimeStamp to confirm that they are the same for both read operations.

```
disp({r1.ItemID;r1.Value;r2.Value})
disp({r1.ItemID;r1.Quality;r2.Quality})
disp({r1.ItemID;r1.TimeStamp;r2.TimeStamp})
```

Step 4: Read More Data

By reading first from the cache and then from the device, you can compare the returned data to see if any change has occurred. In this case, the data will not be the same.

```
r3 = read(grp);
r4 = read(grp, `device`);
disp({r3.ItemID;r3.Value;r4.Value})
```

Step 5: Clean Up

Always remove toolbox objects from memory, and the variables that reference them, when you no longer need them.

```
disconnect(da)
delete(da)
clear da grp itm1 itm2 itm3
```

Interpreting Structure Formatted Data

All data returned by the `read`, `opcread`, and `getdata` functions, and included in the data change and read async event structures passed to callback functions, has the same underlying format. The format is best explained by starting with the output from the `read` function, which provides the basic building block of structure formatted data.

Structure Formatted Data for a Single Item

When you execute the `read` function with a single `daitem` object, the following structure is returned.

```
rSingle = read(itm1)

rSingle =

    ItemID: 'Random.Real8'
    Value: 1.0440e+004
    Quality: 'Good: Non-specific'
    TimeStamp: [2004 3 10 14 46 9.5310]
    Error: ''
```

All structure formatted data for an item will contain the `ItemID`, `Value`, `Quality`, and `TimeStamp` fields.

Note The `Error` field in this example is specific to the `read` function, and is used to indicate any error message the server generated for that item.

Structure Formatted Data for Multiple Items

If you execute the read function with a group object containing more than one item, a structure array is returned.

```
rGroup = read(grp)

rGroup =

3x1 struct array with fields:
    ItemID
    Value
    Quality
    TimeStamp
    Error
```

In this case, the structure array contains one element for each item that was read. The `ItemID` field in each element identifies the item associated with that element of the structure array.

Note When you perform asynchronous read operations, and for data change events, the order of the items in the structure array is determined by the OPC server. The order may not be the same as the order of the items passed to the read function.

Structure Formatted Data for Events

Event structures contain information specifically about the event, as well as the data associated with that event.

The following example displays the contents of a read async event.

```
cleareventlog(da);
tid = readasync(itm);
% Wait for the read async event to occur
pause(1);
event = get(da, 'EventLog')

event =
```

```
Type: 'ReadAsync'  
Data: [1x1 struct]
```

The Data field of the event structure contains

```
event.Data  
  
ans =  
  
LocalEventTime: [2004 3 11 10 59 57.6710]  
TransID: 4  
GroupName: 'StructExample'  
Items: [1x1 struct]
```

The Items field of the Data structure contains

```
event.Data.Items  
  
ans =  
  
ItemID: 'Random.Real8'  
Value: 9.7471e+003  
Quality: 'Good: Non-specific'  
TimeStamp: [2004 3 11 10 59 57.6710]
```

From the example, you can see that the event structure embeds the structure formatted data in the `Items` field of the `Data` structure associated with the event. Additional fields of the `Data` structure provide information on the event, such as the source of the event, the time the event was received by the toolbox, and the transaction ID of that event.

Structure Formatted Data for a Logging Task

OPC Toolbox software logs data to memory and/or disk using the data change event. When you return structure formatted data for a logging task using the `opcread` or `getdata` function, the returned structure array contains the data change event information arranged in a structure array. Each element of the structure array contains a *record*, or data change event. The structure array has the `LocalEventTime` and `Items` fields from the data change event. The `Items` field is in turn a structure array containing the fields `ItemID`, `Value`, `Quality`, and `TimeStamp`.

When to Use Structure Formatted Data

For the read, read async and data change events, you must use structure formatted data. However, for a logging task, you have the option of retrieving the data in structure format, or numeric or cell array format.

For a logging task, you should use structure formatted data when you are interested in

- The “raw” event information returned by the OPC server. The raw information may help in diagnosing the OPC server configuration or the client configuration. For example, if you see a data value that does not change frequently, yet you know that the device should be changing frequently, you can examine the structure formatted data to determine when the OPC server notifies clients of a change in Value, Quality and/or TimeStamp.
- Timing information rather than time series data. If you need to track when an operator changed the state of a switch, structure formatted data provides you with event-based data rather than time series data.

For other tasks that involve time series data, such as visualization of the data, analysis, modeling, and optimization operations, you should consider using the cell or numeric array output format for `getdata` and `opcread`. For more information on array formats, see “Understanding Array Formatted Data” on page 5-15.

Converting Structure Formatted Data to Array Format

If you retrieve data from memory or disk in structure format, you can convert the resulting structure into array format using the `opcstruct2array` function. You pass the structure array to the function, and it will return the `ItemID`, `Value`, `Quality`, `TimeStamp`, and `EventTime` information contained in that structure array.

The `opcstruct2array` function is particularly useful when you want to visualize or analyze time series data without removing it from memory. Because `peekdata` only returns structure arrays (due to speed considerations), you can use `opcstruct2array` to convert the contents of the structure data into separate arrays for visualization and analysis purposes.

Note You should always retrieve data in numeric or cell array format whenever you only want to manipulate the time series data. Although the `opcstruct2array` function has been designed to use as little memory as possible, conversion in MATLAB® software still requires storage space for both the structure array and the resulting arrays.

For an example of using `opcstruct2array`, see “Example: Writing a Callback Function” on page 6-17.

Understanding Array Formatted Data

In this section...

“Array Content” on page 5-15

“Conversion of Logged Data to Arrays” on page 5-16

Array Content

OPC Toolbox™ software can return arrays of Value, Quality, and TimeStamp information from a logging task. You can retrieve arrays from memory using `getdata`, or from disk using `opcread`, by specifying the data type as `'cell'` or any MATLAB® numeric array data type, such as `'double'` or `'uint32'`. Consult the function reference pages for details on how to specify the data type.

When you request array formatted data, the toolbox returns arrays of each of the following elements of the records in memory or on disk:

- **ItemID** — A 1-by-*nItems* list of all item IDs occurring in the structure array. Each record is searched and all unique item IDs are returned in a cell array. The order of the item IDs must be used to interpret any of the Value, Quality, or TimeStamp arrays.
- **Value** — An *nRecs*-by-*nItems* array of values for each item ID defined in the `ItemID` variable, at each time stamp defined by the `TimeStamp` array. Each column of the `Value` array represents the history of values for the corresponding item in the `ItemID` array. Each row corresponds to one record. See “Treatment of Missing Data” on page 5-16 for information on how the `Value` array is populated.
- **Quality** — An *nRecs*-by-*nItems* cell array of quality strings. Each column represents the history of qualities for the corresponding item in the `ItemID` array. Each row corresponds to the qualities for a particular record. If a particular item ID was not part of a record (because the item did not change during that period), the corresponding column in that row is set to `'Repeat'`.
- **TimeStamp** — An *nRecs*-by-*nItems* array of time stamps for each value in the `Value` field. The time stamps are in MATLAB date number format. For

more information on MATLAB date numbers, see the `datenum` function help.

- `EventTime` — An *nRecs*-by-1 array of times that the record was received by OPC Toolbox software (the `LocalEventTime` field of the record in structure format). The times are in MATLAB date number format. For more information on MATLAB date numbers, see the `datenum` function help.

Conversion of Logged Data to Arrays

When you request array formatted data from `getdata` or `opcread`, you must define the desired data type for the returned `Value` array. OPC Toolbox software automatically converts each record of logged data from the item's data type (defined by the `DataType` property of that item) to the requested data type.

When converting logged data to arrays, the toolbox must consider two factors when populating the returned arrays:

- A record may not contain information for every item in the logging task. “Treatment of Missing Data” on page 5-16 discusses how the toolbox deals with missing data.
- A record may contain an array value for a single item. Such values cannot easily be converted to a single value of numeric data types. “Treatment of Array Data Values” on page 5-17 discusses how the toolbox deals with this issue.

Treatment of Missing Data

When OPC Toolbox software logs data, each logged record may not contain all items in the logging task. When converting the data to array format, every item involved in the logging task must be allocated a value, a quality, and a time stamp for each record. Therefore, in a logging task there may be "missing" data for a particular item in a particular record. The toolbox uses the following rules to determine how to fill the missing entry in each array:

- `Value` — When you request the `'cell'` array data type, the value used for the missing entry is an empty double array (`[]`). When requesting a numeric data type, the value used for the missing entry is the last value for that item. If no previous value is known, the equivalent NaN (not a number) entry is used. For example, if the very first record does not contain

an entry for that item, NaN is used to fill in the missing entry in the first row of the Value array. The equivalent NaN value for integer and logical data types is 0.

- **Quality** — The missing entry is filled with the specific quality string 'Repeat'.
- **TimeStamp** — The time stamp used for the missing entry is the first time stamp found in that particular record (row).

Treatment of Array Data Values

For each record stored in memory or on disk during a logging task, a single item may return an array of values. When converting logged data to array format, each item in each record has only one entry in the Value array allocated to that record and item.

For the 'cell' data type, OPC Toolbox software is able to store the array returned as the Value for that element, because a MATLAB cell array is able to store any data type of any size in each element of the cell array.

For numeric data types, such as 'double' or 'uint32', the resulting Value array provides space for only a single value. Consequently, if an array value is found in a logging task, and you have requested a numeric array data type, an error will be generated. You must use the 'cell' data type or the structure format to return logged data that contains arrays as values.

Working with Different Data Types

In this section...

“Conversion Between MATLAB® Data Types and COM Variant Data Types” on page 5-18

“Conversion of Values Written to an OPC Server” on page 5-20

“Conversion of Values Read from an OPC Server” on page 5-20

“Handling Arrays for Item Values” on page 5-20

Conversion Between MATLAB® Data Types and COM Variant Data Types

The OPC Data Access Standard uses the Microsoft® COM Specification for communication between the OPC server and OPC client. A significant amount of the data exchanged between the OPC server and the client is the value from a server item or the value that a client wants to write to a server item. The Microsoft COM Specification uses Microsoft Variants to send different data types between the client and server. This section discusses how OPC Toolbox™ software converts MATLAB® data types to COM Variants when writing values, and COM Variants to MATLAB data types when reading values.

OPC servers require all values to be written to server items in COM Variant format. The server also provides the toolbox with COM Variants when an item’s Value property is read or returned by the server. The toolbox automatically converts between the COM Variant type and MATLAB data types according to the table shown below.

Table 5-1 Conversion from MATLAB® Data Type to COM Variant Data Type

MATLAB Data Type	OPC Server Data Type (COM Variant Type)	Remarks
double	VT_R8	
single	VT_R4	

Table 5-1 Conversion from MATLAB® Data Type to COM Variant Data Type (Continued)

MATLAB Data Type	OPC Server Data Type (COM Variant Type)	Remarks
char	VT_BSTR	
logical	VT_BOOL	
uint8	VT_UI1	
uint16	VT_UI2	
uint32	VT_UI4	
uint64	VT_UI8	
int8	VT_I1	
int16	VT_I2	
int32	VT_I4	
int64	VT_I8	
function_handle	N/A	Not allowed
cell	N/A	Not allowed
struct	N/A	Not allowed
object	N/A	Not allowed
N/A	VT_DISPATCH	Not allowed
N/A	VT_BYREF	Not allowed
double	VT_EMPTY	Returns the empty matrix ([])

Conversion of Values Written to an OPC Server

When you write values to the OPC server using the `write` or `writeasync` function, you can provide any MATLAB data for the write operation. When you write data to an OPC server, the following data conversions take place:

- 1** OPC Toolbox software converts the value into the equivalent COM Variant according to Table 5-1. If any disallowed data type is encountered (for example, if you attempt to write a MATLAB structure), an error will be generated.
- 2** The COM Variant is sent to the OPC server.
- 3** The OPC server will attempt to convert the COM Variant to the server item's canonical data type, using COM Variant conversion rules. If the conversion fails, the server will return an error.

Conversion of Values Read from an OPC Server

When an OPC server returns values for a server item to MATLAB, the OPC server will first convert the value to the COM Variant equivalent of the data type specified by the `daitem` object's `DataType` property. If the conversion fails, an error message is returned with the value. When OPC Toolbox software receives the value, the COM Variant is converted to the equivalent MATLAB data type according to Table 5-1.

Handling Arrays for Item Values

The OPC Specification supports arrays of values being written to a server item, and read from a server item. However, a specific server item may not accept an array of values. The behavior of the server in that case is server-dependent. For example, one server may use only the first value of the array. Another server may return an error when attempting to write an array of values to a server item that only supports a scalar value. OPC Toolbox software is not able to determine if a server item accepts only scalar values.

For all of the data types listed in Table 5-1 that can be converted between MATLAB and a COM Variant, scalar and array data are permitted by the toolbox. However, the OPC Specification supports only one-dimensional arrays of data. Higher dimension MATLAB arrays are flattened into a one-dimensional vector when writing data to the OPC server.

Using Events and Callbacks

You can enhance the power and flexibility of your OPC application by using *event callbacks*. An event is a specific occurrence that can happen while an OPC Data Access client object (opcda client object) is connected to an OPC server. The toolbox defines a set of events that include starting, stopping, or acquiring records during a logging task, as well as events for asynchronous reads and writes, data changes, and server shutdown notification.

When a particular event occurs, the toolbox can execute a function that you specify. This is called a *callback*. Certain events can result in one or more callbacks. You can use callbacks to perform processing tasks while your client object is connected. For example, you can display a message, analyze data, or perform other tasks. Callbacks are controlled through OPC Toolbox™ object properties. Each event type has an associated property. You specify the function that you want executed as the value of that property.

Example: Using the Default
Callback Function (p. 6-2)

Introduces events and callbacks by
showing a simple example

Event Types (p. 6-5)

Defines all the event types supported
by the toolbox

Retrieving Event Information
(p. 6-10)

Describes the information generated
with each event and describes how
to access it

Creating and Executing Callback
Functions (p. 6-16)

Describes how to write a callback
function and associate it with an
event callback

Example: Using the Default Callback Function

In this section...
“Overview” on page 6-2
“Step 1: Create OPC Toolbox™ Group Objects” on page 6-2
“Step 2: Configure the Logging Task Properties” on page 6-3
“Step 3: Configure the Callback Properties” on page 6-3
“Step 4: Start the Logging Task” on page 6-3
“Step 5: Clean Up” on page 6-4

Overview

To illustrate how to use callbacks, this section presents a simple example that creates an OPC Toolbox™ object hierarchy and associates a callback function with the start event, records acquired event, and stop event of the OPC Data Access Group object (dagroup object). For information about all the event callbacks supported by the toolbox, see “Event Types” on page 6-5.

The example uses the default callback function provided with the toolbox, `opccallback`. The default callback function displays the name of the object along with information about the type of event that occurred and when it occurred. To learn how to create your own callback functions, see “Creating and Executing Callback Functions” on page 6-16.

Step 1: Create OPC Toolbox™ Group Objects

This example creates a hierarchy of OPC Toolbox objects for the Matrikon™ Simulation Server. To run this example on your system, you must have the Matrikon Simulation Server installed. Alternatively, you can replace the values used in the creation of the objects with values for a server you can access.

```
da = opcda('localhost','Matrikon.OPC.Simulation.1');  
connect(da);  
grp = addgroup(da,'CallbackTest');  
itm = additem(grp,{'Random.Real8','Saw-toothed Waves.UInt2'});
```

Step 2: Configure the Logging Task Properties

For this example, we log 20 records at 0.5-second intervals.

```
set(grp, 'RecordsToAcquire', 20);  
set(grp, 'UpdateRate', 0.5);
```

Step 3: Configure the Callback Properties

Set the values of three callback properties. The example uses the default callback function `opccallback`.

```
set(grp, 'StartFcn', @opccallback)  
set(grp, 'StopFcn', @opccallback)  
set(grp, 'RecordsAcquiredFcn', @opccallback)
```

For this example, specify how often to generate a records acquired event.

```
set(grp, 'RecordsAcquiredFcnCount', 5);
```

Step 4: Start the Logging Task

Start the `dagroup` object. The object logs 20 records at 0.5-second intervals, and then stops. With the three callback functions enabled, the object outputs information about each event as it occurs. The records acquired event occurs four times for this example.

```
start(grp)  
OPC Start event occurred at local time 18:52:38  
  Group 'CallbackTest': 0 records acquired.  
OPC RecordsAcquired event occurred at local time 18:52:41  
  Group 'CallbackTest': 5 records acquired.  
OPC RecordsAcquired event occurred at local time 18:52:44  
  Group 'CallbackTest': 10 records acquired.  
OPC RecordsAcquired event occurred at local time 18:52:47  
  Group 'CallbackTest': 15 records acquired.  
OPC RecordsAcquired event occurred at local time 18:52:49  
  Group 'CallbackTest': 20 records acquired.  
OPC Stop event occurred at local time 18:52:49  
  Group 'CallbackTest': 20 records acquired.
```

Step 5: Clean Up

Always remove toolbox objects from memory, and the variables that reference them, when you no longer need them.

```
disconnect(da)
delete(da)
clear da grp itm
```


Event Types

OPC Toolbox™ software supports several different types of events. Each event type has an associated toolbox object property that you can use to specify the function that executes when the event occurs.

The following table lists the supported event types, the name of the object property associated with the event, and a brief description of the event, including the object class associated with the event. For detailed information about these callback properties, see the reference information for the property.

The toolbox generates a specific set of information for each event and stores it in an event structure. To learn more about the contents of these event structures and how to retrieve this information, see “Retrieving Event Information” on page 6-10.

Events and Callback Function Properties

Event	Callback Property	Description
Cancel Async	CancelAsyncFcn	<p>The toolbox generates a cancel async event when an asynchronous operation is cancelled. You cancel an asynchronous operation using the <code>cancelasync</code> function.</p> <p>When a cancel async event occurs, the toolbox executes the function specified by the <code>CancelAsyncFcn</code> property. By default, the toolbox executes the default callback function for this event, <code>opccallback</code>, which displays information about the cancel async event at the MATLAB® command line.</p> <p>Cancel async events occur at the <code>dagroup</code> object level.</p>

Events and Callback Function Properties (Continued)

Event	Callback Property	Description
Data Change	DataChangeFcn	<p>The toolbox generates a data change event when the server notifies the toolbox that data for a group has changed. The server will notify the toolbox of data changes only if the group's Active property is set to 'on' and the Subscription property is set to 'on'. For more information on controlling data change events, see “Data Change Events and Subscription” on page 4-12.</p> <p>When a data change event occurs, the toolbox executes the function specified by the DataChangeFcn property.</p> <p>Data change events occur at the dagroup object level.</p>
Error	ErrorFcn	<p>The toolbox generates an error event when a run-time error occurs, such as a data type conversion error or time-out. Run-time errors do not include configuration errors such as setting an invalid property value.</p> <p>When an error event occurs, the toolbox executes the function specified by the ErrorFcn property. By default, the toolbox executes the default callback function for this event, opccallback, which displays the error message at the MATLAB command line.</p> <p>Error events occur at the opcda client object level.</p>

Events and Callback Function Properties (Continued)

Event	Callback Property	Description
Read Async	ReadAsyncFcn	<p>The toolbox generates a read async event when an asynchronous read operation completes. You execute an asynchronous read operation using the <code>readasync</code> function.</p> <p>When a read async event occurs, the toolbox executes the function specified by the <code>ReadAsyncFcn</code> property. By default, the toolbox executes the default callback function for this event, <code>opccallback</code>, which displays information about the read async event at the MATLAB command line.</p> <p>Read async events occur at the <code>dagroup</code> object level.</p>
Records Acquired	RecordsAcquiredFcn	<p>The toolbox generates a records acquired event every time an integer multiple of a specified number of records have been acquired. You use the <code>RecordsAcquiredFcnCount</code> property to specify this number.</p> <p>When a records acquired event occurs, the toolbox executes the function specified by the <code>RecordsAcquiredFcn</code> property.</p> <p>Records acquired events occur at the <code>dagroup</code> object level.</p>

Events and Callback Function Properties (Continued)

Event	Callback Property	Description
Shutdown	ShutDownFcn	<p>The toolbox generates a shutdown event when the OPC server notifies the client that the server is about to shut down.</p> <p>When a shutdown event occurs, the toolbox executes the function specified by the ShutDownFcn property, and the client object is then disconnected from the server. By default, the toolbox executes the default callback function for this event, opccallback, which displays information about the shutdown event at the MATLAB command line.</p> <p>Shutdown events occur at the opcda client object level.</p>
Start	StartFcn	<p>The toolbox generates a start event when an object is started. You use the start function to start an object.</p> <hr/> <p>Note If an error occurs in the start callback function, the object does not start.</p> <hr/> <p>When a start event occurs, the toolbox executes the function specified by the StartFcn property.</p> <p>Start events occur at the dagroup object level.</p>
Stop	StopFcn	<p>The toolbox generates a stop event when the object stops running. An object stops running when the stop function is called, or when the specified number of records is acquired.</p> <p>When a stop event occurs, the toolbox executes the function specified by the StopFcn property.</p> <p>Stop events occur at the dagroup object level.</p>

Events and Callback Function Properties (Continued)

Event	Callback Property	Description
Timer	TimerFcn	<p>The toolbox generates a timer event when an integer multiple of a specified amount of time expires. You use the <code>TimerPeriod</code> property to specify the amount of time. Time is measured relative to when the <code>opcda</code> client object is connected.</p> <hr/> <p>Note Some timer events might not execute if your system is significantly slowed or if the <code>TimerPeriod</code> is set too small.</p> <hr/> <p>When a timer event occurs, the toolbox executes the function specified by the <code>TimerFcn</code> property.</p> <p>Timer events occur at the <code>opcda</code> client object level.</p>
Write Async	WriteAsyncFcn	<p>The toolbox generates a write async event when an asynchronous write operation completes. You execute an asynchronous write operation using the <code>writeasync</code> function.</p> <p>When a write async event occurs, the toolbox executes the function specified by the <code>WriteAsyncFcn</code> property. By default, the toolbox executes the default callback function for this event, <code>opccallback</code>, which displays information about the write async event at the MATLAB command line.</p> <p>Write async events occur at the <code>dagroup</code> object level.</p>

Retrieving Event Information

In this section...
“Event Structures” on page 6-10
“Example: Accessing Data in the Event Log” on page 6-13

Event Structures

Each event has a set of information associated with that event. The information is generated by the OPC server or the OPC Toolbox™ software, and stored in an event structure. This information includes the event type, the time the event occurred, and other event-specific information. For some events, the toolbox records event information in the `opcda` client object's `EventLog` property. You can also access the event structure associated with an event in a callback function.

For information about accessing event information in a callback function, see “Creating and Executing Callback Functions” on page 6-16.

An event structure contains two fields: `Type` and `Data`. For example, this is an event structure for a start event.

```
Type: 'Start'  
Data: [1x1 struct]
```

The `Type` field is a text string that specifies the event type. For a start event, this field contains the text string 'Start'.

The `Data` field is a structure that contains information about the event. The composition of this structure varies, depending on which type of event occurred. For details about the information associated with specific events, see the following sections:

- “Data Fields for Cancel Async, Data Change, Error, Read Async, and Write Async Events” on page 6-11
- “Data Fields for Start, Stop, and Records Acquired Events” on page 6-12
- “Data Fields for Shutdown Events” on page 6-12

- “Data Fields for Timer Events” on page 6-13

Data Fields for Cancel Async, Data Change, Error, Read Async, and Write Async Events

For cancel async, data change, error, read async, and write async events, the Data structure contains these fields.

Field Name	Description
GroupName	The name of the group associated with the event.
LocalEventTime	Absolute time the event occurred, returned in MATLAB® date vector format: [year month day hour minute seconds]
TransID	The transaction ID for the operation. In the case of a cancel async event, TransID contains the transaction ID that was cancelled.
Items	A structure array containing information about each item in the asynchronous operation. The cancel async event structure does not contain this field.

The Items structure array for read async events contains the following fields.

Field Name	Description
ItemID	The item ID for this record in the structure array.
Value	The data value.
Quality	The data quality as a string.
TimeStamp	The time the OPC server updated the value and quality. The time is returned in MATLAB date vector format: [year month day hour minute seconds]

The Items structure array for write async events contains one field: ItemID.

The Items structure array for error events contains the ItemID field and an Error field, containing a string describing the error that occurred for that item.

Data Fields for Start, Stop, and Records Acquired Events

For start, stop, and records acquired events, the Data structure contains these fields.

Field Name	Description
GroupName	The name of the group associated with the event.
LocalEventTime	Absolute time the event occurred, returned in MATLAB date vector format: [year month day hour minute seconds]
RecordsAcquired	The total number of records acquired in the current logging session.

Data Fields for Shutdown Events

For shutdown events, the Data structure contains these fields.

Field Name	Description
LocalEventTime	Absolute time the event occurred, returned in MATLAB date vector format: [year month day hour minute seconds]
Reason	A string containing the reason the OPC server provided for shutting down.

Data Fields for Timer Events

For timer events, the Data structure contains these fields.

Field Name	Description
LocalEventTime	Absolute time the event occurred, returned in MATLAB date vector format: [year month day hour minute seconds]

Example: Accessing Data in the Event Log

While an opcda client object is connected, the toolbox stores event information in the opcda client object's EventLog property. The value of this property is an array of event structures. Each structure represents one event. For detailed information about the composition of an event structure for each type of event, see "Event Structures" on page 6-10.

The toolbox adds event structures to the EventLog array in the order in which the events occur. The first event structure reflects the first event recorded, the second event structure reflects the second event recorded, and so on.

Note Data change events, records acquired events, and timer events are not included in the EventLog. Event structures for these events (and all the other events) are available to callback functions. For more information, see "Creating and Executing Callback Functions" on page 6-16.

To illustrate the event log, this example creates an OPC Toolbox object hierarchy, executes a logging task, and then examines the object's EventLog property:

Step 1: Create the OPC Toolbox™ Object Hierarchy

This example creates a hierarchy of OPC Toolbox objects for the Matrikon™ Simulation Server. To run this example on your system, you must have the Matrikon Simulation Server installed. Alternatively, you can replace the values used in the creation of the objects with values for a server you can access.

```
da = opcda('localhost','Matrikon.OPC.Simulation.1');
connect(da);
grp = addgroup(da,'CallbackTest');
itm1 = additem(grp,'Triangle Waves.Real8');
```

Step 2: Start the Logging Task

Start the dagroup object. By default, the object acquires 120 records at 0.5-second intervals, and then stops. Wait for the object to stop logging data.

```
start(grp)
wait(grp)
```

Step 3: View the Event Log

Access the EventLog property of the opcda client object. The execution of the group logging task generated two events: start and stop. Thus the value of the EventLog property is a 1-by-2 array of event structures.

```
events = da.EventLog
events =

1x2 struct array with fields:
    Type
    Data
```

To list the events that are recorded in the EventLog property, examine the contents of the Type field.

```
{events.Type}
ans =
    'Start'    'Stop'
```

To get information about a particular event, access the Data field in that event structure. The example retrieves information about the stop event.

```
stopdata = events(2).Data

stopdata =
    LocalEventTime: [2004 3 2 21 33 45.8750]
    GroupName: 'CallbackTest'
    RecordsAcquired: 120
```

Step 4: Clean Up

Always remove toolbox objects from memory, and the variables that reference them, when you no longer need them. Deleting the `opcda` client object also deletes the group and item objects.

```
disconnect(da)
delete(da)
clear da grp itm1
```

Creating and Executing Callback Functions

In this section...
“Creating Callback Functions” on page 6-16
“Specifying Callback Functions” on page 6-18
“Example: Viewing Recently Logged Data” on page 6-20

Creating Callback Functions

The power of using event callbacks is that you can perform processing in response to events. You decide which events with which you want to associate callbacks, and which functions these callbacks execute.

Note Callback function execution might be delayed if the callback involves a CPU-intensive task, or if MATLAB® software is processing another task.

M-file callback functions require at least two input arguments:

- The OPC Toolbox™ object
- The event structure associated with the event

The function header for this callback function illustrates this basic syntax.

```
function mycallback(obj,event)
```

The first argument, `obj`, is the toolbox object itself. Because the object is available, you can use in your callback function any of the toolbox functions, such as `getdata`, that require the object as an argument. You can also access all object properties, including the parent and children of the object.

The second argument, `event`, is the event structure associated with the event. This event information pertains only to the event that caused the callback function to execute. For a complete list of supported event types and their associated event structures, see “Event Structures” on page 6-10.

In addition to these two required input arguments, you can also specify application-specific arguments for your callback function.

Note If you specify input arguments in addition to the object and event arguments, you must use a cell array when specifying the name of the function as the value of a callback property. For more information, see “Specifying Callback Functions” on page 6-18.

Example: Writing a Callback Function

This example implements a callback function for a records acquired event. This callback function enables you to monitor the records being acquired by viewing the most recently acquired records in a plot window.

To implement this function, the callback function acquires the last 60 records of data (or fewer if not enough data is available in the OPC Toolbox software engine) and displays the data in a MATLAB figure window. The function also accesses the event structure passed as an argument to display the time stamp of the event. The `drawnow` command in the callback function forces MATLAB to update the display.

```
function display_opcdata(obj,event)

numRecords = min(obj.RecordsAvailable, 60);
lastRecords = peekdata(obj,numRecords);
[i, v, q, t, et] = opcstruct2array(lastRecords);
plot(t, v);
isBad = strncmp('Bad', q, 3);
isRep = strncmp('Repeat', q, 6);
hold on
for k=1:length(i)
    h = plot(t(isBad(:,k),k), v(isBad(:,k),k), 'o');
    set(h,'MarkerEdgeColor','k', 'MarkerFaceColor','r')
    h = plot(t(isRep(:,k),k), v(isRep(:,k),k), '*');
    set(h,'MarkerEdgeColor',[0.75, 0.75, 0]);
end
axis tight;
set(gca,'YLim',[0, 200]);
```

```
datetick('x','keeplimits');
eventTime = event.Data.LocalEventTime;
title(sprintf('Event occurred at %s', ...
    datestr(eventTime, 13)));
drawnow; % force an update of the figure window
hold off;
```

To see how this function can be used as a callback, see “Example: Viewing Recently Logged Data” on page 6-20.

Specifying Callback Functions

You associate a callback function with a specific event by setting the value of the OPC Toolbox object property associated with that event. You can specify the callback function as the value of the property in one of three ways:

- “Using a Text String to Specify Callback Functions” on page 6-18
- “Using a Cell Array to Specify Callback Functions” on page 6-19
- “Using Function Handles to Specify Callback Functions” on page 6-19

The following sections provide more information about each of these options.

Note To access the object or event structure passed to the callback function, you must specify the function as a cell array or as a function handle.

Using a Text String to Specify Callback Functions

You can specify the callback function as a string. For example, this code specifies the callback function `mycallback` as the value of the start event callback property `StartFcn` for the group object `grp`.

```
grp.StartFcn = 'mycallback';
```

In this case, the callback is evaluated in the MATLAB workspace.

Using a Cell Array to Specify Callback Functions

You can specify the callback function as a text string inside a cell array.

For example, this code specifies the callback function `mycallback` as the value of the start event callback property `StartFcn` for the group object `grp`.

```
grp.StartFcn = {'mycallback'};
```

To specify additional parameters, include them as additional elements in the cell array.

```
time = datestr(now,0);  
grp.StartFcn = {'mycallback',time};
```

The first two arguments passed to the callback function are still the OPC Toolbox object (`obj`) and the event structure (`event`). Additional arguments follow these two arguments.

Using Function Handles to Specify Callback Functions

You can specify the callback function as a function handle.

For example, this code specifies the callback function `mycallback` as the value of the start event callback property `StartFcn` for the group object `grp`.

```
grp.StartFcn = @mycallback;
```

To specify additional parameters, include the function handle and the parameters as elements in the cell array.

```
time = datestr(now,0);  
grp.StartFcn = {@mycallback,time};
```

If you are executing a local callback function from within an M-file, you must specify the callback as a function handle.

Specifying a Toolbox Function as a Callback

In addition to specifying callback functions of your own creation, you can also specify toolbox functions as callbacks. For example, this code sets the value of the stop event callback to the start function.

```
grp.StopFcn = @start;
```

Disabling Callbacks

If an error occurs in the execution of the callback function, the toolbox disables the callback and displays a message similar to the following.

```
start(grp)
??? Error using ==> myrecords_cb
Too many input arguments.
```

```
Warning: The RecordsAcquiredFcn callback is being disabled.
```

To enable a callback that has been disabled, set the value of the property associated with the callback.

Example: Viewing Recently Logged Data

This example configures an OPC Toolbox object hierarchy and sets the records acquired event callback function property to the `display_opcdata` function, created in “Example: Writing a Callback Function” on page 6-17.

When run, the example displays the last 60 records of acquired data every time 5 records have been acquired. Repeat values are highlighted with magenta circles, and bad values are highlighted with red circles.

Step 1: Create the OPC Toolbox™ Object Hierarchy

This example creates a hierarchy of OPC Toolbox objects for the Matrikon™ Simulation Server. To run this example on your system, you must have the Matrikon Simulation Server installed. Alternatively, you can replace the values used in the creation of the objects with values for a server you can access.

```
da = opcda('localhost','Matrikon.OPC.Simulation.1');
connect(da);
```



```
grp = addgroup(da,'CallbackTest');
itm1 = additem(grp,'Triangle Waves.Real8');
itm2 = additem(grp,'Saw-toothed Waves.UInt2');
```

Step 2: Configure Property Values

This example sets the `UpdateRate` value to 0.2 seconds, and the `RecordsToAcquire` property to 200. The example also specifies as the value of the `RecordsAcquiredFcn` callback the event callback function `display_opcdata`, created in “Example: Writing a Callback Function” on page 6-17. The object will execute the `RecordsAcquiredFcn` every 5 records, as specified by the value of the `RecordsAcquiredFcnCount` property.

```
set(grp,'UpdateRate',0.2);
set(grp,'RecordsToAcquire',200);
set(grp,'RecordsAcquiredFcnCount',5);
set(grp,'RecordsAcquiredFcn',@display_opcdata);
```

Step 3: Acquire Data

Start the `dagroup` object. Every time 5 records are acquired, the object executes the `display_opcdata` callback function. This callback function displays the most recently acquired records logged to the memory buffer.

```
start(grp)
wait(grp)
```

Step 4: Clean Up

Always remove toolbox objects from memory, and the variables that reference them, when you no longer need them. Deleting the `opcda` client object also deletes the group and item objects.

```
disconnect(da)
delete(da)
clear da grp itm1 itm2
```


Using the OPC Toolbox™ Block Library

OPC Toolbox™ software includes a Simulink® interface called the OPC Toolbox block library. This chapter describes how to use the blocks of the OPC Toolbox block library in a Simulink model to communicate with OPC servers.

Overview (p. 7-2)

Introduces the OPC Toolbox block library.

Example: Reading and Writing Data from the Matrikon™ OPC Simulation Server (p. 7-3)

Provides a simple example of using the library in a model

Using the OPC Client Manager (p. 7-18)

Describes the dialog for managing the association of OPC clients with a Simulink model

Overview

The OPC Toolbox™ block library is a tool for sending data from your Simulink® model to an OPC server, or querying an OPC server to receive live data into your model. You use blocks from the OPC Toolbox block library with blocks from other Simulink libraries to create models capable of sophisticated OPC server communications.

The OPC Toolbox block library requires Simulink, a tool for simulating dynamic systems. Simulink is a model definition environment. Use Simulink blocks to create a block diagram that represents the computations of your system or application. Simulink is also a model simulation environment. Run the block diagram to see how your system behaves. If you are new to Simulink, read *Simulink Getting Started Guide* to better understand its functionality.

The best way to learn about the OPC Toolbox block library is to see an example. “Example: Reading and Writing Data from the Matrikon™ OPC Simulation Server” on page 7-3 provides a simple example. For more detailed information about the blocks in the OPC Toolbox block library, see Chapter 12, “Block Reference”.

Example: Reading and Writing Data from the Matrikon™ OPC Simulation Server

In this section...

“Overview” on page 7-3

“Step 1: Open the OPC Toolbox™ Block Library” on page 7-4

“Step 2: Create a New Model” on page 7-5

“Step 3: Drag the OPC Toolbox™ Blocks into the Model” on page 7-6

“Step 4: Drag Other Blocks to Complete the Model” on page 7-7

“Step 5: Configure OPC Servers for the Model” on page 7-9

“Step 6: Specify the Block Parameter Values” on page 7-12

“Step 7: Connect the Blocks” on page 7-15

“Step 8: Run the Simulation” on page 7-16

Overview

This section provides a step-by-step example to illustrate how to use the OPC Toolbox™ block library. The example builds a simple model using the blocks in the OPC Toolbox block library with blocks from other Simulink® libraries.

This example writes a sine wave to the Matrikon™ OPC Simulation Server, and reads the data back from the same server. You use the OPC Write block to send data to the OPC server, and the OPC Read block to read that same data back into your model.

Note To run the sample code in this example, you must have the Matrikon OPC Simulation Server available on your local machine. To download the Matrikon Simulation Server, visit <http://www.matrikon.com>. The code can be used with other servers with only minor changes.

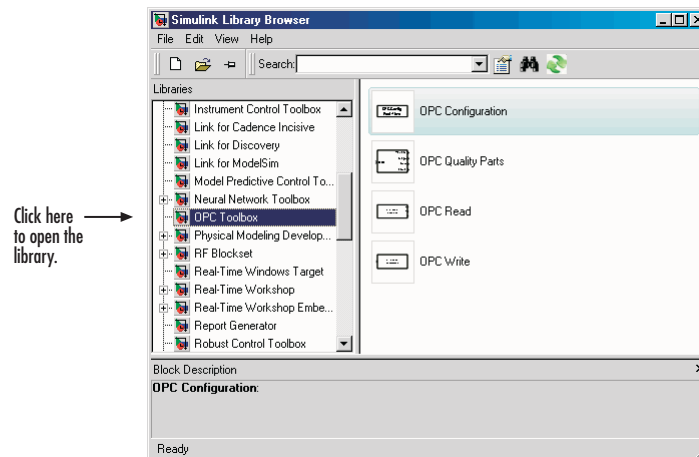
Step 1: Open the OPC Toolbox™ Block Library

To open the OPC Toolbox block library, first start the Simulink Library Browser. To start the Simulink Library Browser, enter

```
simulink
```

at the MATLAB® prompt. MATLAB opens the Simulink Library Browser window. The left pane contains a list of available block libraries in alphabetical order.

To open the OPC Toolbox block library, click its entry in the tree. When you open a library, Simulink loads the library and displays its blocks.



Selecting the OPC Toolbox™ Block Library in the Simulink® Library Browser

Alternatively, you can open the OPC Toolbox block library by typing

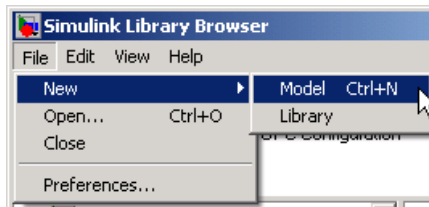
```
opclib
```

at the MATLAB command prompt.

Step 2: Create a New Model

To use a block, you must add it to an existing model or create a new model.

- 1 To create a new model, click the **File** menu in the Simulink Library Browser and select **New > Model**. Simulink opens an empty model window on the display.

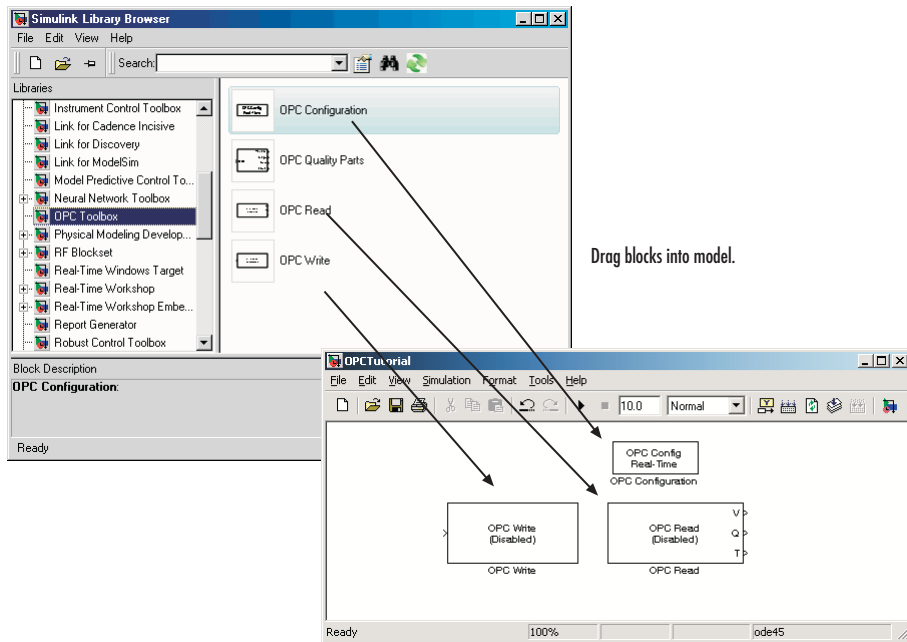


- 2 Use the **Save** option to assign the new model a name.

Step 3: Drag the OPC Toolbox™ Blocks into the Model

The OPC Toolbox block library contains four blocks: OPC Configuration, OPC Quality Parts, OPC Read, and OPC Write. You can use these blocks to configure and manage connections to servers, to send and receive live data between your OPC server and your simulation, and to analyze OPC quality.

To use the blocks in a model, click each block in the library and, holding the mouse button down, drag the block into the model window. For this example, you need one instance each of the OPC Configuration, OPC Write, and OPC Read block in your model.

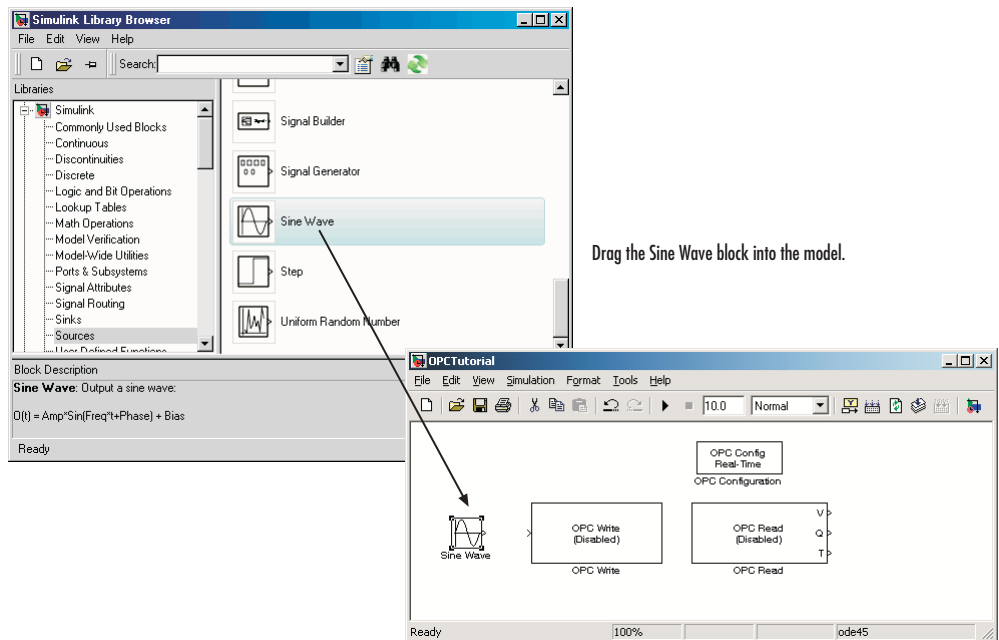


Dragging OPC Toolbox™ Blocks into Model Window

Step 4: Drag Other Blocks to Complete the Model

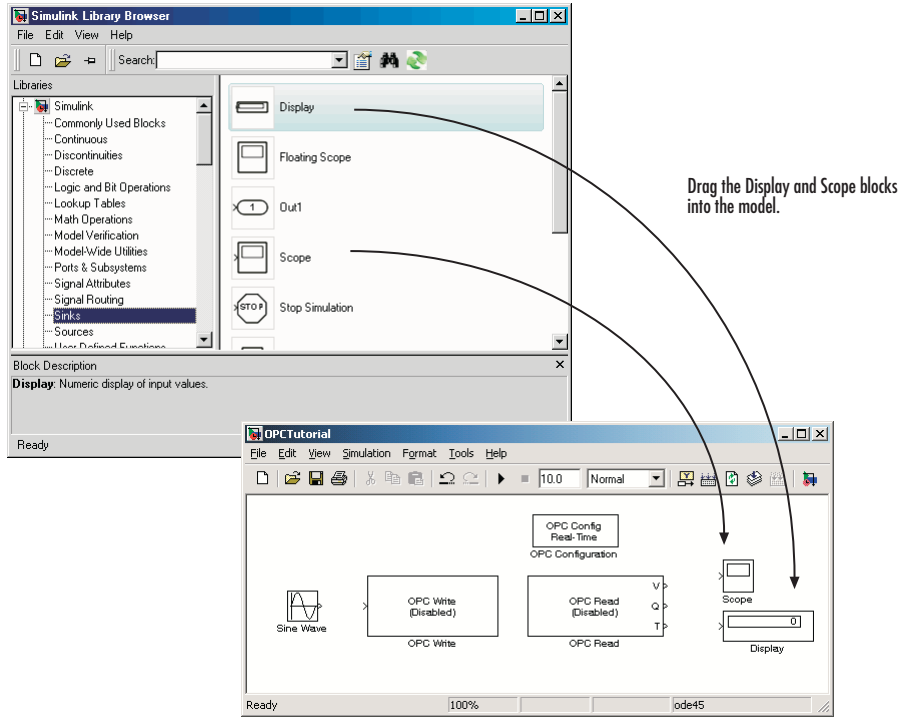
Your model requires three more blocks. One block provides the data sent to the server; the other two blocks display the data received from the server.

To send a sine wave to the server, you can use the Sine Wave block. To access the Sine Wave block, expand the Simulink node in the browser tree, and click the Sources library entry. From the blocks displayed in the right pane, drag the Sine Wave block into the model and place it to the left of the OPC Write block.



Dragging Sine Wave Block into Model Window

You can use the Scope block to show the value received from the server, and a Display block to view the quality of the item. (You will remove the time stamp output port in the next step.) To access the Scope block, click the Sinks library entry in the expanded Simulink node in the browser tree. From the blocks displayed in the right pane, drag the Scope block into the model and place it above and to the right of the OPC Read block. Also drag a Display block into the model and place it below the Scope block.

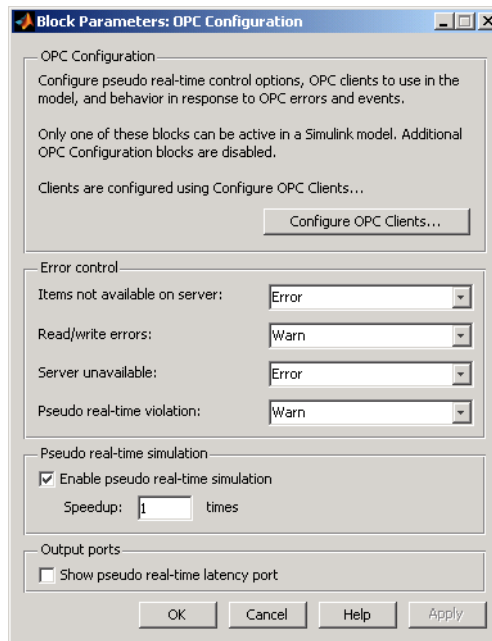


Dragging Display and Scope Blocks into Model Window

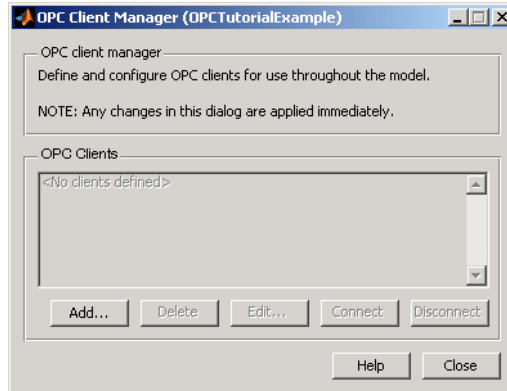
Step 5: Configure OPC Servers for the Model

To communicate with OPC servers from Simulink, you first need to configure those servers in the model. The OPC Configuration block manages and configures OPC servers for a Simulink model. Each OPC Read or OPC Write block uses one server from the configured servers, and defines the items to read from or write to.

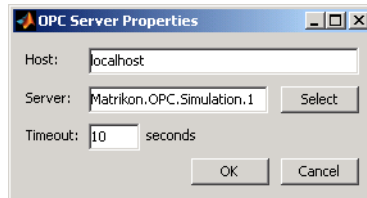
- 1 Double-click the OPC Configuration block to open its parameters dialog.



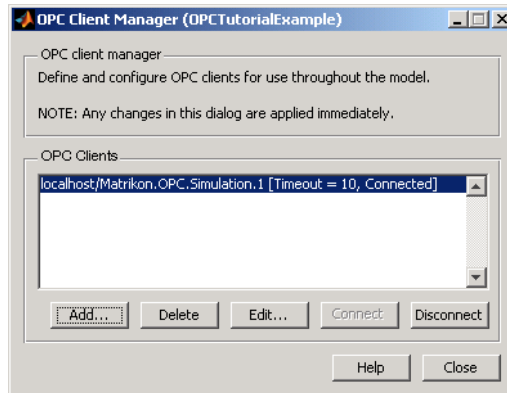
2 Click **Configure OPC Clients** to open the OPC Client Manager.



3 Click **Add** to open the OPC Server Properties dialog. Specify the ID of the server as 'Matrikon.OPC.Simulation.1' (or click **Select** and choose the server from the list of available OPC servers).



- 4 Click **OK** to add the OPC server to the OPC Client Manager.



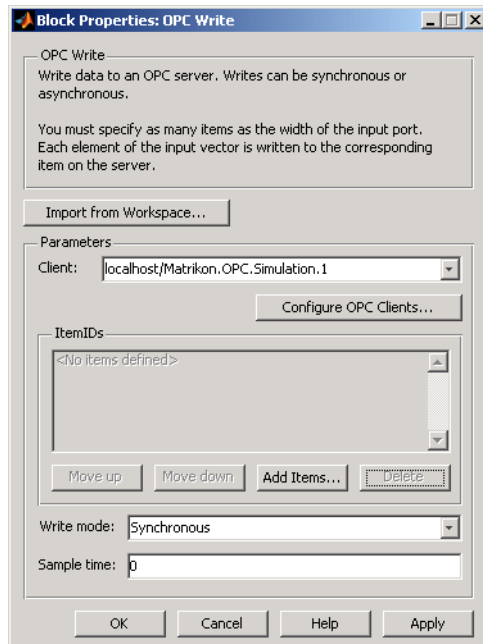
The Matrikon OPC Simulation Server is now available throughout the model for reading and writing.

- 5 Your model will use default values for all other settings in the OPC Configuration block. Click **OK** in the OPC Configuration dialog to close that dialog.

Step 6: Specify the Block Parameter Values

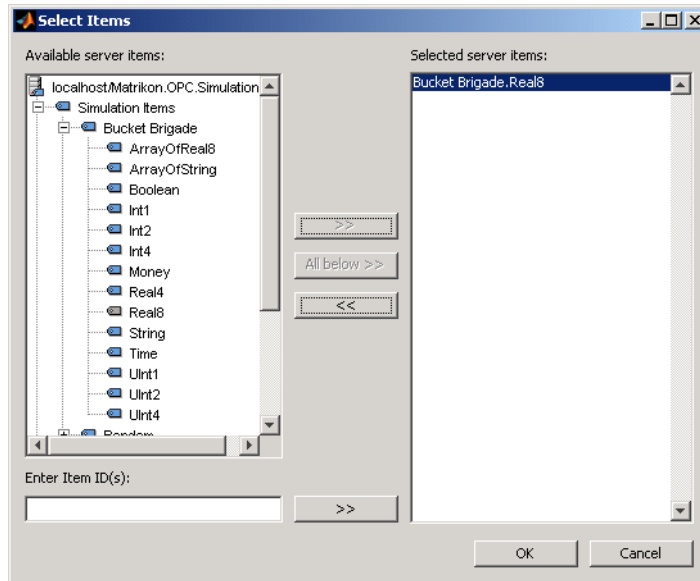
You set parameters for the blocks in your model by double-clicking on the block.

- 1 Double-click the OPC Write block to open its parameters dialog. The Matrikon server is automatically selected for you as the OPC client to use in this block. You need to specify the items for writing.



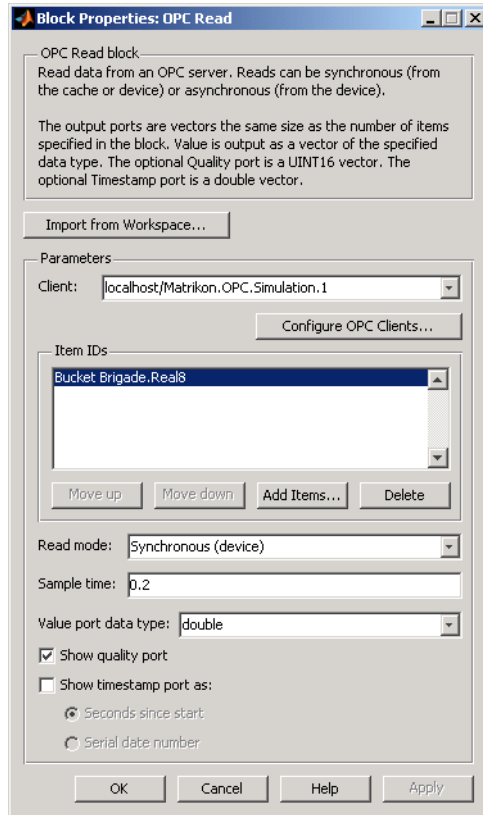
- 2 Click **Add Items** to display a name space browser for the Matrikon OPC Simulation Server.

- Expand the Simulation Items node in the name space, then expand the Bucket Brigade node. Select the Real8 node and click >> to add that item to the selected items list.



- Click **OK** to add the item Bucket Brigade.Real8 to the OPC Write block's ItemIDs list.
- In the OPC Write parameters dialog, click **OK** to accept the changes and close the dialog.
- Double-click the OPC Read block to open its dialog. Add the same item to the OPC Read block, repeating steps 2-5 that you followed for the OPC Write block in this section.
- Set the read mode to 'Synchronous (device)' and the sample time for the block to 0.2.

- 8 Also uncheck the 'Show timestamp port' option. This step removes the time stamp output port from the OPC Read block.

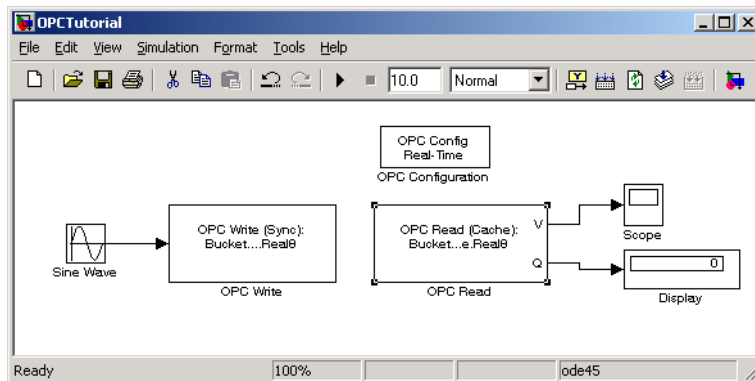


Step 7: Connect the Blocks

Make a connection between the Sine Wave block and the OPC Write block. When you move the cursor near the output port of the Sine Wave block, the cursor becomes crosshairs. Click the Sine Wave output port and hold the mouse button; drag to the input port of the OPC Write block, and release the button.

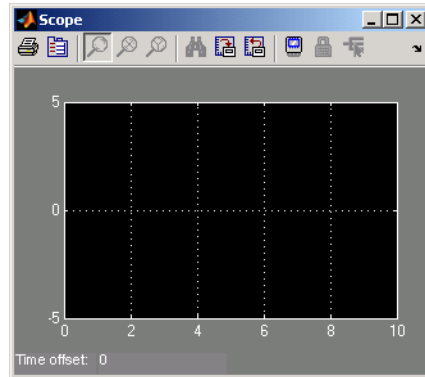
In the same way, make a connection between the first output port of the OPC Read block (labeled V) and the input port of the Scope block. Then connect the other output port of the OPC Read block (labeled Q) to the input port of the Display block.

Note that the OPC Write and OPC Read blocks do not directly connect together within the model. The only communication between them is through an item on the server, which you defined in “Step 5: Configure OPC Servers for the Model” on page 7-9.

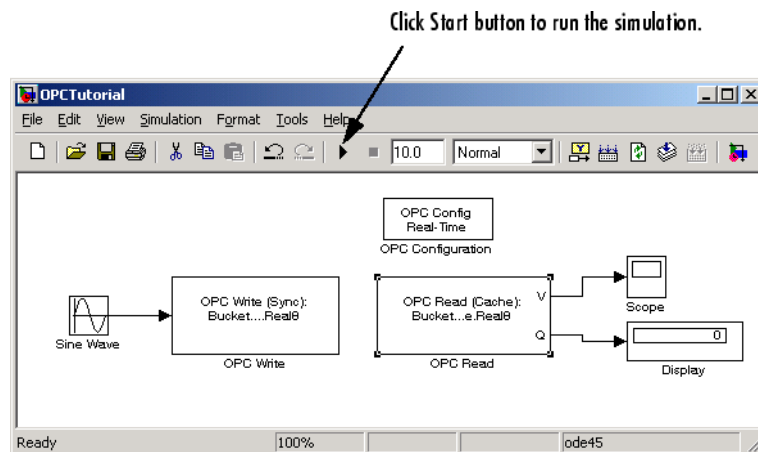


Step 8: Run the Simulation

Before you run the simulation, double-click the Scope block to open the scope view.

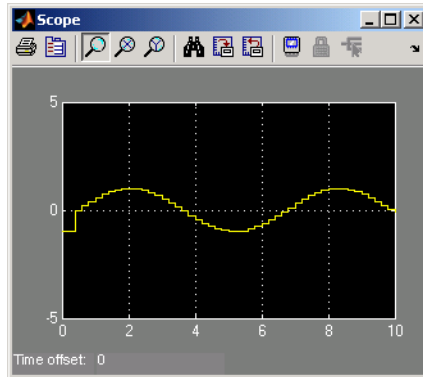


To run the simulation, click the Start button on the model window toolbar. Alternatively, you can use the **Simulation** menu in the model window and choose the **Start** option.



The model writes a sine wave to the OPC server, reads back from the server, and displays the wave in the scope trace. In addition, the quality value is set to 192, which indicates a good quality (see Appendix A, “OPC Quality Strings”).

While the simulation is running, the status bar at the bottom of the model window updates the progress of the simulation, and the sine wave is displayed in the Scope window.



Using the OPC Client Manager

In this section...

“Introduction” on page 7-18

“Adding Clients to the OPC Client Manager” on page 7-19

“Removing Clients from the OPC Client Manager” on page 7-19

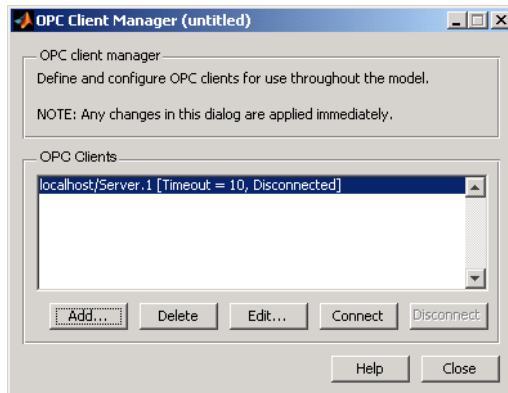
“Modifying the Server Timeout Value for a Client” on page 7-20

“Controlling Client/Server Connections” on page 7-20

Introduction

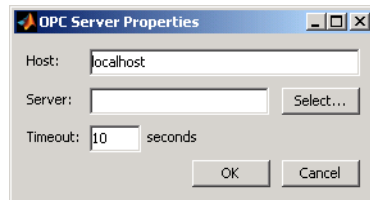
The OPC Client Manager displays and manages all clients for a Simulink® model. Using the OPC Client Manager, you associate one or more clients with a particular model. Each time you use an OPC Read or OPC Write block, you can then choose the client for that block from the list of configured clients. By defining a single list of clients in the OPC Client Manager, you enable a Simulink model to reuse clients among OPC Read and OPC Write blocks.

You access the OPC Client Manager from the parameters dialog of the OPC Configuration, OPC Read, or OPC Write block, by clicking **Configure OPC Clients**. A dialog similar to the following figure appears.



Adding Clients to the OPC Client Manager

You add clients to the OPC Client Manager by clicking **Add**. The following dialog box appears.



Specify the host in the **Host** edit box. You can then type the Server ID of the required server, or use **Select** to query the host for a list of servers.

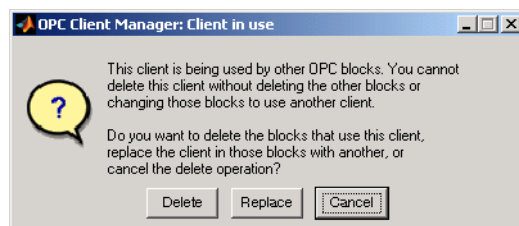
Specify the timeout (in seconds) to use when communicating with the server.

When you click **OK**, the client is added to the OPC Clients list in the OPC Client Manager. You can now use that client in one or more OPC Read or OPC Write blocks within that model.

Removing Clients from the OPC Client Manager

To remove a client from the OPC Client Manager, select the client in the **OPC Clients** list and click **Delete**. A confirmation dialog appears. Click **Delete** to remove the client from the OPC Client Manager.

If you attempt to remove a client that is referenced by one or more OPC Toolbox™ library blocks, you will see the following dialog.



Click **Delete** to remove all blocks that reference the client you want to delete.

Click **Replace** to replace the referenced client with another client in the OPC Client list (this choice is available only if another client is available), and select the replacement client from the resulting list. Click **Cancel** to cancel the delete operation.

Modifying the Server Timeout Value for a Client

Click **Edit** to modify the timeout property of the selected client. The timeout value is specified in seconds, and applies to all server operations (connect, disconnect, read, write).

Controlling Client/Server Connections

OPC Toolbox software automatically attempts to connect a client configured in the OPC Client Manager to its server. This enables you to browse the server name space for items, and speeds up the initialization process of simulating a model.

You can control the client's connection status by highlighting a client in the **OPC Client** list and clicking **Connect** or **Disconnect**.

The OPC Toolbox block library will automatically reconnect any disconnected client to its server when you start that model.

Function Reference

Object Creation and Configuration Functions (p. 8-2)	Create and configure the objects that provide access to OPC servers
Server Exploration Functions (p. 8-2)	Explore server name space, tag properties, and server configuration information
Data Access Functions (p. 8-3)	Read data from OPC server synchronously or asynchronously, or through server-initiated events; write data to OPC server synchronously or asynchronously
OPC Data Visualization Functions (p. 8-3)	Visualize live OPC data
Logging and Buffering Functions (p. 8-4)	Log data provided by OPC data access servers to disk and/or memory; and read logs
Simulink® Support Functions (p. 8-4)	Create Simulink® blocks from MATLAB® group objects
General Functions (p. 8-5)	Manage OPC Toolbox™ objects and connections to OPC servers; get help on using OPC Toolbox software

Object Creation and Configuration Functions

<code>addgroup</code>	Add data access group to <code>opcda</code> object
<code>additem</code>	Add data access items to <code>dagroup</code> object
<code>clonegroup</code>	Clone group into new private group on same client
<code>connect</code>	Connect <code>opcda</code> object to server
<code>copyobj</code>	Make copy of OPC Toolbox™ object
<code>delete</code>	Remove OPC Toolbox objects from memory
<code>disconnect</code>	Disconnect <code>opcda</code> object from server
<code>disp</code>	Summary of information for OPC Toolbox objects
<code>get</code>	OPC Toolbox object properties
<code>isvalid</code>	True for OPC Toolbox objects that are not deleted
<code>makepublic</code>	Convert private group into public group
<code>opcda</code>	Construct OPC data access object
<code>removepublicgroup</code>	Remove public group from server
<code>set</code>	Configure or display OPC Toolbox object properties

Server Exploration Functions

<code>flatnamespace</code>	Flatten hierarchical OPC name space
<code>getnamespace</code>	OPC server name space

opcserverinfo	Version, server, and status information
serveritemprops	Property information for items in OPC server name space
serveritems	Query server or name space for fully qualified item IDs

Data Access Functions

cancelasync	Cancel asynchronous read and write operations
read	Read data synchronously from OPC groups or items
readasync	Read data asynchronously from group or items
refresh	Read all active items in group
write	Write values to group or items
writeasync	Asynchronously write values to group or items

OPC Data Visualization Functions

trend	Display graphical trend of OPC data for group
-------	-----------------------------------------------

Logging and Buffering Functions

<code>flushdata</code>	Remove all logged data associated with dagroup object
<code>getdata</code>	Logged records from OPC Toolbox™ software engine to MATLAB® workspace
<code>opcread</code>	Read logged records from disk to MATLAB workspace
<code>opcstruct2array</code>	Convert OPC data from structure to array format
<code>opcstruct2timeseries</code>	Convert OPC data from structure to time series format
<code>peekdata</code>	Preview most recently acquired data
<code>start</code>	Start a logging task
<code>stop</code>	Stop a logging task
<code>wait</code>	Suspend MATLAB execution until object stops logging

Simulink® Support Functions

<code>genslread</code>	Generate Simulink® OPC Read block from MATLAB® group object
<code>genslwrite</code>	Generate Simulink OPC Write block from MATLAB group object

General Functions

<code>cleareventlog</code>	Clear event log, discarding all events
<code>load</code>	Load OPC Toolbox™ objects from MAT-file
<code>obj2mfile</code>	Convert OPC Toolbox object to MATLAB® code
<code>opccallback</code>	Event information for OPC Toolbox software callbacks
<code>opcfind</code>	Find OPC Toolbox objects with specific properties
<code>opchelp</code>	Help for OPC Toolbox software function or property
<code>opcqid</code>	Construct quality ID from item's quality string
<code>opcqparts</code>	Extract quality parts from OPC quality ID
<code>opcqstr</code>	Convert OPC quality ID into readable string
<code>opcregister</code>	Install and register OPC Foundation Core Components
<code>opcreset</code>	Disconnect and delete all OPC Toolbox objects
<code>opcsupport</code>	Run OPC Toolbox software troubleshooting utility
<code>optool</code>	Open OPC Tool GUI
<code>openosf</code>	Open OPC Tool GUI session file
<code>propinfo</code>	Property information for OPC Toolbox objects
<code>save</code>	Save OPC Toolbox objects to MAT-file
<code>showopcevents</code>	Event log summary for OPC Toolbox software events

Functions — Alphabetical List

addgroup

Purpose Add data access group to opcda object

Syntax

```
GrpObj = addgroup(DAObj)
GrpObj = addgroup(DAObj, 'GName')
GrpObj = addgroup(DAObj, 'GName', 'GrpType')
```

Description GrpObj = addgroup(DAObj) adds a group to the opcda object DAObj. A group is a container for a client to organize and manipulate data items. Typically, you create different groups to support different update rates, activation status, callbacks, etc.

GrpObj is a dagroup object. By default, GrpObj has the Active property set to 'on', GroupType set to 'private', and the Subscription property set to 'on'.

If DAObj is already connected to the server when addgroup is called, a group name is requested from the server. If the server does not supply a group name, or the object is not connected to a server, a unique name is automatically assigned to GrpObj. The unique name follows the convention 'groupN' where N is an integer. You can change this name with the group's Name property.

GrpObj = addgroup(DAObj, 'GName') adds a group to the OPC data access object DAObj with the group name given by 'GName'. The group name must be unique among other group names within Obj.

GrpObj = addgroup(DAObj, 'GName', 'GrpType') adds a group to the opcda object DAObj with the group type specified by 'GrpType'. If 'GrpType' is 'private' (the default) the group is configured to be private to DAObj, and no other client connected to the OPC server can access that group. If 'GrpType' is 'public' then a connection is made to the server's public group named GName. To make a connection to a public group named GName, that group must exist on the server as a public group. You create public groups on the server using the makepublic function. Note that some servers do not support public groups; you can verify whether a server supports public groups by running opcserversinfo(DAObj) and checking the SupportedInterfaces field for the IOPCServerPublicGroups interface.

You can add items to GrpObj using the `additem` function, if the group type is 'private'. For a public group, the items are already defined, and are automatically created when you connect to the public group using `addgroup`.

See Also

`additem`, `opcserverinfo`

additem

Purpose Add data access items to dagroup object

Syntax

```
IObj = additem(GObj, 'IName')  
IObj = additem(GObj, 'IName', 'DataType')  
IObj = additem (GObj, 'IName', 'DataType', 'Active')
```

Description IObj = additem(GObj, 'IName') adds items to the group object GObj with fully qualified item IDs given by IName. The object IObj is the created item object or objects. You specify IName as a single item ID or as a cell array of item IDs.

The daitem object provides a connection to a data variable in the physical device and returns information about the data variable, such as its value, quality, and time stamp. Note that you cannot add a given item to the same group more than once. However, you can add the same item to different groups.

By default, IObj is active; that is, if the group's Subscription property is on, the item's Value, Quality, and TimeStamp properties will be updated at the group's UpdateRate.

Servers often require item IDs to be specified in the correct case. You can use the serveritems function to find valid item IDs.

Note You cannot add items to a public group. A public group has a fixed set of item IDs common to all clients sharing that group. The GroupType property of a dagroup object indicates the type of group.

IObj = additem(GObj, 'IName', 'DataType') adds items to the group object GObj with the requested data type given by 'DataType'. You specify 'DataType' as a cell array of strings, one for each item ID. 'DataType' is the data type in which the item's value will be stored in the MATLAB® workspace. The supported data types are 'logical', 'int8', 'uint8', 'int16', 'uint16', 'int32', 'uint32', 'single', 'double', 'char', and 'date'. Note that if the requested data type is rejected by the server, the item is not added. The requested data

type is stored in the `DataType` property. The canonical data type (the data type used by the server to store the item value) is stored in the `CanonicalDataType` property.

`IObj = additem (GObj, 'IName', 'DataType', 'Active')` adds items to the group object `GObj` with active status given by `'Active'`. You specify `'Active'` as a cell array of strings, one for each item ID. `'Active'` can be `'on'` or `'off'`. The active status is stored in the `Active` property.

Examples

Create a client and a group.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');  
connect(da);  
grp = addgroup(da, 'ExAddItem');
```

Add two items with their canonical data types.

```
itm = additem(grp, {'Random.Real4', 'Random.Real8'})
```

Add an item with a `'double'` data type.

```
itmDbl = additem(grp, 'Random.Int2', 'double')
```

Add an inactive item.

```
itmInact = additem(grp, 'Random.UInt4', 'double', 'off')
```

See Also

`getnamespace`, `serveritems`

cancelasync

Purpose Cancel asynchronous read and write operations

Syntax `cancelasync(GObj)`
`cancelasync(GObj,TransID)`

Description `cancelasync(GObj)` cancels all asynchronous read or write operations that are in progress for the group object specified by `GObj`. Note that this function is asynchronous and does not block the MATLAB® command line.

After the in-progress asynchronous operations are cancelled, the OPC server generates a cancel async event. If you specify an M-file callback for the `CancelAsyncFcn` property, then the callback function executes when this event occurs.

`cancelasync(GObj,TransID)` cancels the asynchronous operation(s), specified by the transaction ID(s) given by `TransID`. You can cancel specific asynchronous requests using this syntax.

See Also `readasync`, `writeasync`

Purpose Clear event log, discarding all events

Syntax `cleareventlog(DAObj)`

Description `cleareventlog(DAObj)` clears the event log for opcda object DAObj. DAObj can be an array of objects. Any events stored in the EventLog property of the objects are discarded.

clonegroup

Purpose Clone group into new private group on same client

Syntax `NewGObj = clonegroup(GObj, 'NewName')`

Description `NewGObj = clonegroup(GObj, 'NewName')` clones the dagroup object specified by `GObj`, making a private group `NewGObj` with name `NewName`. `NewName` must be a unique group name. `GObj` can be a private group or a public group.

The new group `NewGObj` is independent of the original group, but with the same parent (opcda object) and the same items as that group. All the group and item properties are duplicated with the exception of the following:

- The Active property is configured to 'off'.
- The GroupType property is configured to 'private'.

You use `clonegroup` primarily when you want to create a private duplicate of a public group that you can then modify. If you want to create a copy of a group in another client, use the `copyobj` function.

See Also `copyobj`, `makepublic`

Purpose Connect opcda object to server

Syntax `connect(DAObj)`

Description `connect(DAObj)` connects the opcda object `DAObj` to the OPC server specified by the `Host` and `ServerID` properties. When `DAObj` is connected, the `Status` property is set to 'connected'. When `DAObj` is disconnected, the `Status` property is set to 'disconnected'. You can disconnect `DAObj` from the server with the `disconnect` function.

If `DAObj` is an array of objects and one of the objects cannot be connected, an attempt will be made to connect the remaining objects in the array, and a warning message will be generated. If none of the objects can be connected, an error message will be generated.

It is possible to create groups and items before connecting to the server. However, servers impose restrictions on client group and item names. Therefore, if you create a group hierarchy and then connect to the server, groups or items that cannot be supported by the server are automatically deleted, and a warning message is issued.

See Also `disconnect`

copyobj

Purpose Make copy of OPC Toolbox™ object

Syntax
NewObj = copyobj(Obj)
NewObj = copyobj(Obj, ParentObj)

Description NewObj = copyobj(Obj) makes a copy of all the objects in Obj, and returns them in NewObj. Obj can be a scalar OPC Toolbox object, or a vector of toolbox objects.

NewObj = copyobj(Obj, ParentObj) makes a copy of the objects in Obj inside the parent object ParentObj. ParentObj must be a valid scalar parent object for Obj. If any objects in Obj cannot be created in ParentObj, a warning will be generated.

A copied toolbox object contains new versions of all children, their children, and any parents that are required to construct that object. A copied object is different from its parent object in the following ways:

- The values of read-only properties will not be copied to the new object. For example, if an object is saved with a Status property value of 'connected', the object will be recreated with a Status property value of 'disconnected' (the default value). You can use propinfo to determine if a property is read-only. Specifically, a connected opcda object is copied in the disconnected state, and a copy of a logging dagroup object is not reset to the logging state.
- A copied dagroup object that has records in memory from a logging session is copied without those records.

See Also obj2mfile, propinfo

Purpose Remove OPC Toolbox™ objects from memory

Syntax `delete(Obj)`

Description `delete(Obj)` removes the OPC Toolbox object `Obj` from memory. `Obj` can be an array of objects. A deleted object becomes invalid and references to that object should be removed from the workspace with the `clear` command. If you delete an object that contains children (groups or items), then the children are also deleted and references to these children should be removed.

If multiple references to a toolbox object exist in the workspace, then deleting one object invalidates the remaining references.

If `Obj` is an `opcda` object connected to the server when `delete` is called, the object will be disconnected and then deleted.

Examples

```
da = opcda('localhost','Matrikon.OPC.Simulation');
connect(da);
grp = addgroup(da,'DeleteEx');
itm = additem(grp,'Random.Real4');
r = read(grp)
delete(grp);    % deletes itm as well
clear grp itm
```

See Also `disconnect`, `isvalid`

disconnect

Purpose Disconnect opcda object from server

Syntax `disconnect(DAObj)`

Description `disconnect(DAObj)` disconnects the opcda object DAObj from the server. DAObj can be an array of objects.

If DAObj was successfully disconnected from the server, its Status property is set to 'disconnected'. You can reconnect DAObj to the server with the connect function.

If DAObj is an array of objects and one of the objects cannot be disconnected from the server, the remaining objects in the array will be disconnected from the server and a warning will be displayed. If no objects could be disconnected from their server, an error will be generated.

See Also `connect`, `propinfo`

Purpose	Summary of information for OPC Toolbox™ objects
Syntax	Obj disp(Obj)
Description	<p>Obj or disp(Obj) displays summary information for OPC Toolbox object Obj.</p> <p>If Obj is an array of objects, disp outputs a table of summary information about the objects in the array.</p> <p>In addition to the syntax shown above, you can display summary information for Obj by excluding the semicolon when</p> <ul style="list-style-type: none">• Creating a toolbox object, using the opcd, addgroup, or additem functions• Configuring property values using dot notation
Examples	<p>This example illustrates the summary display of a data access client.</p> <pre>da = opcd('localhost', 'My.Server.1') da = Summary of OPC Data Access Client Object: localhost/My.Server.1 Server Parameters Host : localhost ServerID : My.Server.1 Status : disconnected Timeout : 10 seconds Object Parameters Group : 0-by-1 dagroup object Event Log : 0 of 1000 events</pre>

This example shows the summary information displayed for an array of data access clients.

```
da2 = opcda('localhost', 'My.Second.Server.1');
```

```
[da da2]
```

```
OPC Data Access Object Array:
```

Index:	Status:	Name:
1	disconnected	localhost/My.Server.1
2	disconnected	localhost/My.Second.Server.1

See Also

opcda, addgroup, additem

Purpose Flatten hierarchical OPC name space

Syntax FNS = flatnamespace(NS)

Description FNS = flatnamespace(NS) flattens the hierarchical name space NS, by recursively removing all information in the Nodes fields of NS and placing that information into additional entries in the root structure of FNS. You obtain a hierarchical name space using the 'hierarchical' flag in getnamespace.

Examples This example retrieves the name space for the Matrikon™ Simulation Server, and flattens the name space after retrieval.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
connect(da);
hierNS = getnamespace(da)
flatNS = flatnamespace(hierNS)
```

See Also getnamespace, serveritems

flushdata

Purpose	Remove all logged data associated with dagroup object
Syntax	<code>flushdata(GObj)</code>
Description	<p><code>flushdata(GObj)</code> removes all records associated with dagroup object <code>GObj</code> from the OPC Toolbox™ software engine, and sets <code>RecordsAvailable</code> to 0 for that object.</p> <p><code>GObj</code> can be a scalar dagroup object, or a vector of dagroup objects.</p>
See Also	<code>getdata</code> , <code>peekdata</code> , <code>start</code> , <code>stop</code>

Purpose	Generate Simulink® OPC Read block from MATLAB® group object
Syntax	<pre>BlkPath = genslread(GrpObj) BlkPath = genslread(GrpObj, DestSys)</pre>
Description	<p><code>BlkPath = genslread(GrpObj)</code> generates an OPC Read block from the dagroup object <code>GrpObj</code>. The OPC Read block is placed in a new Simulink model. The generated OPC Read block has the same name, update rate, and items as <code>GrpObj</code>. If all items in <code>GrpObj</code> have the same data type, that data type is assigned to the OPC Read block's Value port. <code>BlkPath</code> is returned as the full path to the new OPC Read block.</p> <p><code>BlkPath = genslread(GrpObj, DestSys)</code> generates the OPC Read block and places it into the system defined by <code>DestSys</code>. <code>DestSys</code> must be a model name or a path to a subsystem block. The OPC Read block is automatically placed in a location that attempts to minimize overlap of lines and blocks. However, the block might be placed over an existing annotation.</p>
Examples	<p>Create a group object with two items and an update rate of 2 seconds.</p> <pre>da = opcda('localhost', 'Matrikon.OPC.Simulation'); grp = addgroup(da, 'ExOPCREAD'); itm1 = additem(grp, 'Triangle Waves.Real8'); itm2 = additem(grp, 'Saw-Toothed Waves.Int2'); grp.UpdateRate = 2;</pre> <p>Construct an OPC Read block from the group.</p> <pre>blkPath = genslread(grp)</pre>
See Also	<code>genslwrite</code>

genslwrite

Purpose Generate Simulink® OPC Write block from MATLAB® group object

Syntax
`BlkPath = genslwrite(GrpObj)`
`BlkPath = genslwriteGrpObj, DestSys)`

Description `BlkPath = genslwrite(GrpObj)` generates an OPC Write block from the dagroup object `GrpObj`. The OPC Write block is placed in a new Simulink model. The generated OPC Write block has the same name, update rate, and items as `GrpObj`. `BlkPath` is returned as the full path to the new OPC Write block.

`BlkPath = genslwriteGrpObj, DestSys)` generates the OPC Write block and places it into the system defined by `DestSys`. `DestSys` must be a model name or a path to a subsystem block. The OPC Write block is automatically placed in a location that attempts to minimize overlap of lines and blocks. However, the block might be placed over an existing annotation.

Examples Create a group object with two items and an update rate of 2 seconds.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
grp = addgroup(da, 'ExOPCREAD');
itm1 = additem(grp, 'Triangle Waves.Real8');
itm2 = additem(grp, 'Saw-Toothed Waves.Int2');
grp.UpdateRate = 2;
```

Construct an OPC Write block from the group.

```
blkPath = genslwrite(grp)
```

See Also `genslread`

Purpose OPC Toolbox™ object properties

Syntax

```
Val = get(Obj, 'PropName')  
get(Obj)  
Val = get(Obj)
```

Description Val = get(Obj, 'PropName') returns the value Val of the property specified by PropName for the OPC Toolbox object Obj.

If PropName is a cell array of strings containing property names, then get will return a 1-by-N cell array of values, where N is the length of PropName. If Obj is a vector of toolbox objects, then Val will be an M-by-N cell array of property values where M is equal to the length of Obj and N is equal to the number of properties requested.

get(Obj) displays all property names and their current values for the toolbox object Obj.

Val = get(Obj) returns a structure, Val, where each field name is the name of a property of Obj containing the value of that property. If Obj is an array of toolbox objects, Val will be an M-by-1 structure array.

Examples This example obtains the value of the Status and Group properties of an opcda object, and then displays all of the properties of the object.

```
da = opcda('localhost', 'Dummy.Server');  
get(da, {'Status', 'Group'})  
out = get(da, 'Status')  
get(da)
```

See Also set, propinfo, opchelp

getdata

Purpose

Logged records from OPC Toolbox™ software engine to MATLAB® workspace

Syntax

```
S = getdata(GObj)
S = getdata(GObj, NRec)
TSCell = getdata(GObj, 'timeseries')
TSCell = getdata(GObj, NRec, 'timeseries')
[ItmID, Val, Qual, TStamp, ETime] = getdata(GObj,
'DataType')
[ItmID, Val, Qual, TStamp, ETime] = getdata(GObj, NRec,
'DataType')
```

Description

S = getdata(GObj) returns the number of records specified in the RecordsToAcquire property of dagroup object GObj, from the OPC Toolbox software engine. GObj must be a scalar dagroup object.

S is an NRec-by-1 structure array, where NRec is the number of records returned. S contains the fields 'LocalEventTime' and 'Items'. LocalEventTime is a date vector corresponding to the local event time for that record. Items is an NItems-by-1 structure array containing the fields shown below.

Field Name	Description
ItemID	The fully qualified tag name, as a string.
Value	The data value. The data type is defined by the item's DataType property.
Quality	The data quality, as a string. See Appendix A, "OPC Quality Strings" for a description of quality strings.
TimeStamp	The time the value was changed, as a date vector.

S = getdata(GObj, NRec) retrieves the first NRec records from the toolbox engine.

TSCell = getdata(GObj, 'timeseries') and
TSCell = getdata(GObj, NRec, 'timeseries') assign the data received from the toolbox engine to a cell array of time series objects.

TSCell contains as many time series objects as there are items in the group, with the name of each time series object set to the item ID. The quality value stored in the time series object is offset from the quality value returned by the OPC server by 128. The quality strings displayed by each is the same. Because each record logged might not contain information for every item, the time series objects have only as many data points as there are records containing information about that particular item ID.

```
[ItmID, Val, Qual, TStamp, ETime] = getdata(GObj,  
'DataType') and  
[ItmID, Val, Qual, TStamp, ETime] = getdata(GObj, NRec,  
'DataType') assign the data retrieved from the toolbox engine to  
separate arrays. Valid data types are 'double', 'single', 'int8',  
'int16', 'int32', 'uint8', 'uint16', 'uint32', 'logical',  
'currency', 'date', and 'cell'.
```

ItmID is a 1-by-NItem cell array of item names.

Val is an NRec-by-NItem array of values with the data type specified. If a data type of 'cell' is specified, then Val is a cell array containing data in the returned data type for each item. Otherwise, Val is a numeric array of the specified data type.

Note 'DataType' must be set to 'cell' when retrieving records containing strings or arrays of values.

Qual is an NRec-by-NItem array of quality strings for each value in Val.

TStamp is an NRec-by-NItem array of MATLAB date numbers representing the time when the relevant value and quality were stored on the OPC server.

ETime is an NRec-by-1 array of MATLAB date numbers, corresponding to the local event time for each record.

Each record logged may not contain information for every item returned, since data for that item may not have changed from the previous

update. When data is returned as a numeric matrix, the missing item columns for that record are filled as follows.

Argument	Behavior for Missing Items
Val	The corresponding value entry is set to the previous value of that item, or to NaN if there is no previous value.
Qual	The corresponding quality entry is set to 'Repeat'.
TStamp	The corresponding time stamp entry is set to the first valid time stamp for that record.

getdata is a blocking function that returns execution control to the MATLAB workspace when one of the following conditions is met:

- The requested number of records becomes available.
- The logging operation is automatically stopped by the engine. If fewer records are available than the number requested, a warning is generated and all available records are returned.
- You issue **Ctrl+C**. The logging task does not stop, and no data is removed from the toolbox engine.

When getdata completes, the object's RecordsAvailable property is reduced by the number of records returned by getdata.

Examples

Configure and start a logging task for 60 seconds of data.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
connect(da);
grp = addgroup(da, 'ExOPCREAD');
itm1 = additem(grp, 'Triangle Waves.Real8');
itm2 = additem(grp, 'Saw-Toothed Waves.Int2');
set(grp, 'LoggingMode', 'memory', 'RecordsToAcquire', 60);
start(grp);
```

Retrieve the first two records into a structure. This operation waits for at least two records.

```
s = getdata(grp, 2)
```

Retrieve all the remaining data into a double array and plot it with a legend.

```
[itmID, val, qual, tStamp] = getdata(grp, 'double');  
plot(tStamp(:,1), val(:,1), tStamp(:,2), val(:,2));  
legend(itmID);  
datetick x keeplimits
```

See Also

flushdata, peekdata, start, stop

getnamespace

Purpose OPC server name space

Syntax
S = getnamespace(DAObj)
S = getnamespace(DAObj, '*Filter1*',Val1,'*Filter2*',Val2, ...)

Description S = getnamespace(DAObj) returns the entire name space of the server associated with the opcda object specified by DAObj. S is a recursive structure array representing the name space of the server. Each element of S is a node in the name space. S contains the fields Name, FullyQualifiedID, NodeType, and Nodes. The Name field is a descriptive name; FullyQualifiedID is the fully qualified ItemID of that node; NodeType defines the node as a 'branch' node (containing other nodes) or 'leaf' node (containing no other nodes); and Nodes is a structure array with the same fields as S, representing the nodes contained in this branch of the name space.

S = getnamespace(DAObj, '*Filter1*',Val1,'*Filter2*',Val2, ...) allows you to filter the retrieved name space based on a number of available browse filters. Available filters are described in the following table:

BrowseFilter	Description
'StartItemID'	Specify the FullyQualifiedID of a branch node, as a string. Only nodes contained in that branch node will be returned. Some OPC servers do not support partial name space retrieval based on this option: An error is generated if you attempt to use the 'StartItemID' browse filter on such a server.

BrowseFilter	Description
'Depth'	Specify the depth of the name space that you want returned. A 'Depth' value of 1 returns only the nodes contained in the starting position. A 'Depth' value of 2 returns the nodes contained in the starting position and all of their nodes. A 'Depth' value of Inf returns all nodes. When combined with the 'StartItemID' filter, the 'Depth' filter provides a useful way to investigate a name server hierarchy one layer at a time.
'AccessRights'	Restricts the search to leaf nodes with particular access right characteristics. Specify 'read' to return nodes that include the read access right, and 'write' to return nodes that include the write access right. An empty string ('') returns nodes with any access rights. Note that branch nodes will still be returned in the name space, in order to contain the leaf nodes that have the requested access rights.
'DataType'	Restricts the search to nodes with a particular canonical data type. Valid data types are 'double', 'single', 'int8', 'int16', 'int32', 'uint8', 'uint16', 'uint32', 'logical', 'currency', and 'date'. Use the 'DataType' filter to find server items with a specific data type, such as 'double' or 'date'. Note that branch nodes will still be returned in the name space, in order to contain the leaf nodes that have the required data type.

Remarks

Use flatnamespace to flatten the hierarchical name space.

Examples

Return the entire name space for the Matrikon™ Simulation Server on the local host.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
```

getnamespace

```
connect(da);  
nsFull = getnamespace(da)
```

Return only the first level of the name space.

```
nsPart = getnamespace(da, 'Depth', 1)
```

Add the nodes contained in the first branch of the name space to the existing structure.

```
nsPart(1).Nodes = getnamespace(da, ...  
    'StartItemID', nsPart(1).Name, ...  
    'Depth', 1);
```

See Also

additem, flatnamespace, serveritems

Purpose True for OPC Toolbox™ objects that are not deleted

Syntax A = isvalid(Obj)

Description A = isvalid(Obj) returns a logical array, A, that contains false where the elements of Obj are deleted OPC Toolbox objects and true where the elements of Obj are valid objects.

An invalid toolbox object should be cleared from the workspace with `clear`.

Examples Create two valid OPC data access objects.

```
da(1) = opcda('localhost','Dummy.ServerA');  
da(2) = opcda('localhost','Dummy.ServerB');  
out1 = isvalid(da)
```

Delete the first object and make it invalid.

```
delete(da(1))  
out2 = isvalid(da)
```

Clear the object.

```
clear da
```

See Also delete, opchelp

load

Purpose Load OPC Toolbox™ objects from MAT-file

Syntax

```
load FileName  
load FileName Obj1 Obj2 ...  
S = load('FileName','Obj1','Obj2',...)
```

Description `load FileName` returns all variables from the MAT-file, `FileName`, into the MATLAB® workspace.

`load FileName Obj1 Obj2 ...` returns the specified OPC Toolbox objects, `Obj1`, `Obj2`, ... from the MAT-file, `FileName`, into the MATLAB workspace.

`S = load('FileName','Obj1','Obj2',...)` returns the structure, `S`, with the specified toolbox objects, `Obj1`, `Obj2`, ... from the MAT-file, `FileName`, instead of directly loading the toolbox objects into the workspace. The field names in `S` match the names of the toolbox objects that were retrieved. If no objects are specified, then all variables existing in the MAT-file are loaded.

Values for read-only properties will be restored to their default values upon loading. For example, the `Status` property of an `opcda` object will be restored to `'disconnected'`. You use `propinfo` to determine if a property is read-only.

See Also `opchelp`, `save`, `propinfo`

Purpose Convert private group into public group

Syntax `makepublic(GObj)`

Description `makepublic(GObj)` makes the `dagroup` object specified by `GObj` public. Public groups allow you to share data configuration information across multiple OPC clients. You can check whether a group is public or private using the `GroupType` property.

Public groups on a server cannot have the same name. If you attempt to call `makepublic` on a private group with the same name as an existing public group, an error is generated.

Once a group has been made public, you cannot add items to that group or delete items from that group. You must ensure that a group contains the required items before making the group public.

Not all OPC data access servers support public groups. If you try to make a public group on a server that does not support public groups, an error is generated. To verify that a server supports public groups, use the `opcserverinfo` function on the client connected to that server.

Use the `clonegroup` function to create a private group from a public group.

See Also `clonegroup`, `opcserverinfo`

obj2mfile

Purpose Convert OPC Toolbox™ object to MATLAB® code

Syntax

```
obj2mfile(DAObj, 'FileName')  
obj2mfile(DAObj, 'FileName', 'Syntax')  
obj2mfile(DAObj, 'FileName', 'Mode')  
obj2mfile(DAObj, 'FileName', 'Syntax', 'Mode')
```

Description `obj2mfile(DAObj, 'FileName')` converts the `opcda` object `DAObj` to the equivalent MATLAB code using the `set` syntax and saves the MATLAB code to a file specified by `FileName`. If an extension is not specified, the `.m` extension is used. Only those properties that are not set to their default values are written to `FileName`.

`obj2mfile(DAObj, 'FileName', 'Syntax')` converts the OPC Toolbox object to the equivalent MATLAB code using the specified `'Syntax'` and saves the code to the file, `FileName`. `'Syntax'` can be either `'set'` or `'dot'`. By default, `'set'` is used.

`obj2mfile(DAObj, 'FileName', 'Mode')` and `obj2mfile(DAObj, 'FileName', 'Syntax', 'Mode')` save the equivalent MATLAB code for all properties if `'Mode'` is `'all'`, and save only the properties that are not set to their default values if `'Mode'` is `'modified'`. By default, `'modified'` is used.

If `DAObj`'s `UserData` is not empty or if any of the callback properties are set to a cell array of values or to a function handle, the data stored in those properties is written to a MAT-file when the toolbox object is converted and saved. The MAT-file has the same name as the M-file containing the toolbox object code.

The values of read-only properties will not be restored. For example, if an object is saved with a `Status` property value of `'connected'`, the object will be recreated with a `Status` property value of `'disconnected'` (the default value). You can use `propinfo` to determine if a property is read-only.

To recreate `DAObj`, type the name of the M-file.

Examples

Create a client with a group and an item, then save that client to disk.

```
da = opcda('localhost','Dummy.Server');  
set(da, 'Tag', 'myopcTag','Timeout',300);  
grp = addgroup(da, 'TestGroup');  
itm = additem(grp, 'Dummy.Tag1');  
obj2mfile(da, 'myopc.m','dot','all');
```

Recreate the client under a different name.

```
copyOfDA = myopc;
```

See Also

opchelp, propinfo

opccallback

Purpose Event information for OPC Toolbox™ software callbacks

Syntax `opccallback(Obj,Event)`

Description `opccallback(Obj,Event)` displays a message that contains information about an OPC Toolbox software event. The type of event, the time the event occurred, and the related data for that event are displayed in the MATLAB® Command Window.

`Obj` is the object associated with the event. `Event` is a structure that contains the `Type` and `Data` fields. `Type` is the event type. `Data` is a structure containing event-specific information.

`opccallback` is an example callback function. Use this callback function as a template for writing your own callback function. By default a `dagroup` object's `ReadAsyncFcn`, `WriteAsyncFcn`, and `CancelAsyncFcn` are set to `@opccallback`, and an `opcda` object's `ErrorFcn` and `ShutDownFcn` are set to `@opccallback`.

See Also `showopcevents`

Purpose	Construct OPC data access object
Syntax	<pre>Obj = opcda('Host','ServerID') Obj = opcda('Host','ServerID','P1',V1,'P2',V2,...)</pre>
Description	<p>Obj = opcda('Host','ServerID') constructs an OPC data access object, Obj, for the host specified by Host and the OPC server ID specified by ServerID. When you construct Obj, its Status property is initially set to 'disconnected'. To communicate with the server, you must connect Obj to the server with the connect function.</p> <p>Obj = opcda('Host','ServerID','P1',V1,'P2',V2,...) constructs an OPC data access object, Obj, for the host specified by Host and the OPC server ID specified by ServerID, with the specified property values. If an invalid property name or property value is specified, the object will not be created.</p> <p>Note that the property name/property value pairs can be in any format supported by the set function, i.e., parameter-value string pairs, structures, and parameter-value cell array pairs.</p> <p>At any time, you can view a complete listing of OPC Toolbox™ functions and properties with the opchelp function.</p>
See Also	connect, opchelp, set

opcfind

Purpose Find OPC Toolbox™ objects with specific properties

Syntax
Out = opcfind
Out = opcfind('P1',V1,'P2',V2,...)
Out = opcfind(S)

Description Out = opcfind returns a cell array, Out, of all existing OPC Toolbox objects.

Out = opcfind('P1',V1,'P2',V2,...) returns a cell array, Out, of toolbox objects whose property values match those passed as property name/property value pairs, P1, V1, P2, V2, etc.

Out = opcfind(S) returns a cell array, Out, of toolbox objects whose property values match those defined in structure S. The field names of S are object property names and the field values of S are the requested property values.

Examples Create some OPC Toolbox objects.

```
da1 = opcda('localhost','Dummy.ServerA');  
da2 = opcda('localhost','Dummy.ServerB');  
set(da1, 'Tag','myopcTag', 'Timeout',300);  
grp = addgroup(da2, 'TestGroup');  
itm = additem(grp, {'Dummy.Tag1', 'Dummy.Tag2'});
```

Find all OPC Toolbox objects.

```
allObjCell = opcfind;
```

Find all objects with the Tag 'myopcTag'.

```
myOPC = opcfind('Tag', 'myopcTag')
```

Find all daitem objects.

```
itmCell = opcfind('Type', 'daitem')
```

See Also delete

Purpose Help for OPC Toolbox™ software function or property

Syntax

```
opchelp
opchelp('Name')
Out = opchelp('Name')
opchelp(Obj)
opchelp(Obj, 'Name')
Out = opchelp(Obj, 'Name')
```

Description opchelp displays a complete listing of OPC Toolbox software functions with a brief description of each function.

opchelp('Name') displays online help for the function or property, Name. If Name is an OPC Toolbox class, a complete listing of the functions and properties for that class is displayed with a brief description of each. The online help for the object constructor for that class is also displayed. If Name is an OPC Toolbox class with the .m extension, then only the online help for the object constructor is displayed.

You can display object-specific function information by specifying Name to be object/function. For example, to display the online help for the data access object's connect function, Name would be 'opcda/connect'.

You can display object-specific property information by specifying Name to be object.property. For example, to display the online help for the data access object's Status property, Name would be 'opcda.Status'.

Out = opchelp('Name') returns the help text to the string Out.

opchelp(Obj) displays a complete listing of functions and properties for the OPC Toolbox object Obj, along with the online help for the object's constructor.

opchelp(Obj, 'Name') displays the help for function or property, Name, for the toolbox object Obj.

Out = opchelp(Obj, 'Name') returns the help text to the string Out.

When displaying property help in the command window, the names in the "See also" section that contain all uppercase letters are function

names. The names that contain a mixture of uppercase and lowercase letters are property names.

When displaying function help, the “See also” section contains only function names.

Examples

Display all OPC Toolbox functions and a brief description of each function.

```
opchelp
```

Display help on the `opcda` constructor.

```
daHelp = opchelp('opcda')
```

Display help on the OPC Toolbox `set` function.

```
opchelp set
```

Display help on the `opcda` object's `disconnect` function.

```
opchelp opcda/disconnect
```

Create an `opcda` object and queries help information on that object. The object's `Timeout` and `Status` properties are also queried.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');  
opchelp(da)  
timeoutHelp = opchelp(da, 'Timeout');  
opchelp(da, 'Status');
```

See Also

```
propinfo
```

Purpose	Construct quality ID from item's quality string
Syntax	QualityID = opcqid(QualityStr)
Description	<p>QualityID = opcqid(QualityStr) returns the quality ID, which a number between 0 and 255, corresponding to the specified quality string. The quality string must be in the form '<i>Major Quality: Quality Sub-status (Limit Status)</i>'.</p> <p>If QualityStr is a cell array of quality strings, QualityID will be a matrix having the same size as QualityStr.</p> <p>For more information on quality values, see Appendix A, "OPC Quality Strings".</p>
Examples	<p>Construct the quality ID from the quality string of the item Random.Real8 on the Matrikon™ OPC Simulation Server.</p> <pre>da = opcda('localhost', 'Matrikon.OPC.Simulation'); connect(da) grp = addgroup(da); itm = additem(grp, 'Random.Real8'); qualityID = opcqid(itm.Quality)</pre>
See Also	get, opcqstr

Purpose	Extract quality parts from OPC quality ID
Syntax	[MajorQual, Substatus, Limit, Vendor] = opcqparts(QualityID)
Description	<p>[MajorQual, Substatus, Limit, Vendor] = opcqparts(QualityID) extracts the major quality, the quality substatus, the limit status, and the vendor-specific quality information fields, given the daitem object QualityID property value.</p> <p>The QualityID is a double value ranging from 0 to 65535, made up of four parts. The high 8 bits of the QualityID represent the vendor-specific quality information. The low 8 bits are arranged as QQSSSSL, where QQ represents the major quality, SSSS represents the quality substatus, and LL represents the limit status.</p> <p>For more information on quality values, see Appendix A, “OPC Quality Strings”.</p>
Examples	<p>Extract the major quality, substatus, and limit status of the item Random.Qualities on the Matrikon™ OPC Simulation Server.</p> <pre>da = opcda('localhost','Matrikon.OPC.Simulation'); connect(da) grp = addgroup(da); itm = additem(grp, 'Random.Qualities'); [quality, substatus, limit] = opcqparts(itm.QualityID)</pre>
See Also	get, opcqstr

Purpose	Convert OPC quality ID into readable string
Syntax	<code>QualityStr = opcqstr(QualityID)</code>
Description	<p><code>QualityStr = opcqstr(QualityID)</code> constructs a quality string from a quality ID, stored in the <code>QualityID</code> property of a <code>daitem</code> object. The string is of the form 'Major Quality: Quality Substatus: Limit Status'. The Limit Status part is omitted if the limit status is set to Not Limited. For information on each of the quality parts, see <code>opcqparts</code>.</p> <p>If <code>QualityID</code> is specified as a vector or matrix of quality IDs, then <code>QualityStr</code> will be a cell array having the same size as <code>QualityID</code>.</p> <p>For more information on quality values, see Appendix A, “OPC Quality Strings”.</p>
Examples	<p>Construct the quality string from the quality ID of the item <code>Random.Qualities</code> on a Matrikon™ OPC Simulation Server.</p> <pre>da = opcda('localhost', 'Matrikon.OPC.Simulation'); connect(da) grp = addgroup(da); itm = additem(grp, 'Random.Qualities'); qualitystr = opcqstr(itm.QualityID)</pre>
See Also	<code>get</code> , <code>opcqid</code> , <code>opcqparts</code>

opcread

Purpose Read logged records from disk to MATLAB® workspace

Syntax

```
S = OPCREAD('LogFileName')
S =
opcread('LogFileName','PropertyName','PropertyValue',...)
TSCell = opcread('LogFileName','DataType','timeseries')
[I,V,Q,TS,ET] = opcread('LogFileName',
'DataType', DType,...)
```

Description S = OPCREAD('LogFileName') returns all available records from the OPC log file named LogFileName. If no extension is specified as part of LogFileName, then .olf is used.

S is an NRec-by-1 structure array, where NRec is the number of records returned. S contains the fields 'LocalEventTime' and 'Items'. LocalEventTime is a date vector corresponding to the local event time for that record. Items is an NItems-by-1 structure array containing the fields show below.

Field Name	Description
ItemID	The fully qualified item ID, as a string.
Value	The data value. The data type is dependent on the original Item's DataType property.
Quality	The data quality, as a string.
TimeStamp	The time the value was changed, as a date vector.

S =
opcread('LogFileName','PropertyName','PropertyValue',...)
limits the data read from the specified OPC log file based on the properties and values provided. Valid property names and property values are defined in the table below.

Property Name	Property Value
'Records'	Specify the required records as [startRec endRec]. If no records fall within those bounds, opcread returns empty outputs.
'Dates'	Specify the date range for records as [startDt endDt]. The dates must be in MATLAB date number format. If no records fall within those bounds, opcread returns empty outputs.
'ItemIDs'	Specify the required item IDs as a string or cell array of strings. If no records match the required ItemIDs, OPCREAD returns empty outputs.

TSCell = opcread('LogFileName', 'DataType', 'timeseries') assigns the data received from the OPC log file to a cell array of time series objects. TSCell contains as many time series objects as there are items in the group, with the name of each time series object set to the item ID. The quality value stored in the time series object is offset from the quality value returned by the OPC server by 128. The quality strings displayed by each is the same. Because each record logged might not contain information for every item, the time series objects have only as many data points as there are records containing information about that particular item ID.

[I,V,Q,TS,ET] = opcread('LogFileName', 'DataType', DType,...) assigns the data retrieved from the OPC log file to separate arrays. Valid data types for DType are 'double', 'single', 'int8', 'int16', 'int32', 'uint8', 'uint16', 'uint32', 'logical', 'currency', 'date', and 'cell'.

I is a 1-by-NItem cell array of item names.

V is an NRec-by-NItem array of values with the data type specified. If a data type of 'cell' is specified, V is a cell array containing data in the returned data type for each item. Otherwise, V is a numeric array of the specified data type.

Note *DType* must be set to 'cell' when retrieving records containing strings or arrays of values.

Q is an NRec-by-NItem array of quality strings for each value in V.

TS is an NRec-by-NItem array of MATLAB date numbers representing the time when the relevant value and quality were stored on the OPC server.

ET is an NRec-by-1 array of MATLAB date numbers, corresponding to the local event time for each record.

Each record logged may not contain information for every item returned, since data for that item may not have changed from the previous update. When data is returned as a numeric matrix, the missing item columns for that record are filled as follows.

- | | |
|----|-------------------------------------------------------------------------------------------------------------------|
| V | The corresponding value entry is set to the previous value of that item, or to NaN if there is no previous value. |
| Q | The corresponding quality entry is set to 'Repeat'. |
| TS | The corresponding time stamp entry is set to the first valid time stamp for that record. |

Examples

Configure and start a logging task. Wait for the task to complete.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
connect(da);
grp = addgroup(da, 'ExOPCREAD');
itm1 = additem(grp, 'Triangle Waves.Real8');
itm2 = additem(grp, 'Saw-Toothed Waves.Int2');
set(grp, 'LoggingMode', 'disk', 'RecordsToAcquire', 30);
set(grp, 'LogFileName', 'ExOPCREAD.olf');
start(grp);
wait(grp);
```

Retrieve the first two records into a structure.

```
s = opcread('ExOPCREAD.olf', 'Records', [1, 2]);
```

Retrieve all the data and plot it with a legend.

```
[itmID, val, qual, tStamp] = opcread('ExOPCREAD.olf', ...  
    'DataType', 'double');  
plot(tStamp(:,1),val(:,1), tStamp(:,2),val(:,2));  
legend(itmID);  
datetick x keeplimits
```

See Also

getdata, flushdata, peekdata, start, stop

opcregister

Purpose Install and register OPC Foundation Core Components

Syntax

```
opcregister
opcregister('repair')
opcregister('remove')
opcregister(..., '-silent')
```

Description `opcregister` installs the OPC Foundation Core Components so that OPC Toolbox™ software is able to communicate with OPC servers.

`opcregister('repair')` repairs an existing OPC Foundation Core Components installation. Use this option if you are experiencing problems querying hosts with the `opcserverinfo` function.

`opcregister('remove')` removes all OPC Foundation Core Components from your workstation. Use this option if you no longer wish to access any servers using OPC.

`opcregister(..., '-silent')` runs the selected option without prompting you for confirmation, and without showing any progress dialog. Note that your machine might be restarted without prompting you if you choose this option. If you are concerned about restarting your machine, do not use the `'-silent'` option.

Note You must clear any OPC Toolbox objects that you have previously created in this MATLAB® session before you can run `opcregister`. If you attempt to run `opcregister` and OPC Toolbox objects already exist, an error is generated. Use `opcret` to clear objects from the MATLAB session.

OPC Foundation Core Components are redistributed under license from the OPC Foundation, <http://www.opcfoundation.org>.

See Also `opcret`

Purpose Disconnect and delete all OPC Toolbox™ objects

Syntax `opcreset`
`opcreset -force`

Description `opcreset` disconnects and deletes all OPC Toolbox objects. Any data that is stored in the buffer is flushed, all asynchronous operations are canceled, and open log files are closed.

You cannot reconnect a toolbox object to the server after it has been deleted. Therefore, you should remove it from the workspace with the `clear` function.

Note that you cannot call `opcreset` if an `opctool` session is open, or if Simulink® models containing OPC Toolbox blocks are open. Close all `opctool` sessions and all open Simulink models containing OPC Toolbox blocks before calling `opcreset`.

`opcreset -force` closes all open `opctool` sessions and all Simulink models containing OPC Toolbox blocks, without prompting to save those sessions and models. You will lose any unsaved changes to those sessions and models if you use the `-force` option. Use the `-force` option only as a last resort.

Examples This example creates an `opcda` object, and adds a group to that object. The OPC Toolbox objects are then deleted using `opcreset`, and all variables are cleared from the workspace.

```
da = opcda('localhost', 'Dummy.Server');
grp = addgroup(da);
opcreset; % Deletes all objects
% Clear the variables
clear da grp
opcfind
```

See Also `clear`, `delete`, `opcfind`, `opctool`

opcserverinfo

Purpose Version, server, and status information

Syntax
Out = opcserverinfo
Out = opcserverinfo('Host')
Out = opcserverinfo(DAObj)

Description Out = opcserverinfo returns a structure, Out, that contains information about OPC Toolbox™ and MATLAB® software, including product version numbers.

Out = opcserverinfo('Host') returns a structure, Out, that contains OPC server information associated with the host name or IP address specified by Host. The information includes the ServerID you can use to create a client associated with that server, and other information about each server.

Out = opcserverinfo(DAObj) returns a structure, Out, that contains information about the server associated with the opcda object DAObj. DAObj must be a scalar, and must be connected to the server. The information includes the current server status, as well as time information related to the server.

Examples This example returns information about servers installed on the local machine.

```
opcserverinfo('localhost')
```

This example returns information about the Matrikon™ Simulation Server installed on the local host.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');  
connect(da);  
matrikonInfo = opcserverinfo(da)
```

See Also connect, opcda

Purpose

Convert OPC data from structure to array format

Syntax

```
[ItmID,Val,Qual,TStamp,EvtTime] = opcstruct2array(S)
[ItmID,Val,Qual,TStamp,EvtTime] = opcstruct2array(S,
    'DataType')
```

Description

[ItmID,Val,Qual,TStamp,EvtTime] = `opcstruct2array(S)` converts the OPC data structure `S` into separate arrays for the item ID, value, quality, time stamp, and event time. `S` must be a structure as returned by the `getdata` and `opcread` functions. `S` must contain the fields `LocalEventTime` and `Items`. The `Items` field of `S` must contain the fields `ItemID`, `Value`, `Quality`, and `TimeStamp`.

`ItmID` is a 1-by-*nItm* cell array containing the item IDs of all unique items found in the `ItemID` field of the `Items` structures in `S`.

`Val` is an *nRec*-by-*nItm* array of doubles containing the value of each item in `ItmID`, at each time specified by `TStamp`.

`Qual` is an *nRec*-by-*nItm* cell array of strings containing the quality of each value in `Val`.

`TStamp` is an *nRec*-by-*nItm* array of doubles containing the time stamp for each value in `Val`.

`EvtTime` is *nRec*-by-1 array of doubles containing the local time each data change event occurred.

Each row of `Val` represents data from one record received by OPC Toolbox™ software at the corresponding entry in `EvtTime`, while each column of `Val` represents the time series for the corresponding item ID in `ItmID`.

[ItmID,Val,Qual,TStamp,EvtTime] = `opcstruct2array(S,'DataType')` uses the data type specified by the string `'DataType'` for the value array. Valid data types are `'double'`, `'single'`, `'int8'`, `'int16'`, `'int32'`, `'uint8'`, `'uint16'`, `'uint32'`, `'logical'`, `'currency'`, `'date'`, and `'cell'`.

See Also

`getdata`, `opcread`

opcstruct2timeseries

Purpose Convert OPC data from structure to time series format

Syntax `TS = opcstruct2timeseries(S)`

Description `TS = opcstruct2timeseries(S)` converts the OPC data structure `S` into a cell array of time series objects. `S` must be a structure in the format returned by the `getdata` and `opcread` functions. `S` must contain the fields `LocalEventTime` and `Items`. The `Items` field of `S` must contain the fields `ItemID`, `Value`, `Quality`, and `TimeStamp`.

The cell array `TS` contains as many time series objects as there are unique item IDs in the data structure, with the name of each time series object set to the item ID. The quality is stored in the time series object although the time series object's quality value is offset from the quality value returned by the OPC server by 128. However, the quality strings displayed are the same. Because each record logged might not contain information for every item, the time series objects have only as many data points as there are records containing information about that particular item ID.

See Also `getdata`, `opcread`, `opcstruct2array`, `timeseries`

Purpose Run OPC Toolbox™ software troubleshooting utility

Syntax

```
opcsupport
opcsupport('HostName')
opcsupport('HostName','FileName')
```

Description

opcsupport returns diagnostic information for all OPC servers installed on the local machine, and saves the output to the text file opcsupport.txt in the current directory.

opcsupport('HostName') returns diagnostic information for the OPC servers installed on the host named HostName, and saves the output to the text file opcsupport.txt in the current directory.

opcsupport('HostName','FileName') returns diagnostic information for the host named HostName, and saves the results to the text file FileName in the current directory.

Examples

```
opcsupport
opcsupport('area1')
opcsupport('area1','myfile.txt')
```

See Also opcda, opcserverinfo

opctool

Purpose Open OPC Tool GUI

Syntax `opctool`
`opctool(SessionName)`

Description `opctool` opens the OPC Tool graphical user interface (GUI). The OPC Tool GUI allows you to graphically browse the contents of an OPC server, view server item properties, as well as create and configure OPC Toolbox™ clients, groups and items. OPC Tool can also be used to read and write OPC data, configure and start a logging session and export logged data to the workspace.

Clients, groups and items configured using the OPC Tool GUI can be exported to the workspace, to a MAT-file, or as an OPC Session File that can be imported into the GUI at a later stage.

`opctool(SessionName)` opens the OPC Tool GUI and loads a previously saved OPC Session File. `SessionName` is the name of the OPC Session File to load. If an extension is not specified in `SessionName`, `.osf` is used.

Purpose Open OPC Tool GUI session file

Syntax `openosf('Name.osf')`

Description `openosf('Name.osf')` opens the OPC Tool GUI with the session file `Name.osf`. Specifying the `.osf` extension is optional. `Name.osf` must exist on the MATLAB® path, or you must specify the full path to the `.osf` file.

This function is provided mainly to facilitate opening `.osf` files from the file browser window.

See Also `opctool`, `open`

peekdata

Purpose Preview most recently acquired data

Syntax `S = peekdata(GObj, NRec)`

Description `S = peekdata(GObj, NRec)` returns the `NRec` most recently acquired records for the dagroup object, `GObj`, without removing those records from the OPC Toolbox™ software engine. `GObj` must be a scalar dagroup object. `S` is a structure array containing data for each record, in the same format as the structure returned by `getdata`.

If `NRec` is greater than the number of records currently available, a warning will be generated and all available records will be returned.

You use `peekdata` when you want to return logged data but you do not want to remove the data from the buffer. The object's `RecordsAvailable` property value will not be affected by the number of samples returned by `peekdata`.

`peekdata` is a non-blocking function that immediately returns records and execution control to the MATLAB® workspace.

Examples Configure and start a logging task for 60 seconds of data.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
connect(da);
grp = addgroup(da, 'ExOPCREAD');
itm1 = additem(grp, 'Triangle Waves.Real8');
itm2 = additem(grp, 'Saw-Toothed Waves.Int2');
set(grp, 'LoggingMode', 'memory', 'RecordsToAcquire', 60);start(grp);
```

Wait for 2 seconds and peek at the two most recent records.

```
pause(2);
s = peekdata(grp, 2)
s.Items(1).Value
```

See Also `flushdata`, `getdata`, `start`, `stop`

Purpose Property information for OPC Toolbox™ objects

Syntax

```
Out = propinfo(Obj)
Out = propinfo(Obj, 'PropName')
```

Description `Out = propinfo(Obj)` returns a structure array, `Out`, with field names given by the property names for `Obj`. Each property name in `Out` contains a structure with the fields shown below.

Field Name	Description
Type	Data type of the property. Possible values are 'any', 'callback', 'double', and 'string'.
Constraint	Type of constraint on the property value. Possible values are 'bounded', 'callback', 'enum', and 'none'.
ConstraintValue	List of valid string values or a range of valid values
DefaultValue	Default value for the property
ReadOnly	Condition under which a property is read-only: <ul style="list-style-type: none"> • 'always' — Property cannot be configured. • 'whileConnected' — Property cannot be configured while Status is set to 'connected'. • 'whileLogging' — Property cannot be configured while Logging is set to 'on'. • 'never' — Property can be configured at any time.

`Out = propinfo(Obj, 'PropName')` returns a structure array, `Out`, for the property specified by `PropName`. If `PropName` is a cell array of strings, a cell array of structures is returned for each property.

propinfo

Examples

```
da = opcda('localhost', 'Dummy.Server');  
allInfo = propinfo(da)  
serverIDInfo = propinfo(da, 'ServerID')
```

See Also

opchelp

Purpose Read data synchronously from OPC groups or items

Syntax

```
S = read(GObj)
S = read(IObj)
S = read(GObj, 'Source')
S = read(IObj, 'Source')
```

Description S = read(GObj) and S = read(IObj) read data for all the items contained in the dagroup object, GObj, or for the vector of daitem objects, IObj. The data is read from the OPC server's cache. S is a structure array containing data for each item in the following fields:

Field Name	Description	Type
ItemID	Fully qualified item name	string
Value	Value	double, string
Quality	Quality of the value	string
TimeStamp	The time that the value and quality was obtained by the device (if this is available), or the time the server updated or validated the value and quality in its cache	Date vector
Error	Error message	string

You can synchronously read from the cache only if the Active property is set to 'on' for both the item and the group that contains the item. A warning is issued if any of the objects passed to read are inactive. An inactive item is still returned in S, but the Quality is set to 'BAD: Out of Service'.

S = read(GObj, 'Source') and S = read(IObj, 'Source') read data from the source specified by 'Source'. 'Source' can be 'cache' or 'device'. If 'Source' is 'device', data is returned directly from the device. If 'Source' is 'cache', data is returned from the OPC server's

read

cache, which contains a copy of the device data. Note that the `Active` property is ignored when reading from `'device'`. Note also, that reading data from the device can be slow.

When a read operation succeeds, the `Value`, `Quality`, and `Timestamp` properties of the associated items are updated to reflect the values obtained from the read operation.

Examples

Configure a client and a group and item, for the Matrikon™ Simulation Server. Set the update rate for this group to prevent frequent cache updates.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
connect(da);
grp = addgroup(da, 'ExRead');
set(grp, 'UpdateRate', 20);
itm = additem(grp, 'Random.Real8');
```

Read twice from the cache, noting that the values are the same each time.

```
v1 = read(grp)
v2 = read(grp)
```

Now read twice from the device, noting that the value updates each time.

```
v3 = read(grp, 'device')
v4 = read(grp, 'device')
```

See Also

`readasync`, `refresh`, `write`, `writeasync`

Purpose	Read data asynchronously from group or items
Syntax	TransID = readasync(GObj) TransID = readasync(IObj)
Description	<p>TransID = readasync(GObj) and TransID = readasync(IObj) asynchronously read data for all the items contained in the dagroup object, GObj, or for the vector of daitem objects specified by IObj. TransID is a unique transaction ID for the asynchronous request.</p> <p>For asynchronous reads, data is always read from the device, not from the server cache. The Active property is ignored for asynchronous reads.</p> <p>When the read operation completes, a read async event is generated by the server. If an M-file callback function is specified for the ReadAsyncFcn property, that function executes when the event is generated.</p> <p>You can cancel an in-progress asynchronous request using cancelasync.</p> <p>When a readasync operation succeeds, the Value, Quality, and Timestamp properties of the associated items are updated to reflect the values obtained from the read operation.</p>
Examples	<p>Configure a client and a group and item, for the Matrikon™ Simulation Server.</p> <pre>da = opcda('localhost', 'Matrikon.OPC.Simulation'); connect(da); grp = addgroup(da, 'ExReadAsync'); set(grp, 'UpdateRate', 20); itm = additem(grp, 'Random.Real8');</pre> <p>Perform two asynchronous read operations.</p> <pre>tid1 = readasync(grp) tid2 = readasync(grp, 'device')</pre>

readasync

Examine the event log

```
pause(2)
disp('Event log:')
showopcevents(da)
```

See Also

cancelasync, read, refresh, write, writeasync

Purpose	Read all active items in group
Syntax	<pre>refresh(GObj) refresh(GObj, 'Source')</pre>
Description	<p><code>refresh(GObj)</code> asynchronously reads data for all active items contained in the <code>dagroup</code> object specified by <code>GObj</code>. Items whose <code>Active</code> property is set to <code>'off'</code> will not be read. <code>GObj</code> can be an array of group objects. The data is read from the OPC server's cache. You can use <code>refresh</code> only if the <code>Active</code> property is set to <code>'on'</code> for <code>GObj</code>.</p> <p>When the <code>refresh</code> operation completes, a <code>DataChange</code> event is generated by the server. If an M-file callback function is specified for the <code>DataChangeFcn</code> property, then the function executes when the event is generated.</p> <p><code>refresh</code> is a special case of subscription that forces a <code>DataChange</code> event for all active items even if the data has not changed. Note that <code>refresh</code> ignores the <code>Subscription</code> property.</p> <p><code>refresh(GObj, 'Source')</code> asynchronously reads data from the source specified by <code>'Source'</code>, which can be <code>'cache'</code> or <code>'device'</code>. If <code>'Source'</code> is <code>'device'</code>, data is returned directly from the device. If <code>'Source'</code> is <code>'cache'</code>, data is returned from the OPC server's cache. Note that reading data from the device can be slow.</p>
Examples	<p>Configure a client, group, and item for the Matrikon™ Simulation Server.</p> <pre>da = opcda('localhost', 'Matrikon.OPC.Simulation'); connect(da); grp = addgroup(da, 'ExRefresh'); itm = additem(grp, 'Random.Real8');</pre> <p>Turn off subscription for the group and add a <code>DataChangeFcn</code> callback.</p> <pre>set(grp, 'Subscription', 'off'); set(grp, 'DataChangeFcn', 'disp(grp.Item)')</pre>

refresh

Call refresh to get group and item updates.

```
refresh(grp)
```

```
refresh(grp)
```

See Also

readasync, read, write, writeasync

Purpose Remove public group from server

Syntax `removepublicgroup(DAObj, 'PublicGroupName')`

Description `removepublicgroup(DAObj, 'PublicGroupName')` removes the public group whose name is specified by `PublicGroupName` from the server that `DAObj` is connected to. `DAObj` must be a connected `opcda` object.

If the public group has clients using that group when you call `removepublicgroup`, a warning is issued and the group is only removed from the server when all clients have stopped using that group. No additional clients can connect to that group after you call `removepublicgroup`.

See Also `makepublic`, `addgroup`

save

Purpose Save OPC Toolbox™ objects to MAT-file

Syntax
`save FileName`
`save FileName Obj1 Obj2 ...`

Description `save FileName` saves all variables in the MATLAB® workspace to the specified MAT-file, `FileName`. If an extension is not specified for `FileName`, then a `.MAT` extension is used.

`save FileName Obj1 Obj2 ...` saves OPC Toolbox objects, `Obj1`, `Obj2`, ... to the specified MAT-file, `FileName`. If an extension is not specified for `FileName`, then a `.MAT` extension is used.

`save` can be used in the functional form as well as the command form shown above. When using the functional form, you must specify the file name and toolbox objects as strings.

Any data associated with the toolbox object will not be stored in the MAT-file. The data can be brought into the MATLAB workspace with `getdata` and then saved to the MAT-file using a separate variable name.

The `load` command is used to return variables from the MAT-file to the MATLAB workspace. Values for read-only properties will be restored to their default values upon loading. For example, the `Status` property for an `opcda` object will be restored to `'disconnected'`. You use `propinfo` to determine if a property is read-only.

See Also `getdata`, `load`, `opchelp`, `propinfo`

Purpose Property information for items in OPC server name space

Syntax
S = serveritemprops(DAObj,ItemID)
S = serveritemprops(DAObj,ItemID,PropID)

Description S = serveritemprops(DAObj,ItemID) returns all property information for the OPC server items specified by ItemID. ItemID is a single, fully qualified ItemID, specified as a string. DAObj is an opcda object connected to the OPC server. S is a structure array with the following fields:

Field Name	Description
PropID	The property number
PropDescription	The property description
PropValue	The property value

The number of properties returned by the server may be different for different ItemIDs.

Item properties include the item's canonical data type, limits, description, current value, etc.

S = serveritemprops(DAObj,ItemID,PropID) returns property information for the property IDs contained in PropID. PropID is a vector of integers. If PropID contains IDs that do not exist for that property, a warning is issued and any remaining property information is returned.

Note This function is not intended to read large amounts of data. Instead, it is intended to allow you to easily browse and read small amounts of data specific to a particular ItemID.

For a complete list of Property IDs defined by the OPC Foundation, consult Appendix B, "OPC Server Item Properties".

serveritemprops

Examples

Find the properties of the Matrikon™ Simulation Server's Random.Real4 tag.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');  
connect(da);  
p = serveritemprops(da, 'Random.Real4');
```

The first property is the item's canonical data type.

```
p(1)
```

The third property is the item's quality.

```
p(3)
```

See Also

serveritems

Purpose Query server or name space for fully qualified item IDs

Syntax

```

FQID = serveritems(DAObj,ItemID)
FQID = serveritems(DAObj)
FQID = serveritems(DAObj, 'Filter1',Val1,'Filter2',Val2,
...)
FQID = serveritems(NS)
FQID = serveritems(NS,ItemID)

```

Description

FQID = serveritems(DAObj,ItemID) returns a cell array of all fully qualified item IDs matching ItemID that are found on the OPC server defined by DAObj. DAObj must be a connected opcda object. ItemID is a partial string to search for, and can contain the wildcard character '*'. FQID is a string or cell array of strings. You can use FQID in a call to additem to construct daitem objects.

FQID = serveritems(DAObj) returns all fully qualified item IDs on the OPC server associated with DAObj.

FQID = serveritems(DAObj, 'Filter1',Val1,'Filter2',Val2, ...) allows you to filter the retrieved name space based on a number of available browse filters. Available filters are described in the following table:

Browse Filter	Description
'StartItemID'	Specify the FullyQualifiedID of a branch node, as a string. Only nodes contained in that branch node will be returned. Some OPC servers do not support partial name space retrieval based on this option: An error is generated if you attempt to use the 'StartItemID' browse filter on such a server.

serveritems

Browse Filter	Description
'Depth'	Specify the depth of the name space that you want returned. A 'Depth' value of 1 returns only the nodes contained in the starting position. A 'Depth' value of 2 returns the nodes contained in the starting position and all of their nodes. A 'Depth' value of Inf returns all nodes.
'AccessRights'	Restricts the search to leaf nodes with particular access right characteristics. Specify 'read' to return nodes that include the read access right, and 'write' to return nodes that include the write access right. An empty string ('') returns nodes with any access rights.
'DataType'	Restricts the search to nodes with a particular canonical data type. Valid data types are 'double', 'single', 'int8', 'int16', 'int32', 'uint8', 'uint16', 'uint32', 'logical', 'currency', and 'date'. Use the 'DataType' filter to find server items with a specific data type, such as 'double' or 'date'.

`FQID = serveritems(NS)` and `FQID = serveritems(NS,ItemID)` search the name space structure defined by NS, rather than querying the OPC server. NS is the result of a call to `getnamespace` in either hierarchical or flat format.

Note that some servers may return item IDs that cannot be created on that server. These item IDs are usually branches of the OPC server name space.

You use the results of a call to `serveritems` in a call to `serveritemprops` to return the property information for items in the OPC server name space. The properties of the items in the server name space include the server item's canonical data type, limits, description, current value, etc.

Examples

Create a client for the Matrikon™ Simulation Server and connect to the server.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');connect(da);
```

Find all item IDs in the Matrikon Server containing the word 'Real'.

```
realItmIDs = serveritems(da, '*Real*');
```

Add all items in the Random node to a group.

```
grp = addgroup(da, 'ServerItemsEx');  
itm = additem(grp, serveritems(da, 'Random.*'));
```

See Also

getnamespace, serveritemprops

Purpose Configure or display OPC Toolbox™ object properties

Syntax

```
set(Obj)
Prop = set(Obj)
set(Obj, 'PropertyName')
Prop = set(Obj, 'PropertyName')
set(Obj, 'PropertyName', PropertyValue)
set(Obj, S)
set(Obj, PN, PV)
set(Obj, 'PropName1', PropValue1, 'PropName2', PropValue2, ...)
```

Description `set(Obj)` displays property names and any enumerated values for all configurable properties of OPC Toolbox object `Obj`. `Obj` must be a single toolbox object.

`Prop = set(Obj)` returns all property names and their possible values for object `Obj`. `Obj` must be a single object. The return value, `Prop`, is a structure whose field names are the property names of `Obj`, and whose values are cell arrays of possible property values or empty cell arrays if the property does not have a finite set of possible string values.

`set(Obj, 'PropertyName')` displays the possible values for the specified property, `PropertyName`, of toolbox object `Obj`. `Obj` must be a single object.

`Prop = set(Obj, 'PropertyName')` returns the possible values for the specified property, `PropertyName`, of object `Obj`. The returned array, `Prop`, is a cell array of possible value strings or an empty cell array if the property does not have a finite set of possible string values.

`set(Obj, 'PropertyName', PropertyValue)` sets the value, `PropertyValue`, of the specified property, `PropertyName`, for object `Obj`. `Obj` can be a vector of toolbox objects, in which case `set` sets the property values for all the objects specified.

Note that if `Obj` is connected to an OPC server, configuring server-specific properties such as `UpdateRate` and `DeadbandPercent` might be time consuming.

`set(Obj,S)` where `S` is a structure whose field names are object property names, sets the properties named in each field name to the values contained in the structure.

`set(Obj,PN,PV)` sets the properties specified in the cell array of strings, `PN`, to the corresponding values in the cell array `PV`, for all objects specified in `Obj`. The cell array `PN` must be a vector, but the cell array `PV` can be `M-by-N`, where `M` is equal to `length(Obj)` and `N` is equal to `length(PN)`, so that each object will be updated with a different set of values for the list of property names contained in `PN`.

`set(Obj,'PropName1',PropValue1,'PropName2',PropValue2,...)` sets multiple property values with a single statement.

Note that it is permissible to use param-value string pairs, structures, and param-value cell array pairs in the same call to `set`.

Examples

Create an `opcda` object and add a group to that object.

```
da = opcda('localhost','Dummy.Server');
grp = addgroup(da,'SetExample');
```

Set the `opcda` object's `Timeout` to 300 seconds and restrict the event log to 2000 entries.

```
set(da,'Timeout',300,'EventLogMax',2000);
```

Set multiple properties using cell array pairs.

```
set(da,{'Name','ServerID'},{'My Opcda object','OPC.Server.1'});
```

Set the group's name.

```
set(grp,'Name','myopcgroup');
```

Query the permissible values for the group's `Subscription` property.

```
set(grp,'Subscription')
```

See Also

`get`, `propinfo`, `opchelp`

showopcevents

Purpose Event log summary for OPC Toolbox™ software events

Syntax
showopcevents(DAObj)
showopcevents(DAObj, Index)
showopcevents(Struct)
showopcevents(Struct, Index)

Description showopcevents(DAObj) displays a summary of the event log for the opcda object specified by DAObj.

showopcevents(DAObj, Index) displays a summary of the events with index of Index. Index can be the numerical index, a string, or a cell array of strings that specifies the type of event. Valid events are CancelAsync, Error, ReadAsync, Shutdown, Start, Stop, and WriteAsync.

showopcevents(Struct) and showopcevents(Struct, Index) display a summary of the events with index of Index for the event structure, Struct. You can obtain an event structure from the object's EventLog property.

The display summary includes the event type, the local time the event occurred, and additional event-specific information.

Examples This example configures a logging task for the Matrikon™ Simulation Server, then displays the event log to find timing information for the logging task.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');  
connect(da)  
grp = addgroup(da);  
set(grp, 'RecordsToAcquire', 10);  
itm = additem(grp, 'Bucket Brigade.Real8');  
start(grp);  
wait(grp);  
showopcevents(da);
```

See Also opccallback

Purpose Start a logging task

Syntax start(GObj)

Description start(GObj) starts a data logging task for GObj. GObj can be a scalar dagroup object, or a vector of dagroup objects. A dagroup object must be active and contain at least one item for start to succeed.

When logging is started, GObj performs the following operations:

- 1** Generates a Start event, and executes the StartFcn callback.
- 2** If Subscription is 'off', sets Subscription to 'on' and issues a warning.
- 3** Removes all records associated with the object from the OPC Toolbox™ software engine.
- 4** Sets RecordsAcquired and RecordsAvailable to 0.
- 5** Sets the Logging property to 'on'.

The Start event is logged to the EventLog.

GObj will stop logging when a stop command is issued, or when RecordsAcquired reaches RecordsToAcquire.

See Also flushdata, getdata, peekdata, stop, wait

stop

Purpose Stop a logging task

Syntax stop(GObj)

Description stop(GObj) stops any logging tasks associated with dagroup object GObj. GObj can be a scalar dagroup object or a vector of dagroup objects. When a logging task is stopped, the object's Logging property is set to 'Off', and the StopFcn callback is executed.

A dagroup object will also stop running when the requested records are acquired. This occurs when RecordsAcquired equals RecordsToAcquire.

The Stop event is recorded in the object's EventLog property.

See Also start, wait

Purpose Display graphical trend of OPC data for group

Syntax
`H = trend(GObj)`
`H = trend(GObj, 'PropertyName', PropertyValue, ...)`

Description `H = trend(GObj)` displays the newest 100 points of live data for the items defined in the dagroup object `GObj` in the current axes. `GObj` must be an active group containing one or more items. The handles to the created Handle Graphics® objects are returned in `H`.

All the items are displayed in the same axes, with no scaling. New data is displayed on the far right of the axes, and oldest data is displayed on the left. If no old data exists (such as at the beginning of a plot), the axes are empty. The Handle Graphics objects (including the axis limits) are updated with new data whenever the group object receives a Data Change event from the OPC server.

`H = trend(GObj, 'PropertyName', PropertyValue, ...)` allows you to pass additional property/value pairs to specify additional properties of the created plots. Special property/value pairs are listed in the following table. If any property is not in this list, that property/value pair is passed on to the created Handle Graphics objects.

Property Name	Description	Default
DisplayTime	Defines the number of seconds of history to display in the plot.	<code>100*gObj.UpdateRate</code>
Parent	Defines the parent axes objects in which to display the trends. The value can be a scalar, or a vector the same length as the number of items in <code>GObj</code> . If the value is a vector, each item's value is displayed in the respective axes object.	Current axes

trend

Property Name	Description	Default
PlotType	Defines the plot types for each item. Valid plot types are 'line', 'stairs', and 'stem'. The value can be a scalar, or a cell array the same length as the number of items in GObj. If the value is a cell array of strings, each item's plot type is set to the respective plot type in the value array.	'line'
DateFormat	Sets the display format for the <i>x</i> -axis of all axes objects into which data is plotted. DateFormat must be one of the date formats recognized by datetick.	'HH:MM:SS'
BufferTime	Defines the number of seconds of history to store for all items. Setting this value to a number greater than the value of DisplayTime allows you to pause the trend (by setting the Subscription property of the group to 'off') and panning the axes in question.	10*DisplayTime

Remarks

You can fix the axes *y*-limits to a particular value by using the YLim property of the axes containing your visualized data. For example, to set the limits of the *y*-axis to the instrument range reported by the OPC server, use the following code:

```
props = serveritemprops(da, itmName, 102:103);  
set(gca, 'YLim', [props.PropValue]);
```

If you add items to a group that currently has an active trend, the item is not shown. Call trend again to include that item in the trend view. (If

you set the hold state of the axes to 'on', when you call trend, existing trend objects are reused, without destroying their current view.)

If you delete an item from a group that currently has an active trend, the trend display shows no data for that item, and the item's trend eventually disappears off the graph.

Note This function overwrites the following properties of the group object:

- The DataChangeFcn property is set to update the axes with new data whenever it is received from the OPC server. If there is an existing DataChangeFcn callback, the trend functionality overwrites the callback.
- The Subscription property is configured to 'on' to receive Data Change events from the OPC server. You can change Subscription to 'off' after calling trend, in which case the trend stops updating until you set Subscription back to 'on' or issue a readasync command.

Examples

Configure a group with two items:

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
connect(da);
grp = addgroup(da, 'ExOPCTREND');
itm1 = additem(grp, 'Triangle Waves.Real8');
itm2 = additem(grp, 'Saw-Toothed Waves.Int2');
```

Create a trend showing the last two minutes of data in two separate axes:

```
ax1 = subplot(2,1,1);
ax2 = subplot(2,1,2);
trend(grp, 'DisplayTime', 120, 'Parent', [ax1, ax2]);
```

trend

See Also

hold, datetick

Purpose	Suspend MATLAB® execution until object stops logging
Syntax	<code>wait(GObj)</code> <code>wait(GObj, TSec)</code>
Description	<p><code>wait(GObj)</code> suspends MATLAB execution until the group object <code>GObj</code> has stopped logging. <code>GObj</code> must be a scalar dagroup object.</p> <p><code>wait(GObj, TSec)</code> will wait at most <code>TSec</code> seconds for <code>GObj</code> to stop logging. If the group object is still logging when the timeout value is exceeded, an error message is generated.</p> <p>The <code>wait</code> function can be useful when you want to guarantee that data is logged before another task is performed.</p> <p>You can press <code>Ctrl+C</code> to interrupt the <code>wait</code> function. An error message will be generated, and control will return to the MATLAB command window.</p>
Examples	<p>This example logs 60 seconds of data from the Matrikon™ Simulation Server's <code>Random.Real8</code> and <code>Random.UInt4</code> tags, at 1-second intervals. A message indicating that acquisition is complete is displayed, and the data is retrieved and plotted.</p> <pre>da = opcda('localhost','Matrikon.OPC.Simulation'); connect(da) grp = addgroup(da,'WaitExample'); itm = additem(grp, {'Random.Real8','Random.UInt4'}); set(grp, 'RecordsToAcquire',60, 'UpdateRate',1); start(grp); wait(grp) disp('Acquisition complete'); [itmID,v,q,t]=getdata(grp, 'double'); plot(t(:,1),v(:,1), t(:,2), v(:,2)); legend(itmID);</pre>
See Also	<code>start</code> , <code>stop</code> , <code>getdata</code>

write

Purpose Write values to group or items

Syntax `write(GObj,Values)`
`write(IObj,Values)`

Description `write(GObj,Values)` writes values to all the items contained in the dagroup object `GObj`. `Values` is a cell array of values—one for each item. To ensure that a specific value is written to the correct item object, you should construct the `Values` cell array based on the order of the items returned by the `Item` property.

`write(IObj,Values)` writes values to all the items contained in the vector of `daitem` objects specified by `IObj`.

The data types of the values do not need to match the canonical data type of the associated items. However an error is returned if a data type conversion cannot be performed.

Because the values are written to the device, this operation might be slow. The function does not return until it verifies that the device has actually accepted or rejected the data.

Note The behavior of an OPC server when writing NaN to an item is server-dependent. If you attempt to write NaN to an OPC server, the value might be silently ignored by the OPC server. That is, the server might not generate any events in response to writing NaN to an item.

Examples Configure a client, group, and items for the Matrikon™ Simulation Server.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');
connect(da);
grp = addgroup(da, 'ExWrite');
itm = additem(grp, {'Bucket Brigade.Real8', ...
    'Bucket Brigade.String'});
```

Read and write values to/from the items.

```
write(grp, {23, 'Hello World!'})  
r = read(grp)  
write(itm(1), 15)  
r2 = read(itm(1))
```

See Also

read, readasync, refresh, writeasync

writeasync

Purpose Asynchronously write values to group or items

Syntax
TransID = writeasync(GObj,Values)
TransID = writeasync(IObj,Values)

Description TransID = writeasync(GObj,Values) asynchronously writes values to all the items contained in the dagroup object GObj. Values is a cell array of values and is the same size as the number of items in GObj. TransID is a unique transaction ID for the asynchronous request.

TransID = writeasync(IObj,Values) asynchronously writes values to all the items contained in the vector of daitem objects specified by IObj.

To ensure that a specific value is written to the correct item object, you should construct the Values cell array based on the order of the items returned by the Item property. Because the values are written to the device, this operation might be time consuming.

The data types of the values do not need to match the canonical data type of the associated items. If a data type conversion cannot be performed, a warning is issued.

When the asynchronous write operation completes, a write async event is generated by the server. If an M-file callback function is specified for the WriteAsyncFcn property, then the function executes when the event is generated.

Note The behavior of an OPC server when writing NaN to an item is server-dependent. If you attempt to write NaN to an OPC server, the value might be silently ignored by the OPC server. That is, the server might not generate any events in response to writing NaN to an item.

Examples Configure a client and a group and items, for the Matrikon™ Simulation Server.

```
da = opcda('localhost', 'Matrikon.OPC.Simulation');  
connect(da);
```

```
grp = addgroup(da, 'ExWrite');  
itm = additem(grp, {'Bucket Brigade.Real8', ...  
    'Bucket Brigade.String'});
```

Configure the WriteAsyncFcn callback to read from the group

```
grp.WriteAsyncFcn = 'r=read(grp, ''device'')';
```

Write values asynchronously.

```
writeasync(grp, {123.456, 'MATLAB is great!'})
```

See Also

`cancelasync`, `read`, `readasync`, `refresh`, `write`

Property Reference

OPC Data Access Client Object Properties (p. 10-2)	Information and behavior of opcda client object
Data Access Group Object Properties (p. 10-4)	Information and behavior of opcda group object
Data Access Item Object Properties (p. 10-7)	Information and behavior of opcda item object

OPC Data Access Client Object Properties

General Properties (p. 10-2)	Basic information about client object
Callback Function and Event Properties (p. 10-2)	Information about object event and callback behavior
Server Connection Properties (p. 10-3)	Information about object connections

General Properties

Group	Data Access Group objects contained by client
Name	Descriptive name for OPC Toolbox™ object
Tag	Label to associate with OPC Toolbox object
Type	OPC Toolbox object type
UserData	Data to associate with OPC Toolbox object

Callback Function and Event Properties

ErrorFcn	M-file callback function to execute when error event occurs
EventLog	Event information log
EventLogMax	Maximum number of events to store in event log
ShutDownFcn	M-file callback function to execute when OPC server shuts down
TimerFcn	M-file callback function to execute when predefined period passes
TimerPeriod	Period between timer events

Server Connection Properties

Host	DNS name or IP address of server
ServerID	Server identity
Status	Status of connection to OPC server
Timeout	Maximum time to wait for completion of instruction to server

Data Access Group Object Properties

General Properties (p. 10-4)	Basic information about group object
Callback Function and Event Properties (p. 10-4)	Information about object event and callback behavior
Subscription and Logging Properties (p. 10-5)	Information about object logging, records, and subscription

General Properties

GroupType	Public status of dagroup object
Item	Data Access Item objects contained by group
Name	Descriptive name for OPC Toolbox™ object
Parent	OPC Toolbox object that contains dagroup or daitem object
Tag	Label to associate with OPC Toolbox object
TimeBias	Time bias of group
Type	OPC Toolbox object type
UserData	Data to associate with OPC Toolbox object

Callback Function and Event Properties

CancelAsyncFcn	M-file callback function to execute when asynchronous operation is canceled
DataChangeFcn	M-file callback function to execute when data change event occurs

ReadAsyncFcn	M-file callback function to execute when asynchronous read completes
RecordsAcquiredFcn	M-file callback function to execute when RecordsAcquired event occurs
RecordsAcquiredFcnCount	Number of records to acquire before RecordsAcquired event occurs
StartFcn	M-file callback function to execute immediately before logging starts
StopFcn	M-file callback function to execute immediately after logging stops
WriteAsyncFcn	M-file callback function to execute when asynchronous write completes

Subscription and Logging Properties

Active	Group or item activation state
DeadbandPercent	Percentage change in item value that causes subscription callback
LogFileName	Name of disk file to which logged data is written
Logging	Status of data logging
LoggingMode	Specify destination for logged data
LogToDiskMode	Method of disk file handling for logged data
RecordsAcquired	Number of records acquired
RecordsAvailable	Number of records available in OPC Toolbox software engine
RecordsToAcquire	Number of records to acquire for a logging session

Subscription

Enable server update when data changes

UpdateRate

Rate, in seconds, at which subscription callbacks occur

Data Access Item Object Properties

General Properties (p. 10-7)

Basic information about item object

Data Properties (p. 10-7)

Information about item data

General Properties

AccessRights

Inherent nature of access to item

Active

Group or item activation state

ItemID

Fully qualified ID on OPC server

Parent

OPC Toolbox™ object that contains dagroup or daitem object

ScanRate

Fastest possible data update rate

Tag

Label to associate with OPC Toolbox object

Type

OPC Toolbox object type

UserData

Data to associate with OPC Toolbox object

Data Properties

CanonicalDataType

Server's data type for item

DataType

Client item's data type

Quality

Quality of data value as string

QualityID

Quality of data value as 16-bit integer

TimeStamp

Time when item was last read

Value

Item value

Properties — Alphabetical List

AccessRights

Purpose Inherent nature of access to item

Description AccessRights represents the server's ability to access a single OPC data item. The property value can be 'read', 'write', or 'read/write'. If AccessRights is 'read', you can read the server item's value. If AccessRights is 'write', you can write values to the server item. If AccessRights is 'read/write', you can read and change the server item's value. If you attempt a read or write operation on an item that does not have the required access rights, the server may return an error.

Characteristics	Access	Read-only
	Applies to	daitem
	Data type	string
	Values	['read' 'read/write' 'write']
		The value is set by the server when an item is created.

See Also **Functions**
read, readasync, refresh, write, writeasync

Properties
Subscription

Purpose Group or item activation state

Description Active can be 'on' or 'off'. If Active is 'on', the OPC server will return data for the group or item when requested by the read function or when the corresponding data items change (subscriptions). If Active is 'off', the OPC server will not return information about the group or item.

By default, Active is set to 'on' when you create a dagroup or daitem object. Set Active to 'off' when you are temporarily not interested in that daitem or dagroup object's values. You configure Active for both dagroup and daitem objects. Changing the state of the group does not change the state of the items.

The activation state of a dagroup or daitem object affects reads and subscriptions, and depends on whether the data is obtained from the cache or from the device. The active state of a group or item affects operations as follows.

Operation	Source	Active State
read	Cache	Both group and items must be active. Inactive items in active groups, and all items in inactive groups, return bad quality.
read	Device	Active is ignored.
write	N/A	Active is ignored.
Subscription	N/A	Both group and items must be active. Inactive items in active groups, and all items in inactive groups, return bad quality.
readasync	N/A	Active is ignored.

A transition from 'off' to 'on' results in a change in quality, and causes a subscription callback for the item or items affected. Changing the Active state from 'on' to 'off' will cause a change in quality but

Active

will not cause a callback since by definition callbacks do not occur for inactive items.

You enable subscription callbacks with the `Subscription` property. Use the `DataChangeFcn` property to specify an M-file callback function to execute when a data change event occurs.

Characteristics

Access	Read/write
Applies to	dagroup, daitem
Data type	string
Values	['off' {'on'}]

See Also

Functions

read, readasync, refresh

Properties

DataChangeFcn, Subscription

Purpose M-file callback function to execute when asynchronous operation is canceled

Description You configure CancelAsyncFcn to execute an M-file callback function when a cancel async event occurs. A cancel async event occurs after an asynchronous read or write operation is canceled.

When a cancel async event occurs, the function specified in CancelAsyncFcn is passed two parameters: Obj and EventInfo. Obj is the object associated with the event, and EventInfo is an event structure containing the fields Type and Data. The Type field is set to 'CancelAsync'. The Data field contains a structure with the fields shown below.

Field Name	Description
LocalEventTime	The time, as a MATLAB® date vector, that the event occurred.
TransID	The transaction ID of the canceled read or write asynchronous operation.
GroupName	The group name.

Cancel async event information is stored in the EventLog property.

Characteristics

Access	Read/write
Applies to	dagroup
Data type	String, function handle, or cell array
Values	The default value is @opccallback.

CancelAsyncFcn

See Also

Functions

cancelasync, opccallback, readasync, writeasync

Properties

EventLog

Purpose Server's data type for item

Description CanonicalDataType indicates the data type of the item as stored on the OPC server. The MATLAB® supported data types are as for the DataType property.

You can specify that the item's value is stored in the daitem object using a data type that differs from the canonical data type, by setting the DataType property of the item to a value different from CanonicalDataType. Translation between the CanonicalDataType and the DataType is automatic.

Refer to the DataType property reference for a listing of the COM Variant data types and their equivalent MATLAB data types.

Characteristics	Access	Read-only
	Applies to	daitem
	Data type	string
	Values	The default value is determined when the item is created.

See Also **Functions**

additem

Properties

DataType

DataChangeFcn

Purpose

M-file callback function to execute when data change event occurs

Description

You configure DataChangeFcn to execute an M-file callback function when a data change event occurs. A data change event occurs for subscribed active items within an active group when the value or quality of the item has changed. The events will happen no faster than the time specified for the UpdateRate property of the group. The DeadbandPercent property is used to determine what percentage change in the value or quality initiates the callback. A data change event is only generated when both the Active and Subscription properties are 'on'.

When a data change event occurs, the function specified in DataChangeFcn is passed two parameters: Obj and EventInfo. Obj is the object associated with the event, and EventInfo is an event structure containing the fields Type and Data. The Type field is set to 'DataChange'. The Data field contains a structure with the fields defined below.

Field Name	Description
LocalEventTime	The time, as a MATLAB® date vector, that the event occurred
TransID	0, or the Refresh transaction ID if the data change event was generated by refresh
GroupName	The group name
Items	A structure containing information about each item whose value or quality updated

The Items structure contains the fields defined below.

Field Name	Description
ItemID	The item name

Field Name	Description
Value	The data value
TimeStamp	The time, as a MATLAB date vector, that the server's cache was updated

Data change event information is not stored in the EventLog property

Characteristics

Access	Read/write
Applies to	dagroup
Data type	string, function handle, or cell array
Values	The default value is an empty matrix ([]).

See Also

Functions

opccallback, refresh

Properties

Active, DeadbandPercent, Subscription, UpdateRate

Data Type

Purpose Client item's data type

Description `Data Type` indicates the data type of the item as stored in the `daitem` object in the MATLAB® workspace. You can specify the data type when the item is created using the `additem` function. If you do not specify a data type, or if the requested data type is rejected by the server, the canonical (native) data type is used. If the client associated with the item is not connected, the data type is set to 'unknown' until the client is connected.

The OPC server uses this data type to store the item value. The `CanonicalDataType` property of a `daitem` object provides information on the canonical data type of that item on the server.

OPC communication uses COM Variant data types to send information between the server and client. These are automatically translated to an equivalent MATLAB data type for the COM Variant types defined below. Any data type not included in this list is returned as 'unknown'.

OPC Toolbox™ Software Data Type	COM Data Type	MATLAB Data Type
double	VT_R8	double
char	VT_BSTR	char
single	VT_R4	single
uint8	VT_UI1	uint8
uint16	VT_UI2	uint16
uint32	VT_UI4	uint32
uint64	VT_UI8	uint64
int8	VT_I1	int8
int16	VT_I2	int16
int32	VT_I4	int32
int64	VT_I8	int64

OPC Toolbox™ Software Data Type	COM Data Type	MATLAB Data Type
currency	VT_CY	double
date	VT_DATE	double
logical	VT_BOOL	logical
double	VT_EMPTY	Empty array ([])

Characteristics

Access	Read-only while logging.
Applies to	daitem
Data type	string
Values	[{'unknown'} 'double' 'char' 'single' 'uint8' 'uint16' 'uint32' 'uint64' 'int8' 'int16' 'int32' 'int64' 'currency' 'date' 'logical']

See Also

Functions

additem

Properties

CanonicalDataType

DeadbandPercent

Purpose Percentage change in item value that causes subscription callback

Description You configure DeadbandPercent to a value between 0 and 100. The default value is 0, which specifies that any value change will update the OPC server's cache. A non-zero value results in the cache value being updated only if the difference between the cached value and the current value of the item exceeds

$$\text{DeadbandPercent} * (\text{High EU} - \text{Low EU}) / 100$$

The DeadbandPercent property only affects items that have an analogue data type and 'High EU' and 'Low EU' properties defined (Property IDs 102 and 103 respectively). You can query data types and item properties using serveritemprops.

Note OPC servers may not implement the DeadbandPercent property behaviour, even for values that have High EU and Low EU properties defined. For servers that do not support DeadbandPercent, an error will be generated if you attempt to set the DeadbandPercent property to a value other than 0.

DeadbandPercent is applied group wide for all analog daitem objects, and is used to prevent noisy signals from updating the client unnecessarily.

Characteristics	Access	Read/write
	Applies to	dagroup
	Data type	double
	Values	Any value from 0 to 100, inclusive. The default value is 0.

See Also

Functions

serveritemprops

Properties

Active, Subscription, UpdateRate

ErrorFcn

Purpose

M-file callback function to execute when error event occurs

Description

You configure ErrorFcn to execute an M-file callback function when an error event occurs. An error event is generated when an asynchronous transaction fails. For example, an asynchronous read on items that cannot be read generates an error event. An error event is not generated for configuration errors such as setting an invalid property value, nor for synchronous read and write operations.

When an Error event occurs, the function specified in ErrorFcn is passed two parameters: Obj and EventInfo. Obj is the object associated with the event, and EventInfo is an event structure containing the fields Type and Data. The Type field is set to 'Error'. The Data field contains a structure with the following fields:

Field Name	Description
LocalEventTime	The local time (as a date vector) the event occurred.
TransID	The transaction ID associated with the event.
GroupName	The group name.
Items	A structure containing information on each item that generated an error during that transaction.

The Items structure array contains the following fields:

Field Name	Description
ItemID	The item name.
Error	The error message.

The default value for ErrorFcn is @opccallback.

Note that error event information is also stored in the EventLog property.

Characteristics	Access	Read/write
	Applies to	opcda
	Data type	string, function handle, or cell array
	Values	@opccallback is the default callback function.

See Also

Functions

opccallback, showopcevents

Properties

EventLog, Timeout

EventLog

Purpose Event information log

Description EventLog contains a structure array that stores information related to OPC Toolbox™ software events. Every element in the structure array corresponds to an event.

Each element in the EventLog structure contains the fields Type and Data. The Type value can be 'WriteAsync', 'ReadAsync', 'CancelAsync', 'Shutdown', 'Start', 'Stop' or 'Error'.

Data stores event-specific information as a structure. For information on the fields contained in Data, refer to the associated callback property reference pages. For example, to find information on the fields contained in Data for a Start event, refer to the StartFcn property.

You specify the maximum number of events to store with the EventLogMax property.

Note that some events are not stored in the EventLog. If you want to store these events, you must specify a callback for that event.

You can execute a callback function when an event occurs by specifying a function for the associated callback property. For example, to execute a callback when a read async event is generated, you use the ReadAsyncFcn property.

If the event log is full (the number of events in the log equals the value of the EventLogMax property) and a new event is received, the oldest event is removed to make space for the new event. You clear the event log using the `cleareventlog` function.

Characteristics	Access	Read-only
	Applies to	opcda
	Data type	Structure array
	Values	The default value is an empty matrix ([]).

Examples

The following example creates a client and configures a group with two items. A 30 second logging task is run, and after 10 seconds the item values are read. When the logging task stops, the event log is retrieved and examined.

```

da = opcda('localhost', 'Matrikon.OPC.Simulation');
connect(da);
grp = addgroup(da, 'EvtLogExample');
itm1 = additem(grp, 'Random.Real8');
itm2 = additem(grp, 'Triangle Waves.UInt1');
set(grp, 'UpdateRate', 1, 'RecordsToAcquire', 30);
start(grp);
pause(10);
tid = readasync(grp);
wait(grp);
el = get(da, 'EventLog')
el = get(da, 'EventLog')

el =
1x3 struct array with fields:
    Type
    Data

```

Now examine the first event, which is the start event.

```

el(1)
ans =
    Type: 'Start'
    Data: [1x1 struct]

```

The Data field contains the following information.

```

el(1).Data
ans =
    LocalEventTime: [2004 1 13 16 16 25.1790]
    GroupName: 'EvtLogExample'
    RecordsAcquired: 0

```

The second event is a ReadAsync event. Examine the Data structure and the first element of the Items structure.

```
e1(2)
ans =
    Type: 'ReadAsync'
    Data: [1x1 struct]

e1(2).Data
ans =
    LocalEventTime: [2004 1 13 16 16 35.2100]
    TransID: 2
    GroupName: 'EvtLogExample'
    Items: [2x1 struct]

e1(2).Data.Items(1)
ans =
    ItemID: 'Random.Real8'
    Value: 2.4619e+003
    Quality: 'Good: Non-specific'
    TimeStamp: [2004 1 13 16 16 35.1870]
```

See Also

Functions

cleareventlog, start

Properties

CancelAsyncFcn, DataChangeFcn, EventLogMax, ErrorFcn, ReadAsyncFcn, StartFcn, StopFcn, WriteAsyncFcn

Purpose Maximum number of events to store in event log

Description If the event log is full (the number of events in the log equals the value of the EventLogMax property) and a new event is received, the oldest event is removed to make space for the new event. You clear the event log using the `cleareventlog` function.

By default, EventLogMax is set to 1000. To continually store events, specify a value of `Inf`. To store no events, specify a value of 0. If EventLogMax is reduced to a value less than the number of existing events in the event log, the oldest events are removed until the number of events is equal to EventLogMax.

Characteristics

Access Read/write

Applies to opcda

Data type double

Values Any integer in the range [0 Inf]. The default value is 1000.

See Also

Functions

`cleareventlog`

Properties

EventLog

Group

Purpose Data Access Group objects contained by client

Description Group is a vector of dagroup objects contained by the opcda object. Group is initially an empty vector. The size of Group increases as you add groups with the addgroup function, and decreases as you remove groups with the delete function.

Characteristics	Access	Read-only
	Applies to	opcda
	Data type	dagroup array
	Values	The default value is an empty array ([]).

See Also **Functions**
addgroup, delete

Purpose Public status of dagroup object

Description GroupType indicates whether a group is private or public. A private group is local to the opcda client, and other clients must create their own private groups. A public group is available from the server for any other OPC client on the network.

Characteristics

Access	Read-only
Applies to	dagroup
Data type	string
Values	[{'private'} 'public']

See Also **Functions**
addgroup

Host

Purpose DNS name or IP address of server

Description Host is the name or IP address of the machine hosting the OPC server. If you specify the host using an IP address, no name resolution is performed on that address.

Characteristics

Access	Read-only while connected
Applies to	opcda
Data type	string
Values	The value is configured when the object is created.

See Also **Functions**

opcda

Properties

ServerID

Purpose Data Access Item objects contained by group

Description Item is a vector of daitem objects contained by the dagroup object. Item is initially an empty vector. The size of Item increases as you add items with the additem function, and decreases as you remove items with the delete function.

Characteristics

Access	Read-only
Applies to	dagroup
Data type	daitem
Values	The default value is an empty matrix ([]).

Example This example creates a fictitious client, adds a group and two items.

```
da = opcda('localhost', 'Dummy.Server');
grp = addgroup(da, 'MyGroup');
itm1 = additem(grp, 'Item.Name.1');
itm2 = additem(grp, 'Item.Name.2');
allItems = grp.Item
```

If one of the items is deleted, the Item property is updated to reflect this.

```
delete(itm2);
newItems = grp.Item
```

See Also **Functions**
additem, delete

ItemID

Purpose Fully qualified ID on OPC server

Description ItemID is the fully qualified ID of the data item on the OPC server. The server uses the ItemID to return the appropriate data from the server's cache, or to read and send data to a specific device or location.

You obtain valid ItemID values for a particular server by querying that server's name space using the getnamespace or serveritems functions.

Characteristics	Access	Read-only while connected
	Applies to	daitem
	Data type	string
	Values	The default value is set during creation.

See Also **Functions**
additem, getnamespace, serveritems

Purpose Name of disk file to which logged data is written

Description When you start a logging operation using the start function, and the LoggingMode property is set to 'disk' or 'disk&memory', then DataChange events (records) are logged to a disk file with the name specified by LogFileName. You may specify any value for LogFileName as long as it conforms to the operating system file naming conventions. If no extension is specified as part of LogFileName, then .olf is used.

If a log file with the same name as LogFileName already exists when logging is started, the LogToDiskMode property is used to determine whether to overwrite the existing file, append records to that file, or create an indexed file based on LogFileName.

The log file is an ASCII file in comma-separated variable format, arranged as follows:

```
DataChange: LocalEventTime
ItemID1, Value1, Quality1, TimeStamp1
ItemID2, Value2, Quality2, TimeStamp2
...
ItemIDN, ValueN, QualityN, TimeStampN
DataChange: <LocalEventTime>
ItemID1, Value1, Quality1, TimeStamp1
ItemID2, Value2, Quality2, TimeStamp2
...
ItemIDN, ValueN, QualityN, TimeStampN
...
```

Characteristics	Access	Read-only while logging
	Applies to	dagroup
	Data type	string
	Values	The default value is 'opcdatalog.olf'.

LogFileName

See Also

Functions

start

Properties

LoggingMode, LogToDiskMode

Purpose Status of data logging

Description Logging is automatically set to 'on' when you issue a start command. Logging is automatically set to 'off' when you issue a stop command, or when the requested number of records is logged. You specify the number of records to log with the RecordsToAcquire property.

When Logging is 'on', each DataChange event (a record) is stored to disk or to memory (the buffer) as defined by the LoggingMode property.

Characteristics	Access	Read-only
	Applies to	dagroup
	Data type	string
	Values	[{'off'} 'on']

See Also

Functions

start, stop, wait

Properties

LoggingMode, RecordsToAcquire

LoggingMode

Purpose Specify destination for logged data

Description LoggingMode can be set to 'disk', 'memory', or 'disk&memory'. If LoggingMode is set to 'disk', DataChange events (records) are stored to a disk file as specified by LogFileName. If LoggingMode is set to 'memory', records are stored to memory (the buffer). If LoggingMode is set to 'disk&memory', records are stored to memory and to a disk file. LoggingMode defaults to 'memory'.

The disk file or memory buffer contains data logged from the time you issue the start command, until the time you issue a stop command or the number of records specified by the RecordsToAcquire property has been logged. Each DataChange event constitutes one record, containing one or more items. Only items that change value or quality are included in a DataChange event. The logged data includes the ItemID, Value, TimeStamp, and Quality for each item that changed.

Note that when you issue a refresh command while the toolbox is logging, the results of that operation are included in the log, since a refresh forces a DataChange event on the OPC server.

You extract data from memory with the getdata function. You can return the data stored in a log file to the MATLAB® workspace with the opcread function.

Characteristics	Access	Read-only while logging
	Applies to	dagroup
	Data type	string
	Values	['disk' 'disk&memory' {'memory'}]

See Also

Functions

getdata, opcread, refresh, start, stop

Properties

LogFileName, RecordsToAcquire

LogToDiskMode

Purpose

Method of disk file handling for logged data

Description

LogToDiskMode can be set to 'append', 'overwrite' or 'index'. If LogToDiskMode is set to 'append', then data for a logged session is added to any data that already exists in the log file when logging is started using the start command. If LogToDiskMode is set to 'overwrite', then the log file is overwritten each time start is called. If LogToDiskMode is set to 'index', then a different disk file is created each time start is called, according to the following rules:

- 1** The first log file name attempted is specified by the initial value of LogFileName.
- 2** If the attempted file name exists, then a numeric identifier is added to the value of LogFileName. For example, if LogFileName is initially specified as 'groupRlog.olf', then groupRlog.olf is the first attempted file, groupRlog01.olf is the second file name, and so on. If the LogFileName already contains numbers as the last characters in the file name, then that number is incremented to create the new log file name. For example, if the LogFileName is specified as 'groupLog003.olf', then the next file name would be 'groupLog004.olf'.
- 3** The actual file name used is the first file name that does not exist. In this way, each consecutive logging operation is written to a different file, and no previous data is lost.

Separate dagroup objects are logged to separate files. If two dagroup objects have the same value for LogFileName, then attempting to log data from both objects simultaneously will result in the second object failing during the start operation.

Characteristics

Access	Read-only while logging
Applies to	dagroup
Data type	string
Values	['append' {'index'} 'overwrite']

See Also

Functions

start

Properties

LogFileName, Logging, LoggingMode

Name

Purpose Descriptive name for OPC Toolbox™ object

Description The default object creation behavior is to automatically assign a name to all objects. For the `opcda` object, `Name` follows the naming scheme 'Host/ServerID'. For the `dagroup` object, if a name is not specified upon creation, the name returned by the OPC server is used, or a unique name is automatically assigned to the group. Automatically assigned group names follow the naming scheme 'groupN' where N is an integer. You can change the `Name` of an object at any time. The `Name` can be any string, and is used for display and identification purposes only.

Characteristics	Access	Read/write
	Applies to	<code>opcda</code> , <code>dagroup</code>
	Data type	string
	Values	The default value is defined at object creation time.

See Also **Functions**
`opcda`, `addgroup`

Properties
`Host`, `ItemID`, `ServerID`

Purpose OPC Toolbox™ object that contains dagroup or daitem object

Description For dagroup objects, Parent indicates the opcda object that contains the group. For daitem objects, Parent indicates the dagroup object that contains the daitem object.

Characteristics	Access	Read-only
	Applies to	dagroup, daitem
	Data type	Type of parent object
	Values	The value is defined at object creation time.

See Also **Properties**
Group, Item

Quality

Purpose Quality of data value as string

Description Quality indicates the quality of the `daitem` object's `Value` property as a string. You can use the `Quality` property to determine if a value is useful or not.

The `Quality` string is made up of a major quality string, a substatus string, and an optional limit status string, arranged in the format 'Major: Substatus: Limit status'. The limit status part is omitted if the value is not limited. The major quality can be one of the following values:

Value	Description
Bad	The value is not useful for reasons indicated by the Substatus.
Good	The value is of good quality.
Uncertain	The quality of the value is uncertain for reasons indicated by the Substatus.

For a list of substatus and limit status values and their interpretations, consult Appendix A, “OPC Quality Strings”.

`Quality` is updated when you perform a read operation using `read` or `readasync`, or when a subscription callback occurs. `Quality` is also returned during a synchronous read operation.

Characteristics

Access	Read-only
Applies to	<code>daitem</code>
Data type	string
Values	The default value is 'Bad: Out of Service'.

See Also

Functions

read, readasync, refresh

Properties

QualityID, Subscription, TimeStamp, UpdateRate, Value

QualityID

Purpose

Quality of data value as 16-bit integer

Description

QualityID is a numeric indication of the quality of the daitem object's data value.

QualityID is a number ranging from 0 to 65535, made up of four parts. The high 8 bits of the QualityID represent the vendor-specific quality information. The low 8 bits are arranged as QQSSSSL, where QQ represents the major quality, SSSS represents the quality substatus, and LL represents the limit status.

You use the `opcqparts` function to extract the four quality fields from the QualityID value. Alternatively, you can use the bit-wise functions to extract the fields you are interested in. For example, to extract the major quality, you can bit-wise AND the QualityID with 192 (the decimal equivalent of binary 11000000) using the `bitand` function, and shift the result 6 bits to the right using the `bitshift` function.

You use the `opcqstr` function to obtain the string equivalent of the four quality fields from the QualityID value.

For more information on quality values, see Appendix A, "OPC Quality Strings".

QualityID is updated when you perform a read operation using `read` or `readasync`, or when a subscription callback occurs.

Characteristics

Access	Read-only
Applies to	daitem
Data type	double
Values	An integer from 0 to 65535. The default value is 28 (representing the quality 'Bad: Out of Service').

See Also

Functions

bitand, bitshift, opcqparts, opcqstr, read, readasync, refresh

Properties

Quality, Value

ReadAsyncFcn

Purpose M-file callback function to execute when asynchronous read completes

Description You configure ReadAsyncFcn to execute an M-file callback function when an asynchronous read operation completes. You execute an asynchronous read with the readasync function. A read async event occurs immediately after the data is returned by the server to the MATLAB® workspace.

When a read async event occurs, the function specified in ReadAsyncFcn is passed two parameters: Obj and EventInfo. Obj is the object associated with the event, and EventInfo is an event structure containing the fields Type and Data. The Type field is set to 'ReadAsync'. The Data field contains a structure with the fields defined below.

Field Name	Description
LocalEventTime	The time, as a MATLAB date vector, that the event occurred.
TransID	The transaction ID for the asynchronous read operation.
GroupName	The group name.
Items	A structure containing information about each item whose value or quality updated.

The Items structure contains the fields defined below.

Field Name	Description
ItemID	The item name.
Value	The data value.
TimeStamp	The time, as a MATLAB date vector, that the server's cache was updated.

Read async event information is stored in the EventLog property.

Characteristics	Access	Read/write
	Applies to	dagroup
	Data type	string, function handle, or cell array
	Values	The default value is @opccallback.

See Also

Functions

opccallback, readasync

Properties

EventLog

RecordsAcquired

Purpose Number of records acquired

Description RecordsAcquired is continuously updated to reflect the number of records acquired since the start function was called. When you issue a start command, the group object resets the value of RecordsAcquired to 0 and flushes the memory buffer.

To find out how many records are available in the buffer, use the RecordsAvailable property. You can also configure the RecordsAcquiredFcn to generate an event each time a particular number of records have been acquired.

Characteristics	Access	Read-only
	Applies to	dagroup
	Data type	double
	Values	The default value is 0.

See Also **Functions**

start

Properties

Logging, RecordsAcquiredFcn, RecordsAvailable

Purpose M-file callback function to execute when RecordsAcquired event occurs

Description You configure RecordsAcquiredFcn to execute an M-file callback function when a records acquired event is generated. A records acquired event is generated each time the RecordsAcquired property reaches a multiple of RecordsAcquiredFcnCount.

When a records acquired event occurs, the function specified in RecordsAcquiredFcn is passed two parameters: Obj and EventInfo. Obj is the object associated with the event, and EventInfo is an event structure containing the fields Type and Data. The Type field is set to 'RecordsAcquired'. The Data field contains a structure with the fields defined below.

Field Name	Description
LocalEventTime	The time, as a MATLAB® date vector, that the event occurred
GroupName	The group name
RecordsAcquired	The number of records acquired in the current logging session at the time the event occurred

Records acquired event information is not stored in the EventLog property.

Characteristics

Access	Read/write
Applies to	dagroup
Data type	String, function handle, or cell array
Values	The default value is an empty matrix ([]).

RecordsAcquiredFcn

See Also

Functions

start

Properties

EventLog, RecordsAcquired, RecordsAcquiredFcnCount

Purpose Number of records to acquire before RecordsAcquired event occurs

Description A records acquired event is generated each time the number of records acquired reaches a multiple of RecordsAcquiredFcnCount.

Characteristics

Access	Read-only while logging
Applies to	dagroup
Data type	double
Values	Any integer in the range [0 Inf]. The default value is 20.

See Also **Properties**
RecordsAcquired, RecordsAcquiredFcn

RecordsAvailable

Purpose Number of records available in OPC Toolbox™ software engine

Description RecordsAvailable indicates the number of records that are available in the OPC Toolbox software engine. When you extract records from the engine with the getdata function, the RecordsAvailable value reduces by the number of records extracted. RecordsAvailable is reset to 0 and the toolbox engine is cleared when you issue a start command.

Use the RecordsAcquired property to find out how many records have been acquired since the start command was issued.

Characteristics	Access	Read-only
	Applies to	dagroup
	Data type	double
	Values	Any integer in the range [0 Inf]. The default value is 0.

See Also **Functions**
getdata, start

Properties
RecordsAcquired, RecordsToAcquire

Purpose Number of records to acquire for a logging session

Description RecordsToAcquire specifies the number of records that must be acquired before the engine automatically stops logging. When RecordsAcquired reaches RecordsToAcquire, the Logging property is set to 'off', and no more records are logged.

To continuously log records, specify a value of Inf.

Characteristics	Access	Read-only while logging
	Applies to	dagroup
	Data type	double
	Values	Any integer in the range [0 Inf]. The default value is 120.

See Also **Properties**
Logging, RecordsAvailable

ScanRate

Purpose Fastest possible data update rate

Description ScanRate describes the fastest possible rate at which a server can update an item. The default value is 0, which indicates that the scan rate is not known. Note that the scan rate may not be attainable by the server due to network load, server load and other factors.

Characteristics

Access	Read-only while logging
Applies to	dagroup
Data type	double
Values	The value is set by the server when a daitem object is created or when you connect to the server.

See Also **Properties**
UpdateRate

Purpose Server identity

Description ServerID is the COM style program ID that the opcda object connects to. The program ID is normally defined during installation of the OPC server.

You use `opcserverinfo` to find a list of available servers and their Server IDs.

Characteristics	Access	Read-only while connected
	Applies to	opcda
	Data type	string
	Values	The default value is specified during object creation.

See Also **Functions**
`opcda`, `opcserverinfo`

Properties
Host

ShutDownFcn

Purpose M-file callback function to execute when OPC server shuts down

Description You configure ShutDownFcn to execute an M-file callback function when the OPC server shuts down. Prior to calling the ShutDownFcn callback, the Status property of the opcda object is changed to 'disconnected'.

When a shutdown event occurs, the function specified in ShutDownFcn is passed two parameters: Obj and EventInfo. Obj is the object associated with the event, and EventInfo is an event structure containing the fields Type and Data. The Type field is set to 'Shutdown'. The Data field contains a structure with the following fields.

Field Name	Description
LocalEventTime	The time the event occurred, as a MATLAB® date vector.
Reason	The reason for the server shutdown.

Shutdown event information is stored in the EventLog property.

Characteristics	Access	Read/write
	Applies to	opcda
	Data type	string, function handle, or cell array
	Values	The default value is @opccallback.

See Also **Functions**
opccallback

Properties
EventLog

Purpose M-file callback function to execute immediately before logging starts

Description You configure StartFcn to execute an M-file callback function when all prelogging steps have been completed. You start logging by calling the start function. A start event occurs immediately before Logging is set to 'on'.

When a start event occurs, the function specified in StartFcn is passed two parameters: Obj and EventInfo. Obj is the object associated with the event, and EventInfo is an event structure containing the fields Type and Data. The Type field is set to 'Start'. The Data field contains a structure with the fields given below.

Field Name	Description
LocalEventTime	The time, as a MATLAB® date vector, that the event occurred.
GroupName	The group name.
RecordsAcquired	The number of records acquired in the current logging session at the time the event occurred.

Start event information is stored in the EventLog property.

Characteristics

Access	Read/write
Applies to	dagroup
Data type	string, function handle, or cell array
Values	The default value is an empty matrix ([]).

See Also **Functions**

start

Properties

EventLog, Logging

Status

Purpose Status of connection to OPC server

Description Status can be 'disconnected' or 'connected'. You connect an opcda object with the connect function and disconnect with the disconnect function. If the opcda object is connected to a server and the server shuts down, the Status property will be set to 'disconnected'.

Characteristics	Access	Read-only
	Applies to	opcda
	Data type	string
	Values	[{'disconnected'} 'connected']

See Also **Functions**
connect, disconnect

Properties
ShutDownFcn

Purpose M-file callback function to execute immediately after logging stops

Description You configure StopFcn to execute an M-file callback function when logging has stopped. Logging stops when you issue a stop command, or when the RecordsAcquired value reaches RecordsToAcquire.

When a stop event occurs, the function specified in StopFcn is passed two parameters: Obj and EventInfo. Obj is the object associated with the event, and EventInfo is an event structure containing the fields Type and Data. The Type field is set to 'Stop'. The Data field contains a structure with the fields given below.

Field Name	Description
LocalEventTime	The time, as a MATLAB® date vector, that the event occurred.
GroupName	The group name.
RecordsAcquired	The number of records acquired in the current logging session at the time the event occurred.

Stop event information is stored in the EventLog property.

Characteristics

Access	Read/write
Applies to	dagroup
Data type	string, function handle, or cell array
Values	The default value is an empty matrix ([]).

See Also **Functions**

stop

Properties

EventLog, RecordsAcquired, RecordsToAcquire

Subscription

Purpose Enable server update when data changes

Description Subscription can be 'on' or 'off'. If Subscription is 'on', server update notification is enabled for the group. The update occurs when the server cache quality or value of the data associated with a daitem object contained by the dagroup object changes. In order for the server cache to be updated, the percent change in the item value must also be greater than the value specified for the DeadbandPercent property.

A Subscription value of 'on' instructs the server to issue data change events when items in the group are updated by the server. Additionally, if an M-file callback function is specified for the DataChangeFcn property, then that function executes. If Subscription is 'off', the server may still update item values and/or quality information, but no data change event is generated.

Note that the refresh function is a special case of subscription, where refresh forces a data change event for all active items.

Characteristics	Access	Read/write
	Applies to	dagroup
	Data type	string
	Values	['off' {'on'}]

See Also **Functions**
read, readasync, refresh

Properties
Active, DataChangeFcn, DeadbandPercent, UpdateRate

Purpose Label to associate with OPC Toolbox™ object

Description You configure Tag to be a string value that uniquely identifies an OPC Toolbox object.

Tag is particularly useful when constructing programs that would otherwise need to define the toolbox object as a global variable, or pass the object as an argument between callback routines. You can return a toolbox object with the `opcfind` function by specifying the Tag property value.

Characteristics	Access	Read/write
	Applies to	dagroup, daitem, opcda
	Data type	string
	Values	The default value is an empty string (' ').

See Also **Functions**
`opcfind`

TimeBias

Purpose Time bias of group

Description TimeBias indicates the time difference between the server and client machines. In some cases the data may have been collected by a device operating in a time zone other than that of the client. Then it will be useful to know what the time of the device was at the time the data was collected (e.g., to determine what shift was on duty at the time).

The time is specified in minutes and can be positive or negative.

Characteristics	Access	Read-only
	Applies to	dagroup
	Data type	double
	Values	The default value is 0.

See Also **Properties**
TimeStamp

Purpose Maximum time to wait for completion of instruction to server

Description You configure `Timeout` to be the maximum time, in seconds, to wait for completion of a synchronous read or a synchronous write operation. If a time-out occurs, the read or write operation aborts. The default value is 10.

You can use `Timeout` to abort functions that block access to the MATLAB® command line.

For asynchronous read or write operations, `Timeout` specifies the time to wait for the server to acknowledge the request. It does not limit the time for the instruction to be completed by the server.

Characteristics	Access	Read/write
	Applies to	opcda
	Data type	double
	Values	Any value in the range [0 Inf]. The default value is 10.

See Also **Functions**
read, readasync, write, writeasync

TimerFcn

Purpose M-file callback function to execute when predefined period passes

Description You configure `TimerFcn` to execute an M-file callback function when a timer event occurs. A timer event occurs when the time specified by the `TimerPeriod` property passes. Timer events are only generated when the `Status` property is set to 'connected'. Timer events will stop being generated when the object's `Status` is set to 'disconnected', either by a `disconnect` function call, or when the server shuts down.

Some timer events may not be processed if your system is significantly slowed or if the `TimerPeriod` value is too small. Timer event information is not stored in the `EventLog` property.

Characteristics	Access	Read/write
	Applies to	opcda
	Data type	string, function handle, or cell array
	Values	The default value is an empty matrix (<code>[]</code>).

See Also **Functions**
`connect`, `disconnect`

Properties
`TimerPeriod`

Purpose Period between timer events

Description TimerPeriod specifies the time, in seconds, that must pass before the callback function specified by TimerFcn is called.

Some timer events may not be processed if your system is significantly slowed or if the TimerPeriod value is too small.

Characteristics	Access	Read only while logging
	Applies to	opcda
	Data type	double
	Values	Any value in the range [0.001 Inf]. The default value is 10.

See Also **Functions**
connect, disconnect

Properties
TimerFcn

TimeStamp

Purpose Time when item was last read

Description TimeStamp indicates the time when the Value and Quality properties were obtained by the device (if this is available) or the time the server updated or validated Value and Quality in its cache. TimeStamp is updated when you perform an asynchronous or synchronous read operation or when a subscription callback occurs.

TimeStamp is stored as a MATLAB® date vector. You convert date vectors to date strings with the `datestr` function, and to MATLAB date numbers with the `datenum` function.

Characteristics	Access	Read-only
	Applies to	<code>daitem</code>
	Data type	MATLAB date vector
	Values	The default value is an empty matrix (<code>[]</code>).

See Also **Functions**
`datestr`, `datenum`, `datevec`, `read`, `readasync`, `refresh`

Properties
`Quality`, `Subscription`, `UpdateRate`, `Value`

Purpose OPC Toolbox™ object type

Description Type indicates the type of the object. The OPC Toolbox object types are 'opcda', 'dagroup', and 'daitem'. Once an object is created, the value of Type is automatically defined, and cannot be changed.

You can identify OPC Toolbox objects of a given type using the `opcfind` function and the Type value.

Characteristics	Access	Read-only
	Applies to	dagroup, daitem, opcda
	Data type	string
	Values	The value is set during object creation.

See Also **Functions**

`opcfind`

UpdateRate

Purpose Rate, in seconds, at which subscription callbacks occur

Description UpdateRate specifies the rate, in seconds, at which subscription callbacks occur. Therefore, UpdateRate determines how often the cached data can be updated and how often data change events can occur. Consequently, UpdateRate also controls the rate at which data is logged. You start logging data change events with the start function.

Data change events can occur only for active items in an active group. Additionally, subscription must be enabled for the group.

Note that servers can select an update rate that differs from the requested value. If this occurs, UpdateRate is automatically updated with the returned value. By specifying an update rate of 0, updates will occur as soon as new information becomes available for the daitem object. New information is considered to be a change in the Quality property or a change in the data Value that exceeds the DeadbandPercent property value.

Characteristics	Access	Read-only while logging
	Applies to	dagroup
	Data type	double
	Values	Any value greater than or equal to 0. The default value is 0.5.

See Also **Functions**

start

Properties

Active, DeadbandPercent, Subscription

Purpose Data to associate with OPC Toolbox™ object

Description You configure UserData to store data that you want to associate with an OPC Toolbox object. The object does not use this data directly, but you can access it using the get function.

Characteristics	Access	Read/write
	Applies to	dagroup, daitem, opcda
	Data type	Any MATLAB® data type
	Values	The default value is an empty matrix ([]).

See Also **Properties**
Tag

Value

Purpose Item value

Description Value indicates the value that was last obtained from the OPC server for the item defined by the `ItemID` property. The data type of the value is given by the `DataType` property.

The value returned from the server may be different from the value of the device to which the `ItemID` refers, if the `DeadbandPercent` for the `daitem` object's parent group is not zero. The value is also updated only periodically, based on the parent group's `Active` and `UpdateRate` properties.

You determine the validity of `Value` by checking the `Quality` property for the item.

`Value` is updated when you perform an asynchronous or synchronous read operation or when a subscription callback occurs.

Characteristics	Access	Read-only
	Applies to	<code>daitem</code>
	Data type	Any MATLAB® data type
	Values	The default value is an empty matrix (<code>[]</code>).

See Also **Functions**
`read`, `readasync`, `refresh`

Properties
`Active`, `DataType`, `DeadbandPercent`, `Quality`, `Subscription`, `TimeStamp`, `UpdateRate`

Purpose

M-file callback function to execute when asynchronous write completes

Description

You configure `WriteAsyncFcn` to execute an M-file callback function when an asynchronous write operation completes. You execute an asynchronous write with the `writesync` function. A write async event occurs immediately after the server notifies the client that data has written to the device.

When a write async event occurs, the function specified in `WriteAsyncFcn` is passed two parameters: `Obj` and `EventInfo`. `Obj` is the object associated with the event, and `EventInfo` is an event structure containing the fields `Type` and `Data`. The `Type` field is set to `'WriteAsync'`. The `Data` field contains a structure with the fields defined below.

Field Name	Description
<code>LocalEventTime</code>	The time, as a MATLAB® date vector, that the event occurred.
<code>TransID</code>	The transaction ID for the asynchronous write operation.
<code>GroupName</code>	The group name.
<code>Items</code>	A structure containing information about each item whose value or quality was written.

The `Items` structure contains the fields defined below.

Field Name	Description
<code>ItemID</code>	The item name.

Write async event information is stored in the `EventLog` property.

WriteAsyncFcn

Characteristics

Access	Read/write
Applies to	dagroup
Data type	string, function handle, or cell array
Values	The default value is @opccallback.

See Also

Functions

opccallback, writeasync

Properties

EventLog

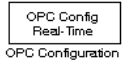
Block Reference

OPC Configuration

Purpose Configure OPC clients to use in model, pseudo real-time control options, and behavior in response to OPC errors and events

Library OPC Toolbox

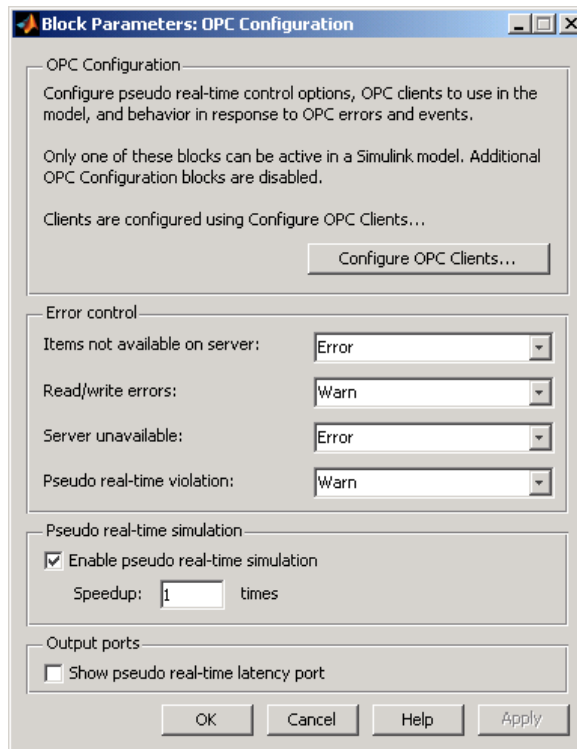
Description The OPC Configuration block defines the OPC clients to be used in a model, configures pseudo real-time behavior for the model, and defines behavior for OPC errors and events.



The block has no input ports. One optional output port displays the model latency (time spent waiting in each simulation step to achieve pseudo real-time behavior).

You cannot place more than one OPC Configuration block in a model. If you attempt to do so, an error message appears, and the second OPC Configuration block becomes disabled.

Dialog Box



Configure OPC Clients

Opens the OPC Client Manager for this model. Each model has a list of clients associated with it. These clients are used during the simulation to read or write data to an OPC server. See “Using the OPC Client Manager” on page 7-18 for more information.

Error control

Defines actions that Simulink® software must take when OPC-specific errors and events are encountered. The available actions are to produce an error and stop the simulation, produce a warning and continue the simulation, or ignore the error or event. The following table describes each error or event.

OPC Configuration

Error/Event	Description	Default
Items not available on server	Defines the behavior for items that are specified in a Read or Write block but do not exist on the server when the simulation starts.	error
Read/write errors	Defines the behavior when a read or write operation fails.	warn
Server unavailable	Defines the behavior when the client cannot connect to the OPC server, or when the server sends a shutdown event to the client.	error
Pseudo real-time violation	Defines the behavior when the simulation runs slower than real time. See the Pseudo real-time simulation options for more information.	warn

Pseudo real-time simulation

Allows you to configure options for running the simulation in pseudo real time. When **Enable pseudo real-time simulation** is checked, the model execution time matches the system clock as closely as possible by slowing down the simulation appropriately. The **Speedup** setting determines how many times faster than the system clock the simulation runs. For example, a setting of 2 means that a 10-second simulation will take 5 seconds to complete.

Note that the real-time control settings do not guarantee real-time behavior. If the model runs slower than real time, a pseudo

real-time latency violation error occurs. You can control how Simulink responds to a pseudo real-time latency violation using the settings in the **Error control** pane. You can also output the model latency using the **Show pseudo real-time latency port** setting.

Show pseudo real-time latency port

When checked, the pseudo real-time latency (in seconds) is output from the block. Pseudo real-time latency is the time spent waiting for the system clock during each step. If this value is negative, the simulation runs slower than real time, and the behavior defined in the **Pseudo real-time violation** setting determines the action that Simulink takes.

See Also

OPC Read, OPC Write

OPC Quality Parts

Purpose Convert OPC quality ID into vendor, major, minor, and limit status

Library OPC Toolbox

Description The OPC Quality Parts block converts an OPC quality ID vector into four parts: the vendor status, major quality, quality substatus, and limit status. The Quality port of an OPC Read block generates quality IDs.



For more information on quality parts, see Appendix A, “OPC Quality Strings”.

See Also OPC Read

Purpose Read data from OPC server

Library OPC Toolbox

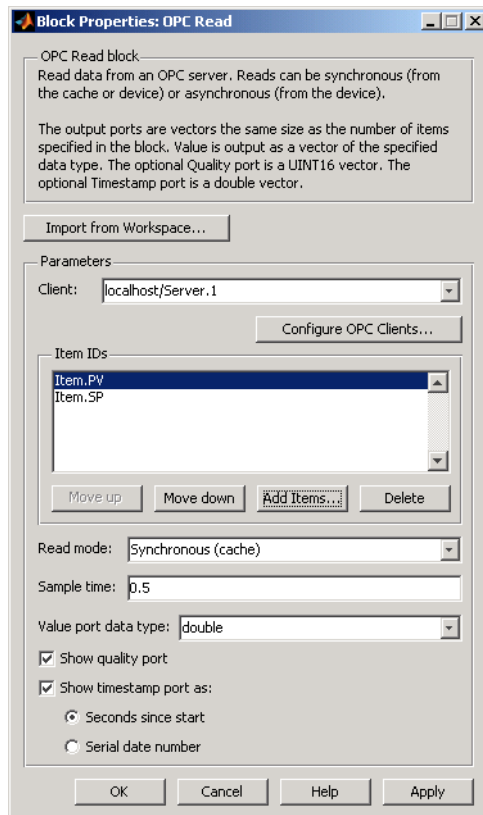
Description The OPC Read block reads data from one or more items on an OPC server. The read operation takes place synchronously (from the cache or from the device) or asynchronously (from the device).

The block outputs the values (V) of the requested items in the first output, and optionally outputs the quality IDs (Q) and the time stamps (T) associated with each data value in additional outputs. The time stamp may be output as a serial date number (real-world time), or as the number of seconds from the start of the simulation (simulation time).

The V,Q,T triple presented at the output ports is the last known data for each of the items read by the block. Use the time stamp output to determine when a sample last changed.

Note You must have an OPC Configuration block in your model to use the OPC Read block. You cannot open the OPC Read dialog without first including an OPC Configuration block in the model.

Dialog Box



Import from Workspace

Allows you to import settings for the OPC Read block from a dagroup object in the base workspace. The client, item IDs, and sample time are updated based on the properties of the imported group. The Value port data type is also set if all items in the group have the same DataType property.

Client

Defines the OPC client associated with this block. You can add additional clients to the list using **Configure OPC Clients**. For

more information, see “Using the OPC Client Manager” on page 7-18.

Item IDs

Shows the items to be read from the specified server. You can add items to the list using **Add Items**, or delete items using **Delete**. You can reorder the items in the list using **Move Up** or **Move Down**. The order of the items determines the order of their values in the block outputs.

Read mode

Defines the read mode for this block. Available options are Asynchronous, Synchronous (cache), or Synchronous (device). Synchronous reads have slightly more overhead than asynchronous reads, but they are generally more reliable than asynchronous reads.

Sample time

Defines the sample time for the block. For synchronous reads, data is read from the server at the specified sample time. For asynchronous reads, the sample time setting defines the update rate for data change events.

Value port data type

Defines the data type for the value output. The OPC server is responsible for converting all data to the required type.

Note For items with a Canonical Data Type of logical, the OPC Read block will output -1 for signed data types, or the maximum value for unsigned data types, when the item value is "true". A value of 0 is output when the item value is "false".

Show quality port

When checked, the quality IDs of all the items are output in the second port as a vector of unsigned 16-bit integers. Use the OPC Quality Parts block to separate the quality ID into component parts.

OPC Read

Show timestamp port

When checked, the timestamps for each of the items are output in the last port as a vector of doubles. You choose whether to output the timestamps as **Seconds since start** (i.e., simulation time) or as **Serial date numbers** (i.e., real-world time).

See Also

OPC Configuration, OPC Quality Parts, OPC Write

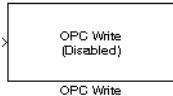
Purpose

Write data to OPC server

Library

OPC Toolbox

Description

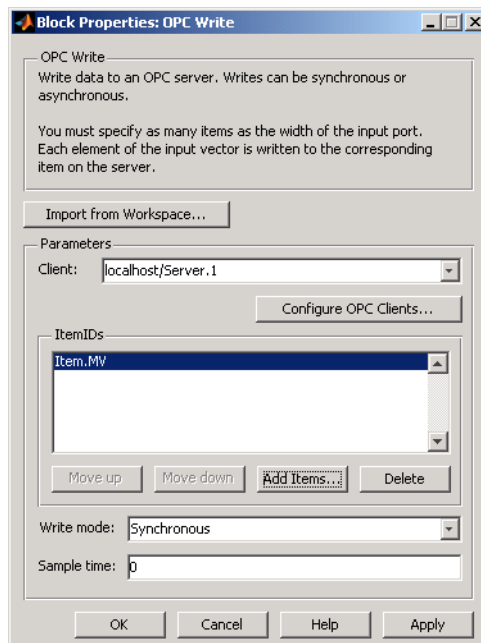


The OPC Write block writes data to one or more items on an OPC server. The write operation takes place synchronously or asynchronously.

Each element of the input vector is written to the corresponding item in the Item ID list defined for the OPC Write block.

Note You must have an OPC Configuration block in your model to use the OPC Write block. You cannot open the OPC Write dialog without first including an OPC Configuration block in the model.

Dialog Box



Import from Workspace

Allows you to import settings for the OPC Write block from a dagroup object in the base workspace. The client, item IDs, and sample time are updated based on the properties of the imported group.

Client

Defines the OPC client associated with this block. You can add clients to the list using **Configure OPC Clients**. For more information, see “Using the OPC Client Manager” on page 7-18.

ItemIDs

Shows the items to be written to the specified server. You can add items to the list using **Add Items**, or delete items using **Delete**. You can reorder the items in the list using **Move Up** or **Move Down**. Each element of the input port is written to the corresponding item in the list.

Write mode

Defines the write mode for this block. Available options are Asynchronous and Synchronous. Synchronous writes have slightly more overhead than asynchronous writes, but they are generally more reliable than asynchronous writes.

Sample time

Defines the sample time for the block. Data is written to the server at the specified sample time. You can specify 0 for continuous mode, or -1 to inherit the sample time of the block connected to the input of the OPC Write block.

See Also

OPC Configuration, OPC Read

OPC Quality Strings

OPC Toolbox™ software uses specific quality values defined by the OPC Foundation, based on a major quality value, a substatus for that major quality value, and a limit status indicating how the value is limited. This appendix describes the standard quality strings defined by the OPC Foundation that are used in the toolbox, and describes any special extensions that the toolbox uses.

An OPC quality value is a number ranging from 0 to 65535, made up of four parts. The high 8 bits of the quality value represent the vendor-specific quality information. The low 8 bits are arranged as QQSSSSL, where QQ represents the major quality, SSSS represents the quality substatus, and LL represents the limit status.

The following sections describe the OPC quality values and strings associated with each quality part.

Major Quality (p. A-2)	Describes the major quality strings.
Quality Substatus (p. A-3)	Describes the substatus strings associated with each major quality.
Limit Status (p. A-6)	Describes the limit status strings.

For more information on OPC quality strings, see the [Quality property reference page](#). The quality of an item is also stored in native value format in the `QualityID` property of the `daitem` object.

Major Quality

OPC Toolbox™ software uses the following major quality values and strings. The major quality is contained in bits 7 and 8 of the quality value.

Major Quality Strings Used in OPC Toolbox™ Software

Value	Quality String	Description
0	Bad	The value is not useful for the reason indicated by the substatus. The table Bad Quality Substatus Strings on page A-5 contains information about the substatus for bad quality.
1	Uncertain	The quality of the value is uncertain for reasons indicated by the substatus. The table Uncertain Quality Substatus Strings on page A-3 contains information about the substatus for uncertain quality.
3	Good	The quality of the value is good. The table Good Quality Substatus Strings on page A-3 contains information about the substatus for good quality.
N/A	Repeat	The value is repeated from a previous known value for this item. This toolbox-specific value occurs only in data returned from <code>getdata</code> or <code>opcread</code> , when you request array formatted values.

Quality Substatus

Each major quality status has an additional substatus that describes the quality of the value in more detail. The following tables describe the quality substatus for each major quality.

- Good Quality Substatus Strings on page A-3
- Uncertain Quality Substatus Strings on page A-3
- Bad Quality Substatus Strings on page A-5

Good Quality Substatus Strings

Value	Substatus String	Description
0	Non-specific	The value is good. There are no special conditions.
6	Local Override	The value has been overridden. Typically, this means that the device has been disconnected from the OPC server (either physically, or through software) and a manually entered value has been forced.

Uncertain Quality Substatus Strings

Value	Substatus String	Description
0	Non-Specific	The server has not published a specific reason why the value is uncertain.

Uncertain Quality Substatus Strings (Continued)

Value	Substatus String	Description
1	Last Usable Value	Whatever was writing the data value has stopped doing so. The returned value should be regarded as "stale." Note that this quality value differs from 'Bad: Last Known Value' in that the "bad" quality is associated specifically with a detectable communications error. The 'Uncertain: Last Usable Value' string is associated with the failure of some external source to "put" something into the value within an acceptable period of time. You can examine the age of the value using the TimeStamp property associated with this quality.
4	Sensor Not Accurate	Either the value has pegged at one of the sensor limits, or the sensor is otherwise known to be out of calibration via some form of internal diagnostics.
5	Engineering Units Exceeded	The returned value is outside the limits defined for this value. Note that this substatus does not imply that the value is pegged at some upper limit. The value may exceed the engineering units even further in future updates.
6	Sub-Normal	The value is derived from multiple sources and has less than the required number of good sources.

Bad Quality Substatus Strings

Value	Substatus String	Description
0	Non-Specific	The value is bad but no specific reason is known.
1	Configuration Error	There is some server-specific problem with the configuration. For example, the item in question is deleted from the running server configuration.
2	Not Connected	The input is required to be logically connected to something, but is not connected. This quality may reflect that no value is available at this time, possibly because the data source has not yet provided one.
3	Device Failure	A device failure has been detected.
4	Sensor Failure	A sensor failure has been detected.
5	Last Known Value	Communication between the device and the server has failed. However, the last known value is available. Note that the age of the last known value can be determined from the TimeStamp property.
6	Comm Failure	Communication between the device and server has failed. There is no last known value available.
7	Out of Service	The Active state of the item or group containing the item is set to off. This quality is also used to indicate that the item is not being updated by the server for some reason.

Limit Status

The limit status is not dependent on the major quality and substatus parts of a quality value.

The following table lists the limit status values and strings used in OPC Toolbox™ software.

Value	Limit Status String	Description
0	Not Limited	The value is free to move. Note that when the limit status has this value, it is omitted from any quality string in the toolbox.
1	Low Limited	The value is fixed at some lower limit.
2	High Limited	The value is fixed at some upper limit.
3	Constant	The value is a constant and cannot change.

OPC Server Item Properties

All server items defined in an OPC server name space have associated properties that describe that server item in more detail. The properties defined by the OPC Foundation are described in this appendix, under the following sections.

Understanding OPC Server Item Properties (p. B-2)	Describes how OPC properties relate to server items.
OPC Specific Properties (p. B-3)	Describes the OPC specific properties. These properties are required for each server item.
OPC Recommended Properties (p. B-4)	Describes the OPC recommended properties. These properties contain additional information commonly associated with server items.

For more information on querying OPC server item properties, consult the help for `serveritemprops`.

Understanding OPC Server Item Properties

Every item defined by an OPC server has specific attributes, or properties, that describe that server item in more detail. These properties include the current Value, Quality and TimeStamp for the server item, plus additional properties that a server may require in order to determine the quality of a value, or to decide whether to generate a DataChange event for groups that have a nonzero DeadbandPercent value. Exposure of the server item properties to a client is intended to provide a client with more information on a specific item, and is not intended to provide efficient access to large amounts of data. Rather, you should use the read function to read data from a large number of server items.

Each property is identified by a Property ID, or *PropID*, which is an integer value. The OPC Data Access Specification defines three sets of these properties, based on their PropID.

OPC Item Property Sets

Set Name	ID Range	Description
OPC Specific	1-99	Information directly related to the OPC server for that item.
OPC Recommended	100-4999	Additional information which is commonly associated with items, such as ranges of valid values, alarm limits, etc.
Vendor Specific	5000 or greater	Specific properties defined by an OPC server vendor. Since these vary from vendor to vendor, the actual descriptions are not presented in this appendix.

Each of the property sets defined by the OPC Foundation is presented in the following sections.

Note OPC servers must implement the OPC specific properties. However, the recommended properties are not mandatory, and an OPC server could provide any subset of the recommended properties, or none of them.

OPC Specific Properties

OPC Specific Properties

PropID	Description
1	<p>“Item Canonical DataType”</p> <p>The data type of the item as stored on the OPC server. This property is also exposed in the CanonicalDataType property of the daitem object.</p>
2	<p>“Item Value”</p> <p>The value that was last obtained from the OPC server for the item. This property is the same as the Value property of the daitem object. Querying this property behaves like a read operation from the device.</p>
3	<p>“Item Quality”</p> <p>The quality of the item’s Value property. This property is the same as the Quality property of the daitem object. Querying this property behaves like a read operation from the device.</p>
4	<p>“Item Timestamp”</p> <p>The time that the Value and Quality was obtained by the device (if this is available) or the time the server updated or validated the Value and Quality in its cache. This property is the same as the TimeStamp property of the daitem object. Querying this property behaves like a read operation from the device.</p>
5	<p>“Item Access Rights”</p> <p>The ability of the server to read or write data to this item.</p>
6	<p>“Server Scan Rate”</p> <p>Represents the fastest rate at which the server could obtain data from the underlying data source. The accuracy of this value could be affected by system load and other factors, and is not a guaranteed rate.</p>
7-99	Reserved for future use

OPC Recommended Properties

The Recommended Properties are divided into the following tables.

- Recommended Properties Related to the Item Value on page B-4
- Recommended Properties Related to Operator Displays on page B-5
- Recommended Properties Related to Alarm and Condition Values on page B-6

Recommended Properties Related to the Item Value

PropID	Description
100	“EU Units” The engineering units for this item.
101	“Item Description” A description of the item.
102	“High EU” Present only for ‘analog’ data. Represents the highest value likely to be obtained in normal operation. Also used by servers that support non-zero DeadbandPercent values for a group.
103	“Low EU” Present only for ‘analog’ data. Represents the lowest value likely to be obtained in normal operation. Also used by servers that support non-zero DeadbandPercent values for a group.
104	“High Instrument Range” Represents the highest value that can be returned by the instrument.
105	“Low Instrument Range” Represents the highest value that can be returned by the instrument.

Recommended Properties Related to the Item Value (Continued)

PropID	Description
106	“Contact Close Label” Present only for ‘discrete’ data. Represents a string to be associated with this contact when it is in the closed (non-zero) state.
107	“Contact Open Label” Present only for ‘discrete’ data. Represents a string to be associated with this contact when it is in the open (zero) state.
108	“Item Timezone” The difference in minutes between the item’s UTC Timestamp and the local time in which the item value was obtained. OPC Toolbox™ software does not use this property to adjust time stamps for an item.
109-199	Reserved for future use.

Recommended Properties Related to Operator Displays

PropID	Description
200	“Default Display” The name of an operator display associated with this item.
201	“Current Foreground Color” The COLORREF in which the item should be displayed.
202	“Current Background Color” The COLORREF in which the item should be displayed.
203	“Current Blink” Defines whether a display of this item should blink.
204	“BMP File” Bitmap file associated with this item.
205	“Sound File” .WAV or .MID file associated with this item.

Recommended Properties Related to Operator Displays (Continued)

PropID	Description
206	“HTML File” URL reference for this item.
207	“AVI File” Video file associated with this item.
208-299	Reserved for future OPC use.

Recommended Properties Related to Alarm and Condition Values

PropID	Description
300	“Condition Status” The current alarm condition status associated with the item.
301	“Alarm Quick Help” A short text string providing a brief set of instructions for the operator to follow when this alarm occurs.
302	“Alarm Area List” An array of strings indicating the plant or alarm areas which include this item.
303	“Primary Alarm Area” A string indicating the primary plant or alarm area including this item.
304	“Condition Logic” An arbitrary string describing the test being performed.
305	“Limit Exceeded” For multistate alarms, the condition exceeded.
306	“Deadband”
307	“HiHi Limit”
308	“Hi Limit”
309	“Lo Limit”

**Recommended Properties Related to Alarm and Condition Values
(Continued)**

PropID	Description
310	“LoLo Limit”
311	“Rate of Change Limit”
312	“Deviation Limit”
313-4999	Reserved for future OPC use.

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