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OPC Historical Data Access Specification

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Synopsis:

This specification is the specification of the interface for developers of OPC clients and OPC servers. The specification is a result of an analysis and design process to develop a standard interface to facilitate the development of servers and clients by multiple vendors that shall inter-operate seamlessly together.

Trademarks:

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Required Runtime Environment:

This specification requires Windows 95 / Windows NT 4.0 or later

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Revision 1.2 Highlights

This revision contains the changes made to the Historical Data Access Custom Interface (1.1 Version Baseline). This revision includes additional minor clarifications to certain ambiguities which were discovered during Interoperability sessions. The affected sections include:

- Clarification of Definitions
- Clarification of Standard Aggregates and example data sets.
- Added two example data sets to demonstrate aggregate usage.
- 4.4.3.1 Clarify NumValues returned with only one time specified and how bounds are treated.
- 4.4.3.1 Highlight requirement for clients to perform ReadRaw call multiple times to return all data over the time range when NumValues is exceeded.
- 4.4.3.1/4.5.1.1 Clarify that a null value signifies an unspecified value for htStartTime/htEndTime
- Addition of OPCHDA_PARTIAL quality.
- Clarifications on use of relative time.
- Clarifications on browsing
- Clarification of interpolation used for ReadAtTime. Sections 4.4.3.3, 4.5.1.5
- Added link to OPC forums for tracking errata

Some issues have been noted that will require modifications to the existing IDL that would affect compatibility. These modifications have been deferred until the next major release the Historical Data Access Custom Interface 2.0. These issues include:

- ENUM precludes servers from specifying more than one method. Affects:
  - 4.4.4.1 SyncUpdate::QueryCapabilties
  - 4.4.5.1 SyncAnnotations::QueryCapabilities
  - 4.5.2.1 AsyncUpdate::QueryCapabilties
  - 4.5.3.1 AsyncAnnotations::QueryCapabilities
- The OnPlayback interface mistakenly has a double pointer for ppItemValues. This should be a single pointer.

Table of Contents

1. Introduction

1.1. Background

Today with the level of automation that is being applied in manufacturing, people are dealing with more and more information.

Historical engines today produce an added source of information that must be distributed to users and software clients that are interested in this information. Currently most historical systems use their own proprietary interfaces for dissemination of data. There is no capability to augment or use existing historical solutions with other capabilities in a plug-and-play environment. This requires the developer to recreate the same infrastructure for their products as all other vendors have had to develop independently with no interoperability with any other systems.

In keeping with the desire to integrate data at all levels of a business (as was stated in the OPC Data background information), historical information can be considered to be another type of data. This information is a valuable component of the information architecture outlined in the OPC Data specification.

Manufacturers and consumers want to use off the shelf, open solutions from vendors that offer superior value that solve a specific need or problem.

1.2. Purpose

A growing number of custom applications are being developed in environments like Visual Basic (VB), Delphi, Power Builder, etc. OPC must take this trend into account. Microsoft understands this trend and designed OLE/COM to allow components (written in C and C++ by experts in a specific domain) to be utilized by a custom program (written in VB or Delphi for an entirely different domain). Developers will write software components in C and C++ to encapsulate the intricacies of accessing Historical data, so that business application developers can write code in VB that requests and utilizes historical data.

The intent of this specification is to facilitate the development of OPC Servers for Historical Data Access in C and C++, and to facilitate development of OPC client applications in the language of choice. The architecture and design of the interfaces described in this specification are intended to support development of OPC servers in other languages as well.

This specification tries to identify interfaces used to pass historical information between components which would be suitable to standardization. Additionally this document details the design of those interfaces in such a way as to complement the existing OPC Data Access Interfaces.

1.3. Relationship to Other OPC Specifications

There is a loose binding between this and other OPC specifications. This OPC specification is not derived from, nor does it inherit interfaces from, another OPC specification.   Where identical interfaces are desired, they are replicated here. Data types are assumed from the Data Access specification. The interfaces in this document provide time series Historical data. If real time data is desired, a Data Access server and its interfaces should be used. This specification does not deal with historical Alarm or relational type data.

1.4. Scope

This document represents the initial release of the HDA specification. The scope of this release was purposely limited to defining interfaces to support the reading, writing, and editing of historical data between client applications and historical data servers. Additional functionality was deferred to future releases of this specification.

1.4.1. General

This document specifies the interfaces a historian is required to support to be classified an OPC Historian server. It does not intend to define the underlining architecture of the historian.

1.4.2. Multiple Levels of Capability

The OPC Historian specification accommodates a variety of applications that need to provide Historical data. In particular, there are multiple levels of capability for handling historical functionality, from the simple to the sophisticated. The simple historian may only support one or two of the interfaces.

1.4.3. Types of Historian Servers

There are several types of Historian servers. Some key types supported by this specification are:

- Simple Trend data servers. These servers provide little other than simple raw data storage. (Data would typically be the types of data available from an OPC Data Access server, usually provided in the form of a tuple [Time, Value & Quality])
- Complex data compression and analysis servers. These servers provide data compression as well as raw data storage. They are capable of providing summary data or data analysis functions, such as average values, minimums and maximums etc. They can support data updates and history of the updates. They can support storage of annotations along with the actual historical data storage.

  These different servers are all covered under this specification by optional interfaces. If a server does not support a group of functions, it is not required to implement the optional interface for that functional group.

1.5. References

OLE for Process Control Standard – RELEASE UPDATE Version 1.0A, OPC Foundation, May 27, 1997.

The Component Object Model Specification, Version 0.9, Microsoft Corporation, (available from Microsoft's FTP site), October 24, 1995.

Kraig Brockschmidt , Inside OLE, Second Edition, Microsoft Press, Redmond, WA, 1995.

OLE Automation Programming Reference, Microsoft Press, Redmond, WA, 1996.

OLE 2 Programming Reference, Vol. 1, Microsoft Press, Redmond, WA, 1994.

The OPC Data Access Custom Interface Specification 2.0, OPC Foundation 1998.

The OPC Alarms and Events Specification 1.0, OPC Foundation 1998

The OPC Common Definition and Interface Specification Version 1.0, OPC Foundation, 1998

1.6. Audience

This document is intended to be used as reference material for developers of OPC compliant historical clients and servers. It is assumed that the reader is familiar with Microsoft OLE/COM technology, the needs of the process control industry and the OPC Data 2.0 specification.

This specification is intended to facilitate development of OPC Servers in C and C++, and of OPC client applications in the language of choice. Therefore, the developer of the respective component is expected to be fluent in the technology required for the specific component.

1.7. Deliverables

The deliverables from the OPC Foundation with respect to the OPC Historical Specification 1.2 include the Specification itself, OPC IDL files (included in this document as Appendices), an Automation Interface Wrapper, and the OPC Error header files (included in this document). As a convenience, standard proxy stub DLLs and a standard Historical Header file for the OPC interfaces generated directly from the IDL will be provided at the OPC Foundation Web Site.

This OPC Historical specification contains design information for the following:

1. **The OPC Historical Custom Interface** - This section will describe the Interfaces and Methods of OPC Components and Objects.

1.8. HDA Errata

Any errors, omissions or corrections to this OPC Historical Specification will be posted to the OPC HDA Errata topic of the OPC foundation forums:

http://www.opcfoundation.org/forum/viewtopic.php?p=1137

2. OPC-HDA Fundamentals

2.1. Overview

This specification describes the OPC COM Objects and their interfaces implemented by OPC Historical Servers. An OPC Client can connect to OPC Historical Servers provided by one or more vendors. Different vendors may provide OPC Historian Servers. Vendor supplied code determines the data to which each server has access, the data names, and the details about how the server physically accesses that data. Vendors may also provide other OPC Servers along with their OPC Historical Data server, but they are not required to. The following figure illustrates possible OPC Vendor server configurations:

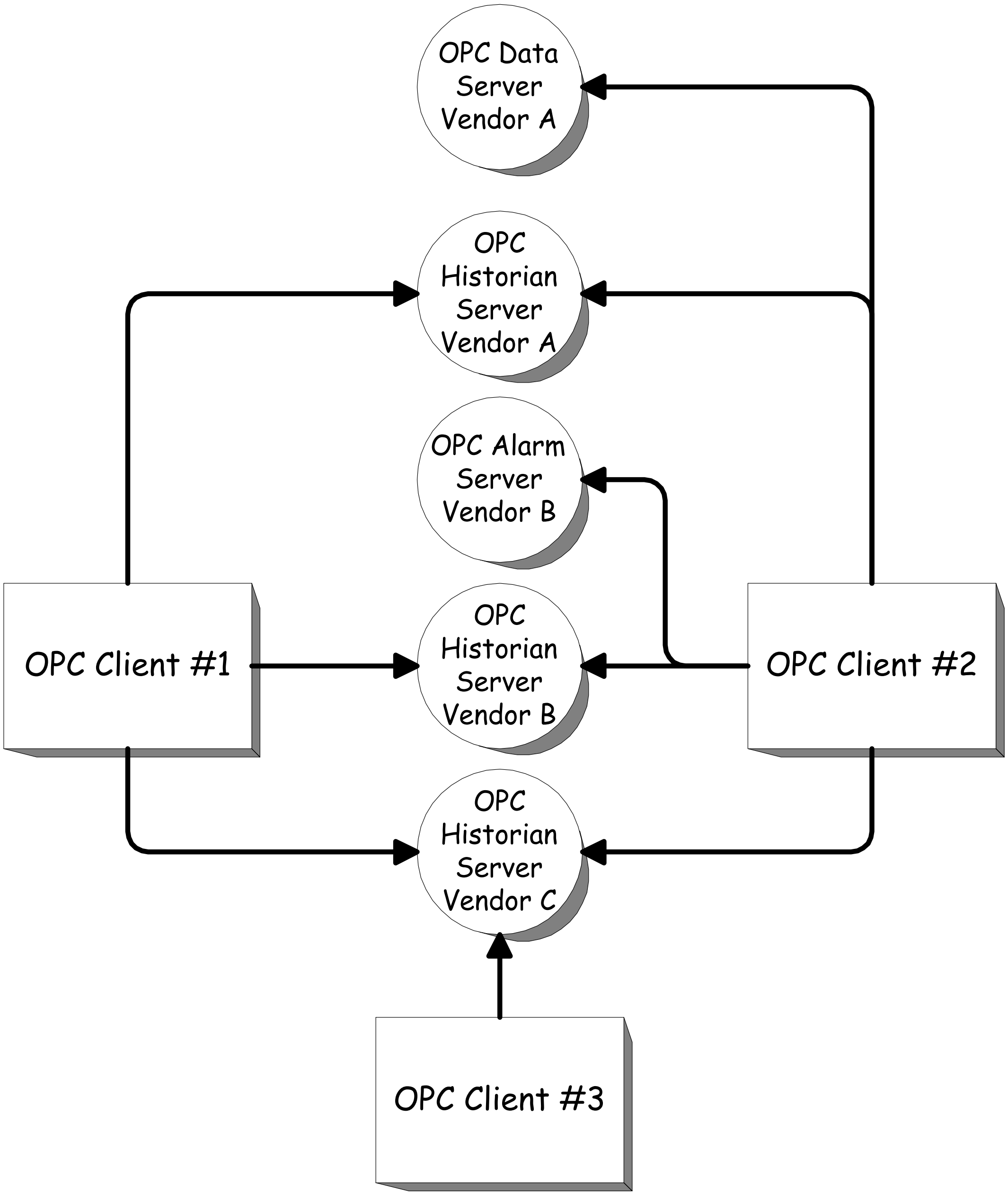

OPC Data Server Vendor A
OPC Historian Server Vendor A
OPC Alarm Server Vendor B
OPC Historian Server Vendor B
OPC Historian Server Vendor C
OPC Client #1
OPC Client #2
OPC Client #3

Figure 1 - Server Interactions

Any vendor, even a vendor that does not provide a server, can provide the clients. The client should be able to function with any of the servers. If another OPC server is required (such as Data Access server) for full functionality, the client should still be able to operate on Historical data without the other OPC server.

2.2. Data Sources

The OPC Historical Data Server provides a way to access or communicate to a set of Historical data sources. The types of sources available are a function of the server implementation.

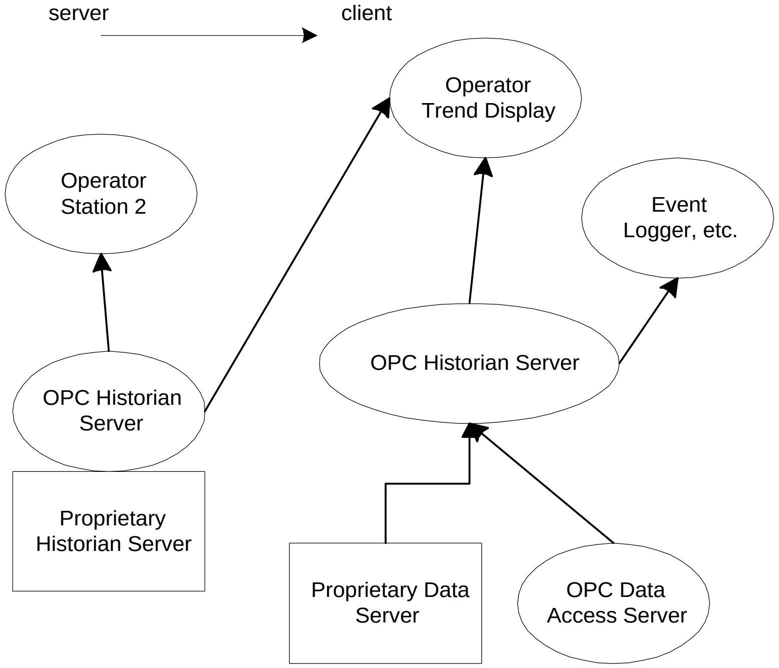
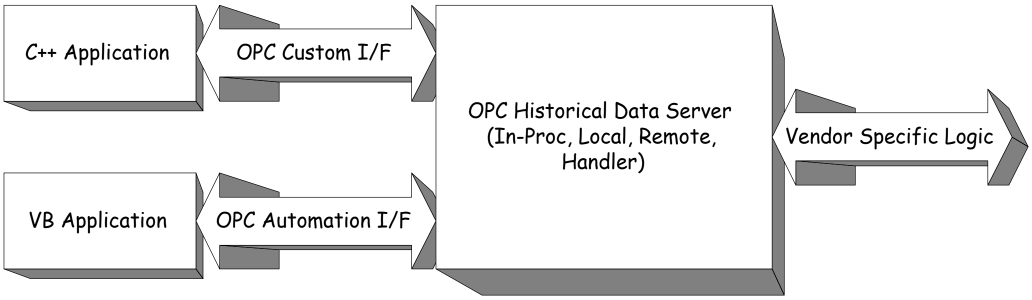


Figure 2 - Possible OPC Historian Servers

The server may be implemented as a stand alone OPC Historical Data Server that collects data from an OPC Data Access server or another data source. It may also be a set of interfaces that are layered on top of an existing Proprietary Historical Data Server. The clients that reference the OPC Historical Data server may be simple trending packages that just want values over a given time frame or they may be complex reports that require data in multiple formats.

2.3. General Architecture and components

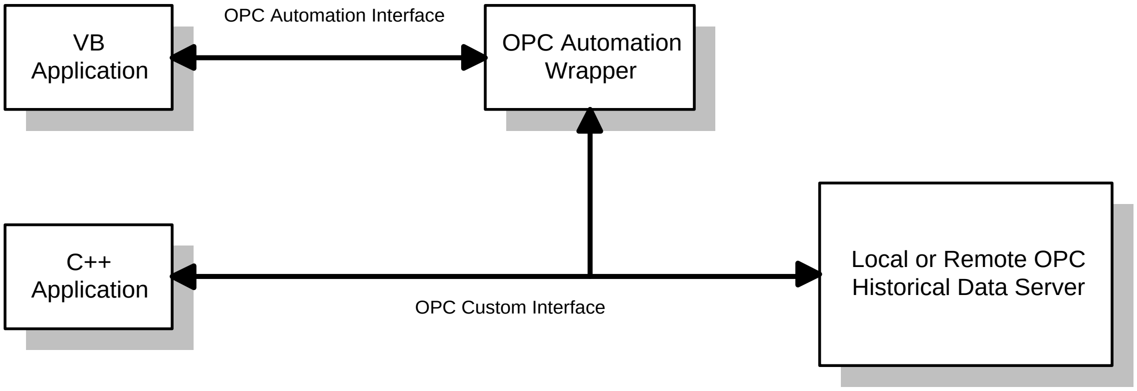
An OPC client application communicates to an OPC Historical Data server through the specified OPC custom and automation interfaces. OPC Historical Data servers must implement the custom interface, and optionally may implement the automation interface.



The OPC Specification specifies COM interfaces (what the interfaces are), not the implementation (not the how of the implementation) of those interfaces. It specifies the behavior that the interfaces are expected to provide to the client applications that use them.

Included are descriptions of architectures and interfaces that seemed most appropriate for those architectures. Like all COM implementations, the architecture of OPC is a client-server model where the OPC Server component provides an interface to the OPC objects and manages them.

An inproc (OPC handler) may be used to marshal the interface and provide the additional Item level functionality of the OPC Automation Interface.



The OPC automation interface may be implemented via a wrapper. A generic wrapper is provided by the OPC foundation. This wrapper would provide the automation interface for any Custom interface.

2.4. Overview of Object and Interfaces

The OPC Historical Data server objects provide the ability to read data from a historical server and write data to a historical server. The types of historical data are server dependent. All COM objects are accessed through Interfaces. The client sees only the interfaces. Thus, the objects described here are 'logical' representations which may not have anything to do with the actual internal implementation of the server. The following figures are a summary of the OPC Objects and their interfaces. Note that some of the interfaces are Optional (as indicated by [ ]).

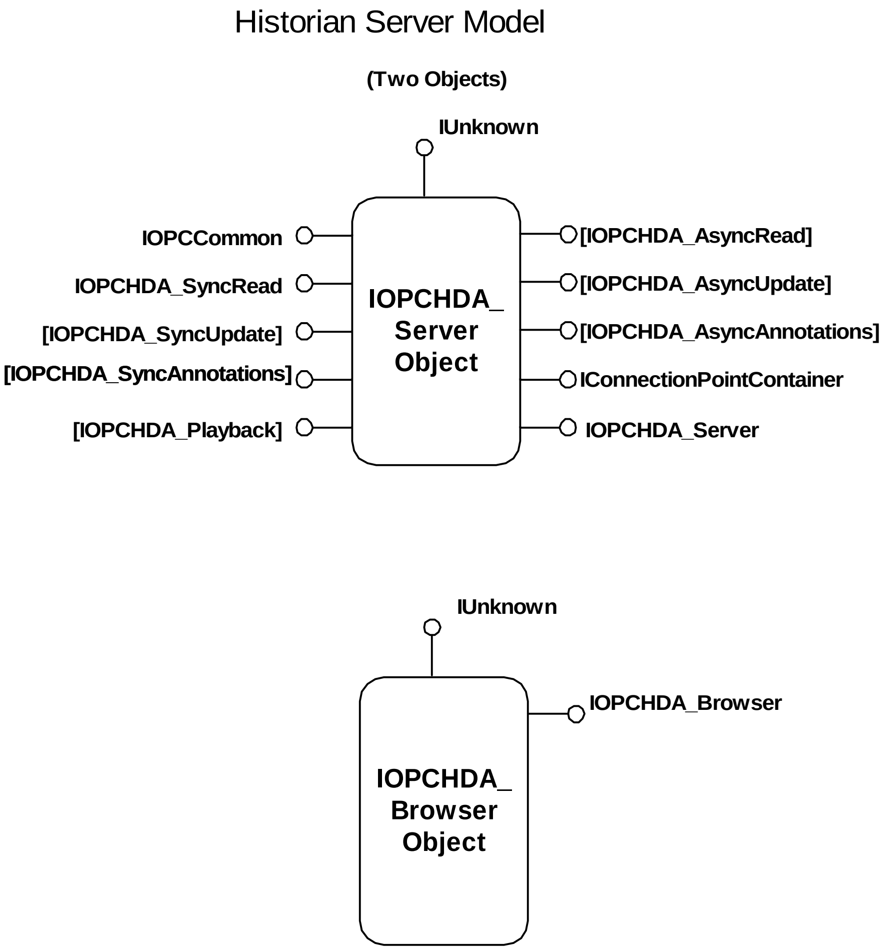


Figure 3 - Model Overview

The browser interface provides a method for the client to review the address space of the historian. It is expected that this address space may be hierarchical for some servers and flat for others. This interface is designed to support the hierarchical view, with a flat address space represented as a single level hierarchical view. The browser interface is essential in most large historical data servers, it allows a client to review the address space in a simple graphical manner.

An OPC Historian Client application must implement a callback interface to support a shutdown request. The client may also implement interfaces for the various asynchronous connections that a server may provide. If the client expects to use (and the server provides) a particular asynchronous interface, the client must implement the matching callback.

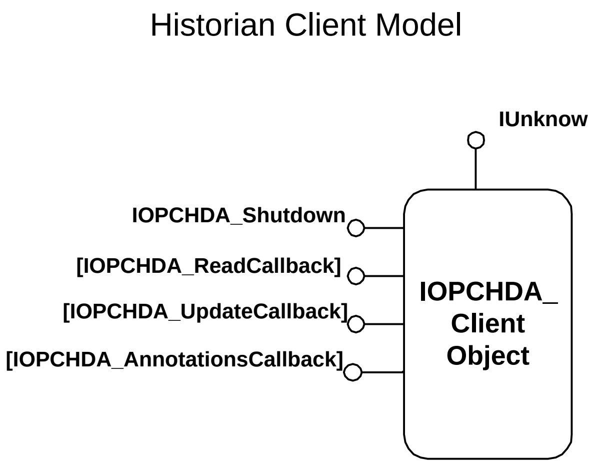


Figure 4 - Client Model Overview

The shutdown request is required to allow the OPC Historical Data Server to shutdown cleanly. When accessed by the HDA server, the client should free server provided memory (see Custom interface memory section) and terminate all connections.

2.5. Required Interface Definition

OPC Historical Data server developers **must** implement all methods of required interfaces, and must implement all functionality of required methods. An OPC Historical client communicates to an OPC Historical Data server by calling functions from the OPC required interfaces. An OPC Historical Data server may return E_NOTIMPL for optional methods on required interfaces.

2.6. Optional Interface Definition

OPC Historical Data server developers **may** implement the functionality of the optional interfaces. When an OPC Historical Data server supports an optional interface, all functions within that optional interface must be implemented, even if the function just returns E_NOTIMPL. An OPC Historical client that wishes to use the functionality of an optional interface will query the OPC Historical Data server for the optional interface. The client must be designed to not require that this optional interface exist.

2.7. Definitions

The following terms and concepts used in this specification are commonly used in Historians but can be defined by different vendors to have slightly different definitions. Their definitions as used in this specification are listed below.

Attribute – An additional qualifier that a particular item may have associated with it. For example, an “Item Value” attribute would probably have the following attributes associated with it: “Data Type” (VT_R4), “Stepped” (0) and “Archiving”(1)., i.e. the “Item Value” returns a 4-byte real number, the value can be displayed as interpolated (sloped line) and data is being archived .

Aggregates – Methods that summarize data values. Common aggregates include Averages over a given time range, Minimum over a time range and Maximum over a time range. These aggregates are performed during the retrieval of the data.

Annotations - An operator or user entered comment that is associated with an item, usually at a given instance in time. There does not have to be a value stored at that time.

Bounding Values - Bounding values are required by clients to determine the entry and exit points when requesting raw data over a time range. If a raw data value exists at the entry or exit point, it is considered the bounding value even though it is part of the data request. If no raw data value exists at the entry or exit point, the next data point outside of the range is considered the bounding value.

Interpolated Data – Data that is derived from the data in the archive, but for which there is no stored value. This may be linearly derived from two stored data points on either side of the requested timestamp, or it may be extrapolated from the data in the archive by a more complex method.

Item Handles – The ItemHandle can be either a client or server value. It is used by the owner to speed access to the items. Its data type is OPCHandle (DWORD).

It is expected that a client will assign a unique value to the client handle if it intends to use any of the asynchronous functions of the OPC HDA interfaces. However, the server should not make any assumptions about the client handle and the client should not make any assumptions about the server handle. Uniqueness of the item handles are implementation dependent.

Item ID - The character string that is a unique reference to a data item in the server address space.

Modified values – A value that has been changed after it was stored in the historian. A lab data entry value is not a modified value, but if a user corrects a lab value, the original value would be considered a modified value, and would be returned on a request for modified values. All methods on all interfaces are assumed to be based upon the current, or most recent, value for the specified Item at the specified timestamp. Requests for modified values are used to access values that have been superseded.

Properties – Within the Automation interface, properties are attributes of the history server that indicate how it operates.

Raw Data - Data that is stored within the historian. The data may be compressed or may be all data collected for the item depending on the historian and the storage rules invoked when the item values were saved.

Start Time / End Time – The times bounding a history request, which define the time domain of the request. For all requests, a value falling at the end of the time domain is not included in the domain, so that requests made for successive, contiguous time domains will include every value in the archive exactly once. See the examples section below.

Time Domain - The interval of time covered by a particular request, or by a particular response. In general, if the start time is earlier than the end time, the time domain is considered to begin at the start time and end just before the end time; if the end time is earlier than the start time, the time domain still begins at the start time and ends just before the end time, with time "running backward" for the particular request and response. In both cases, any value which falls exactly at the end time of the time domain is not included in the domain. See the examples section below.

Note that all timestamps which can legally be represented in a FILETIME are valid timestamps, and the server may not return E_INVALIDARG due to the timestamp being outside of the range for which the server has data. Servers are expected to handle out-of-bounds timestamps gracefully, and return the proper error codes and value to clients, such as OPC_S_NODATA or OPCHDA_NOBOUND.

2.8. Bounding values and Time Domain

As stated above in the Fundamental Concepts, the time domain includes all values between the start and end time, and any value that falls exactly on the start time, but not any value that falls exactly on the end time. Thus, for cases where bounding values are not requested, if data is requested from 1:00 to 1:05, and then from 1:05 to 1:10, a value that exists at exactly 1:05 would be included in the second request, but not in the first.

Given that a historian has values stored at 5:00, 5:02, 5:03, 5:05 and 5:06, the data returned from a RAW data call is given by the following table. In the table, FIRST stands for a tuple with a value of

VT_EMPTY, a timestamp of the specified StartTime, and a quality of OPCHDA_NOBOUND. LAST stands for a tuple with a value of VT_EMPTY, a timestamp of the specified EndTime, and a quality of OPCHDA_NOBOUND.

Start Time	End Time	dwNumValues	Bounds	Data Returned
5:00	5:05	0	Yes	5:00, 5:02, 5:03, 5:05
5:00	5:05	0	No	5:00, 5:02, 5:03
5:01	5:04	0	Yes	5:00, 5:02, 5:03, 5:05
5:01	5:04	0	No	5:02, 5:03
5:05	5:00	0	Yes	5:05, 5:03, 5:02, 5:00
5:05	5:00	0	No	5:05, 5:03, 5:02
5:04	5:01	0	Yes	5:05, 5:03, 5:02, 5:00
5:04	5:01	0	No	5:03, 5:02
4:59	5:05	0	Yes	FIRST, 5:00, 5:02, 5:03, 5:05
4:59	5:05	0	No	5:00, 5:02, 5:03, 5:05
5:01	5:07	0	Yes	5:00, 5:02, 5:03, 5:05, 5:06, LAST
5:01	5:07	0	No	5:02, 5:03, 5:05, 5:06
5:00	5:05	3	Yes	5:00, 5:02, 5:03
5:00	5:05	3	No	5:00, 5:02, 5:03
5:01	5:04	3	Yes	5:00, 5:02, 5:03
5:01	5:04	3	No	5:02, 5:03
5:05	5:00	3	Yes	5:05, 5:03, 5:02
5:05	5:00	3	No	5:05, 5:03, 5:02
5:04	5:01	3	Yes	5:05, 5:03, 5:02
5:04	5:01	3	No	5:03, 5:02
4:59	5:05	3	Yes	FIRST, 5:00, 5:02
4:59	5:05	3	No	5:00, 5:02, 5:03
5:01	5:07	3	Yes	5:00, 5:02, 5:03
5:01	5:07	3	No	5:02, 5:03, 5:05
5:00	NULL	3	Yes	5:00, 5:02, 5:03
5:00	NULL	3	No	5:00, 5:02, 5:03
5:00	NULL	6	Yes	5:00, 5:02, 5:03, 5:05, 5:06
5:00	NULL	6	No	5:00, 5:02, 5:03, 5:05, 5:06
NULL	5:06	3	Yes	5:00, 5:02, 5:03
NULL	5:06	3	No	5:00, 5:02, 5:03
NULL	5:06	6	Yes	5:00, 5:02, 5:03, 5:05, 5:06
NULL	5:06	6	No	5:00, 5:02, 5:03, 5:05, 5:06

2.9. Aggregates

The purpose of this section is to detail the requirements and behaviour for HDA aggregates. The intent is to standardise the HDA aggregates such that HDA clients can reliably predict the results of an aggregate computation and understand its meaning. If users require custom functionality in the aggregates, those aggregates should be written as custom aggregates.

The standard aggregates must be as consistent as possible, meaning that each aggregate’s behavior must be similar to every other aggregate’s behavior where input parameters, raw data, and boundary conditions are similar. Where possible, the aggregates should deal with input and preconditions in a similar manner.
This section is divided up into two parts. The first sub section deals with aggregate characteristics and behavior that are common to all aggregates. The remaining sub sections deal with the characteristics and behavior of aggregates that are aggregate-specific.

2.9.1. Common Characteristics

This sub section deals with aggregate characteristics and behavior that are common to all aggregates.

2.9.1.1. Generating Intervals

To read aggregates, OPC clients must specify three time parameters:

- start time (Start)
- end time (End)
- resample interval (Int)

The OPC server must use these three parameters to generate a sequence of time intervals and then calculate an aggregate for each interval. This section specifies, given the three parameters, which time intervals are generated. In the table, we define Range to be |End - Start|.

Start/End Time	Resample Interval	Resulting Intervals
$Start = End$	*Int* = Anything	No intervals. Returns E_INVALIDARG, regardless of whether there is data at the specified time or not.
$Start < End$	$Int = 0$ or $Int \geq Range$	One interval, starting at *Start* and ending at *End*. Includes *Start*, excludes *End*, i.e., $[Start, End)$.
$Start < End$	$Int \neq 0$, $Int < Range$, *Int* divides *Range* evenly.	*Range/Int* intervals. Intervals are $[Start, Start + Int)$, $[Start + Int, Start + 2 * Int)$,..., $[End - Int, End)$.
$Start < End$	$Int \neq 0$, $Int < Range$, *Int* does not divide *Range* evenly.	$\lceil Range/Int \rceil$ intervals. Intervals are $[Start, Start + Int)$, $[Start + Int, Start + 2 * Int)$,..., $[Start + (\lfloor Range/Int \rfloor - 1) * Int, Start + \lfloor Range/Int \rfloor * Int)$, $[Start + \lfloor Range/Int \rfloor * Int, End)$. In other words, the last interval contains the “rest” that remains in the range after taking away $\lfloor Range/Int \rfloor$ intervals of size *Int*.
$Start > End$	$Int = 0$ or $Int \geq Range$	One interval, starting at *Start* and ending at *End*. Includes *Start*, excludes *End*, i.e., $[End, Start)$.
$Start > End$	$Int \neq 0$, $Int < Range$, *Int* divides *Range* evenly.	*Range/Int* intervals. Intervals are $[Start - Int, Start]$, $[Start – 2 * Int, Start – Int)$,..., $[End, End + Int)$.
$Start > End$	$Int \neq 0$, $Int < Range$, *Int* does not divide *Range* evenly.	$\lceil Range/Int \rceil$ intervals. Intervals are $[Start - Int, Start)$, $[Start – 2 * Int, Start - Int)$,..., $[Start - \lfloor Range/Int \rfloor * Int, Start – (\lfloor Range/Int \rfloor - 1) * Int)$, $[End, Start - \lfloor Range/Int \rfloor * Int)$. In other words, the last interval contains the “rest” that remains in the range after taking away $\lfloor Range/Int \rfloor$ intervals of size *Int* starting at Start.

2.9.1.2. Data Types

All of the following aggregates will only work with numeric data types – i.e. integers or real/floating point numbers. Dates, strings, arrays, etc. are not supported.

However, in some cases the OPC servers may have item types of non-numeric type (i.e. “VT_BSTR”), but the item actually represents a numeric value. Therefore, each aggregate must attempt conversions of the item value to a numeric type using VariantChangeType. This must be done for every item in the raw history list.

If any item in an interval fails to be converted, it should not be used in the aggregate calculation, and the aggregate should have an uncertain/subnormal quality. If all items fail to be converted in an interval, the aggregate placeholder should return a quality of bad, OPCHDA_CONVERSION.

2.9.1.3. Quality

All aggregates should omit bad data values from the calculation. If any values are omitted, the aggregate quality should be uncertain/subnormal.

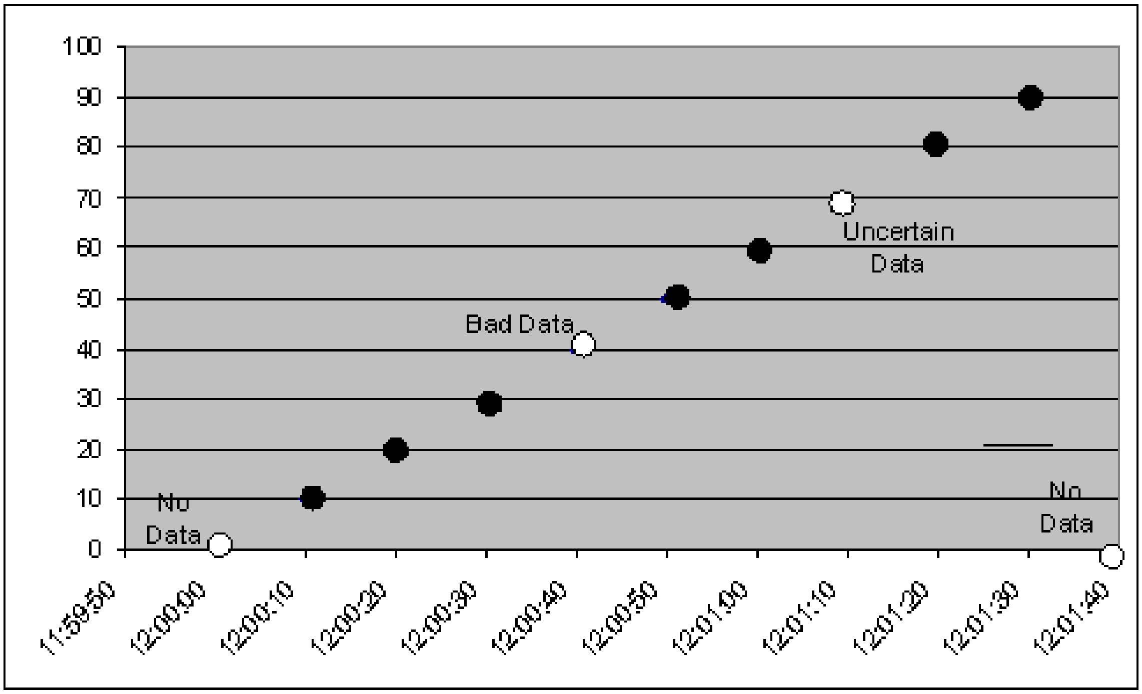
In some cases, there will be values which are uncertain (i.e. neither good, nor bad). It will be server dependant as to whether or not these values are omitted from the aggregate call. The server documentation must clearly state how the server will treat uncertain values. If uncertain values are used in the aggregate calculation, the quality should be uncertain/subnormal for those intervals.

2.9.2. Aggregate Specific characteristics

2.9.2.1. Example aggregate data – Historian 1

For the purposes of examples consider a source historian with the following data:

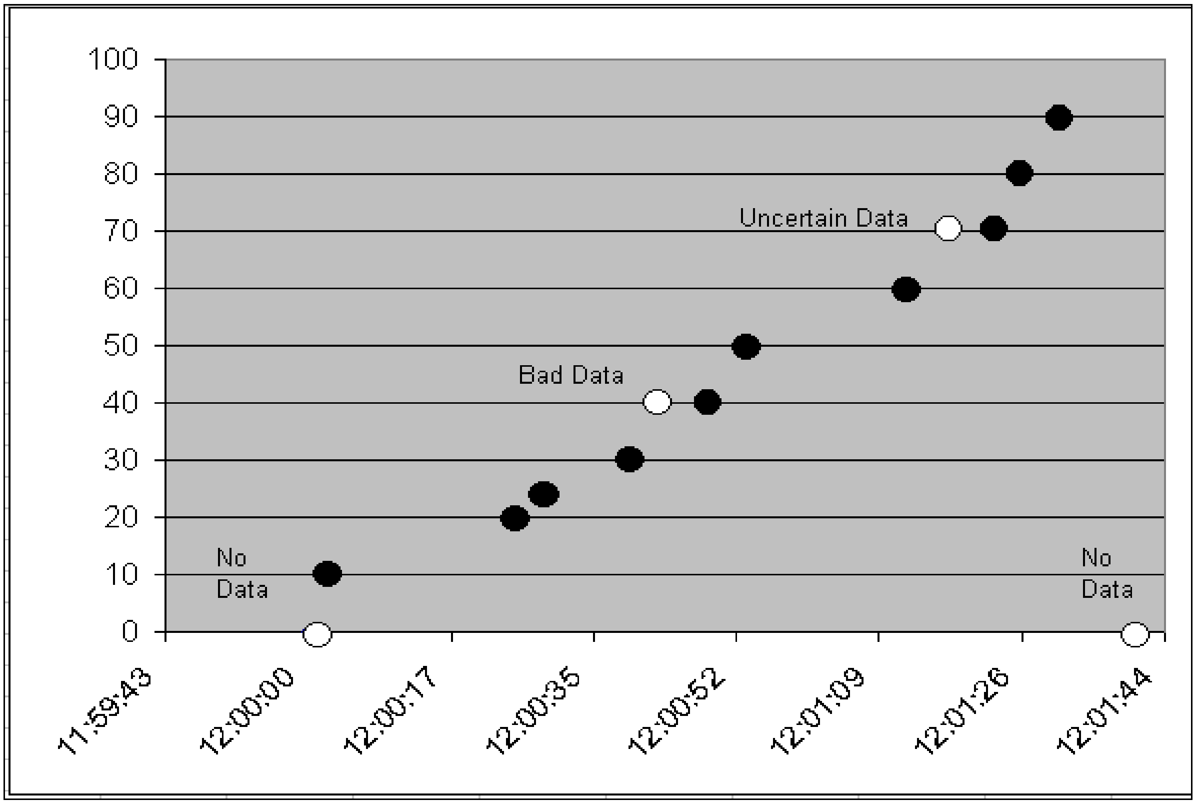
Timestamp	Value	Quality	Notes
Jan-01-2002 12:00:00	0	No Data	First archive entry, Point Created
Jan-01-2002 12:00:10	10	Raw, Good	
Jan-01-2002 12:00:20	20	Raw, Good	
Jan-01-2002 12:00:30	30	Raw, Good	
Jan-01-2002 12:00:40	40	Raw, Bad	Scan failed, Bad data entered
Jan-01-2002 12:00:50	50	Raw, Good	
Jan-01-2002 12:01:00	60	Raw, Good	
Jan-01-2002 12:01:10	70	Raw, Uncertain	Value is flagged as questionable
Jan-01-2002 12:01:20	80	Raw, Good	
Jan-01-2002 12:01:30	90	Raw, Good	
	NULL	No Data	No more entries, awaiting next scan.



2.9.2.2. Example aggregate data – Historian 2

The following data is also include in a separate column to illustrate non-periodic data

Timestamp	Value	Quality	Notes
Jan-01-2002 12:00:00	0	No Data	First archive entry, Point Created
Jan-01-2002 12:00:02	10	Raw, Good	
Jan-01-2002 12:00:25	20	Raw, Good	
Jan-01-2002 12:00:28	25	Raw, Good	
Jan-01-2002 12:00:39	30	Raw, Good	
Jan-01-2002 12:00:42	40	Raw, Bad	Bad quality data received, Bad data entered
Jan-01-2002 12:00:48	40	Raw, Good	Received good quality value
Jan-01-2002 12:00:52	50	Raw, Good	
Jan-01-2002 12:01:12	60	Raw, Good	
Jan-01-2002 12:01:17	70	Raw, Uncertain	Value is flagged as questionable
Jan-01-2002 12:01:23	70	Raw, Good	
Jan-01-2002 12:01:26	80	Raw, Good	
Jan-01-2002 12:01:30	90	Raw, Good	
	NULL	No Data	No more entries, awaiting next value.



2.9.2.3. Example Conditions

For the purposes of all examples,

Historian 1

1. Uncertain values are included in aggregate call.
2. Linear interpolation is used between data points.
3. Stepped extrapolation is used at end boundary conditions

Historian 2

1. Uncertain values are treated as bad quality, and not included in the aggregate call.
2. Linear interpolation is used between data points.
3. Stepped extrapolation is used at end boundary conditions

2.9.2.4. INTERPOLATIVE

In order for the interpolative aggregate to return meaningful data, there must be good values at the boundary conditions. For the purposes of discussion we will use the terms good and non-good. As discussed in the Quality section, what is represented by non-good is server dependant. For some servers non-good represents only bad data, for others it represents bad and uncertain data.

When a non-good value is encountered at a boundary condition, the following rules must be followed:

- If the value at the requested time is non-good, the aggregate looks for good data on both sides of the requested time in order to perform straight line interpolation.

- If there is no end bound (i.e future time), the value should be extrapolated forward in time from the previous good value. In this case the quality would be subnormal.
- The aggregate should not extrapolate backwards in time. If there is no beginning bound, it should return OPCHDANO_DATA. The trailing value should not be pulled forward in time.
- If there happens to be a good raw value at the requested time, the raw value is returned.
- The method of interpolation, stepped (i.e. hold last value) or linear straight line interpolation, will be server dependant. The server documentation must clearly state the method used.
- If any non-good values are skipped in order to find the closest good value, the aggregate will be uncertain/subnormal
- All interval aggregates return timestamp of the start of the interval. Unless otherwise indicated, qualities are good, interpolative.

The following examples demonstrate the various situations:

Case 4.1. Requesting data with good bounding value.
Start: Jan-01-2002 12:00:10 **End:** Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-02 12:00:10	10	Raw, Good	13.4	Interpolated, Good	Value2 –Interpolated between values at 12:00:02 and 12:00:25
Jan-01-02 12:00:15	15	Interpolated, Good	15.6	Interpolated, Good	Value2 –Interpolated between values at 12:00:02 and 12:00:25

Case 4.2. Requesting data with good bounding value with bad data in the interval.
Start: Jan-01-2002 12:00:35 **End:** Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-02 12:00:35	35	Interpolated, Uncertain	28.2	Interpolated, Good	Value2 –Interpolated between values at 12:00:28 and 12:00:39
Jan-01-02 12:00:40	40	Interpolated, Uncertain	31.1	Interpolated, Uncertain	Raw value is Bad, Value2 – Interpolated between values at 12:00:39 and 12:00:48
Jan-01-02 12:00:45	45	Interpolated, Uncertain	36.7	Interpolated, Uncertain	Bounding value Bad, Value2 – Interpolated between values at 12:00:39 and 12:00:48
Jan-01-02 12:00:50	50	Raw, Good	50	Interpolated, Good	
Jan-01-02 12:00:55	55	Interpolated, Good	51.5	Interpolated, Good	

Case 4.3. Requesting data with no good end bounding value.
Start: Jan-01-2002 12:01:20 **End:** Jan-01-2002 12:01:40 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-02 12:01:20	80	Raw, Good	67.3*	Interpolated, Uncertain	Uncertain values excluded. Value2 –Interpolated between values at 12:00:12 and 12:01:23
Jan-01-02 12:01:25	85	Interpolated, Good	76.6	Interpolated, Good	
Jan-01-02 12:01:30	90	Raw, Good	90	Raw, Good	

Jan-01-02 12:01:35	90	Interpolated, Uncertain	90	Interpolated, Uncertain	Bounding value at 12:01:30, Extrapolated using stepped method

* If Historian 2 had treated Uncertian values as Good. The value would be 70, interpolated between 12:00:17 and 12:00:23.

Case 4.4. Requesting data with no good start bounding value.
Start: Jan-01-2002 12:00:00 **End:** Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:00	0	No Data, Bad	0	No Data, Bad	No bounding value, do not extrapolate
Jan-01-2002 12:00:05	0	No Data, Bad	11.3	Interpolated, Good	Value 1 - No bounding value, do not extrapolate Value2 –Interpolated between values at 12:00:02 and 12:00:25
Jan-01-2002 12:00:10	10	Raw, Good	13.4	Interpolated, Good	Value2 –Interpolated between values at 12:00:02 and 12:00:25
Jan-01-2002 12:00:15	15	Interpolated, Good	15.6	Interpolated, Good	Value2 –Interpolated between values at 12:00:02 and 12:00:25

2.9.2.5. TIMEAVERAGE

The time weighted average aggregate uses interpolation as described in the interpolated section above to find the value of a point at the beginning and end of an interval. A straight line is drawn between each raw value in the interval. The area under the line is divided by the length of the interval to yield the average.

For Example:
Given:
Start: Jan-01-2002 12:00:10
End: Jan-01-2002 12:00:15
Interval: 00:00:05
Then:
Point1 = Good Raw value of 10 at 12:00:10
Point2 = interpolated value of 15 at 12:00:15, using bounding values at 12:00:10 and 12:00:20.
Area under the line is 62.5 (1/2b*h + b*h). Interval is 5 seconds
TimeAverage = Area/interval = 12.5

If any of an interval's raw values are non-good, they are ignored, and the aggregate quality for that interval is uncertain/subnormal.

All interval aggregates return timestamp of the start of the interval. Unless otherwise indicated, qualities are
good, calculated.
All cases use the interpolated values determined in Case 4.x

Case 5.1. Requesting data with good bounding value.
Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**	**Historian 2**	**Notes**

	Value	Quality	Value	Quality	
Jan-01-2002 12:00:10	12.5	Calculated, Good	14.5	Calculated, Good	Area under the line between 12:00:10 and 12:00:15 divided by inteval length of 5
Jan-01-2002 12:00:15	17.5	Calculated, Good	16.7	Calculated, Good	

Case 5.2. Requesting data with good bounding value with bad data in the interval.
Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:35	37.5	Calculated, Uncertain	29.7	Calculated, Uncertian	Value1– Interpolate values at :35 and :40 using bounds at :30 and :50 Value2– Interpolate values at :35 and :40 using bounds at :28 and :48 Uncertian means Bad value ignored
Jan-01-2002 12:00:40	42.5	Calculated, Uncertain	33.9	Calculated Uncertain	Value1– Interpolate values at :40 and :45 using bounds at :30 and :50 Value2– Interpolate values at :40 and :45 using bounds at :39 and :48 Uncertian means Bad value ignored
Jan-01-2002 12:00:45	47.5	Calculated, Uncertain	40.9	Calculated Uncertain	Value1– Interpolate value at :45 using bounds at :30 and :50 Value2– Interpolate value at :45 using bounds at :39 and :48 Interpolate value at :50 using bounds at :48 and :52 Uncertian means Bad value ignored
Jan-01-2002 12:00:50	52.5	Calculated, Good	48.3	Calculated, Good	Value1– Interpolate value at :55 using bounds at :50 and 01:00 Value2– Interpolate value at :50 using bounds at :48 and :52 Interpolate value at :55 using bounds at :52 and :01:12
Jan-01-2002 12:00:55	57.5	Calculated, Good	52.8	Calculated, Good	Value1– Interpolate value at :55 using bounds at :50 and 01:00 Value2– Interpolate value at :50 using bounds at :48 and :52 Interpolate value at :55 using bounds at :52 and :01:12

Case 5.3. Requesting data with no good end bounding value.
Start: Jan-01-2002 12:01:20 **End**: Jan-01-2002 12:01:40 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	**Quality**	**Value**	**Quality**	

Jan-01-2002 12:01:20	82.5	Calculated, Good	67.3	Calculated Uncertain	Value1– Interpolate value at :25 using bounds at :20 and :30 Value2– Interpolate value at :20 using bounds at :16 and :23 (Uncertain value at :17 is ignored by this historian) Interpolate value at :25 using bounds at :23 and :26
Jan-01-2002 12:01:25	87.5	Calculated, Good	83.3	Calculated, Good	Value1– Interpolate value at :25 using bounds at :20 and :30 Value2– Interpolate value at :25 using bounds at :23 and :26
Jan-01-2002 12:01:30	90*	Calculated, Uncertain	90*	Calculated, Uncertain	Extrapolate value at :35 using value at :30
Jan-01-2002 12:01:35	90*	Calculated, Uncertain	90*	Calculated, Uncertain	Extrapolate values at :35 and :40 using value at :30

* Stepped extrapolation is used at the boundary. Servers may opt to extrapolate data based on the previous slope.

Case 5.4. Requesting data with no good start bounding value.
Start: Jan-01-2002 12:00:00 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:00	0	No Data, Bad	10.7	Partial, Uncertain	Value1-No bounding value, do not extrapolate. No data in the interval Value2- Interpolate value at :05 using bounds at :02 and :25 Use partial interval :02 to :05, with interval of 3.
Jan-01-2002 12:00:05	0	No Data, Bad	12.4	Calculated, Good	Value1-No bounding value, do not extrapolate. No data in the interval Value2- Interpolate values at :05 and 10 using bounds at :02 and :25
Jan-01-2002 12:00:10	12.5	Calculated, Good	14.5	Calculated, Good	Value1– Interpolate value at :15 using bounds at :10 and :20 Value2– Interpolate values at :10 and :15 using bounds at :02 and :25
Jan-01-2002 12:00:15	17.5	Calculated, Good	16.7	Calculated, Good	Value1– Interpolate value at :15 using bounds at :10 and :20 Value2– Interpolate values at :15 and :20 using bounds at :02 and :25

2.9.2.6. TOTAL

The total aggregate performs the following calculation for each interval:

Total = time_weighted_avg * interval_length (sec)

Where:

Time_weighted_avg is the result from the TIMEAVERAGE aggregate, using the interval supplied to the TOTAL call.

Interval_length is the interval of the aggregate.

The resulting units would be normalized to seconds, i.e. [time_weighted_avg Units]*sec.

All interval aggregates return timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated

2.9.2.7. AVERAGE

The average aggregate adds up the values of all good raw data in a given interval, and divides the sum by the number of good values. If any non-good values are ignored in the computation, the aggregate quality will be uncertain/subnormal.
If no good data exists for an interval, the quality of the aggregate for that interval will be bad, OPCHDA_NODATA.
All interval aggregates return timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated.

Case 7.1. Requesting data with good bounding value.
Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:10	10	Calculated, Good	0	No Data, Bad	Value2-No Raw data in interval
Jan-01-2002 12:00:15	0	No Data, Bad	0	No Data, Bad	No Raw data in intervals

Case 7.2. Requesting data with good bounding value with bad data in the interval.
Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:35	0	No Data, Bad	30	Calculated, Good	
Jan-01-2002 12:00:40	0	No Data, Bad	0	No Data, Bad	Value1-Only Bad data in interval Value 2- No data in interval
Jan-01-2002 12:00:45	0	No Data, Bad	40	Calculated, Good	Value 1- No data in interval
Jan-01-2002 12:00:50	50	Calculated, Good	50	Calculated, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	0	No Data, Bad	No data in intervals

Case 7.3. Requesting data with no good end bounding value.
Start: Jan-01-2002 12:01:20 **End**: Jan-01-2002 12:01:40 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:01:20	80	Calculated, Good	70	Calculated, Good	
Jan-01-2002 12:01:25	0	No Data, Bad	80	Calculated, Good	Value 1- No data in interval
Jan-01-2002 12:01:30	90	Calculated, Good	90	Calculated, Good	
Jan-01-2002 12:01:35	0	No Data, Bad	0	No Data, Bad	No data in intervals

Case 7.4. Requesting data with no good start bounding value.
Start: Jan-01-2002 12:00:00 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:00	0	No Data, Bad	10	Partial, Good	Value1- No data in interval Value2 - Parital interval :02-:05
Jan-01-2002 12:00:05	0	No Data, Bad	0	No Data, Bad	No data in intervals
Jan-01-2002 12:00:10	10	Calculated, Good	0	No Data, Bad	Value 2- No data in interval
Jan-01-2002 12:00:15	0	No Data, Bad	0	No Data, Bad	No data in intervals

2.9.2.8. COUNT

This aggregate retrieves a count of all the raw values within an interval. If one or more raw values are non-good, they are not included in the count, and the aggregate quality is uncertain/subnormal.
If no good data exists for an interval, the count is zero.
All interval aggregates return timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated.

Case 8.1. Requesting data with good bounding value.
Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:10	1	Calculated, Good	0	Calculated, Good	
Jan-01-2002 12:00:15	0	Calculated, Good	0	Calculated, Good	

Case 8.2. Requesting data with uncertain data in the interval.
Start: Jan-01-2002 12:00:50 **End**: Jan-01-2002 12:01:30 **Interval**: 00:00:00

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:50	4*	Calculated, Good	4	Calculated, Uncertain	Value2 treats uncertain as bad, which also changes quality

* Some servers may opt to treat uncertain data as bad, thus the result would be 3.

2.9.2.9. STDEV

The standard deviation aggregate uses the formula:

$$\sqrt{\frac{\sum_{i}^{n} (X - Avg(X))^{2}}{n - 1}}$$

Where X is each good raw value in the interval, Avg(X) is the average of the good raw values, and n is the number of good raw values in the interval.
For every intervals where n=1, then a value of 0 is returned.
If any non-good values were ignored, the aggregate quality is uncertain/subnormal.
All interval aggregates return timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated.

2.9.2.10. VARIANCE

The variance aggregate retrieves the square of the standard deviation. Its behaviour is the same as the standard deviation aggregate. Unless otherwise indicated, qualities are good, calculated.

2.9.2.11. MINIMUM ACTUAL TIME

The minimum actual time aggregate retrieves the minimum good raw value within the interval [s,e), and returns that value with the timestamp at which that value occurs. Note that if the same minimum exists at more than one timestamp, the oldest one is retrieved. If a non-good value is lower than the good minimum, the quality of the aggregate will be uncertain/subnormal.
Unless otherwise indicated, qualities are good, raw. If no values are in the interval no data is returned with a timestamp of the start of the interval

Case 11.1. Requesting data with good bounding value.

Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Notes
	Value	Quality	
Jan-01-2002 12:00:10	10	Raw, Good	
Jan-01-2002 12:00:15	0	No Data, Bad	No raw data in interval, do not interpolate

Timestamp	Historian 2		Notes
	Value	Quality	
Jan-01-2002 12:00:10	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:00:15	0	No Data, Bad	No raw data in interval, do not interpolate

Case 11.2. Requesting data with good bounding value with bad data in the interval.

Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	Historian 1		Notes
	Value	Quality	
Jan-01-2002 12:00:35	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:00:40	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:00:45	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:00:50	50	Raw, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	No raw data in interval, do not interpolate

Timestamp	Historian 2		Notes
	Value	Quality	
Jan-01-2002 12:00:39	30	Raw, Good	
Jan-01-2002 12:00:42	40	Raw, Bad	Only Bad data in interval
Jan-01-2002 12:00:48	40	Raw, Good	
Jan-01-2002 12:00:52	50	Raw, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	No raw data in interval, do not interpolate

Case 11.3. Requesting data with no good end bounding value.

Start: Jan-01-2002 12:01:20 **End**: Jan-01-2002 12:01:40 **Interval**: 00:00:05

Timestamp	Historian 1		Notes
	Value	Quality	
Jan-01-2002 12:01:20	80	Raw, Good	
Jan-01-2002 12:01:25	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:01:30	90	Raw, Good	
Jan-01-2002 12:01:35	0	No Data, Bad	

Timestamp	Historian 2		Notes
	Value	Quality	
Jan-01-2002 12:01:23	70	Raw, Good	
Jan-01-2002 12:01:26	80	Raw, Good	
Jan-01-2002 12:01:30	90	Raw, Good	
Jan-01-2002 12:01:35	0	No Data, Bad	

Case 11.4. Requesting data with no good start bounding value.

Start: Jan-01-2002 12:00:00 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Notes
	Value	Quality	

Jan-01-2002 12:00:00	0	No Data, Bad	
Jan-01-2002 12:00:05	0	No Data, Bad	
Jan-01-2002 12:00:10	10	Raw, Good	
Jan-01-2002 12:00:15	0	No Data, Bad	

Timestamp	Historian 2		Notes
	Value	Quality	
Jan-01-2002 12:00:02	10	Raw, Good	
Jan-01-2002 12:00:05	0	No Data, Bad	
Jan-01-2002 12:00:10	0	No Data, Bad	
Jan-01-2002 12:00:15	0	No Data, Bad	

Case 11.5. Partial Interval.
Start: Jan-01-2002 12:00:05 **End**: Jan-01-2002 12:00:35 **Interval**: 00:00:16

Timestamp	Historian 1		Notes
	Value	Quality	
Jan-01-2002 12:00:10	10	Raw, Good	
Jan-01-2002 12:00:30	30	Partial, Good	

Timestamp	Historian 2		Notes
	Value	Quality	
Jan-01-2002 12:00:05	0	No Data, Bad	
Jan-01-2002 12:00:25	20	Partial, Good	

2.9.2.12. MINIMUM

The minimum aggregate is the same as the minimum actual time, except the timestamp of the aggregate will always be the start of the interval for every interval.
Unless otherwise indicated, qualities are good, calculated.

Case 12.1. Requesting data with good bounding value.
Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:10	10	Raw, Good	0	No Data, Bad	
Jan-01-2002 12:00:15	0	No Data, Bad	0	No Data, Bad	

Case 12.2. Requesting data with good bounding value with bad data in the interval.
Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:35	0	No Data, Bad	30	Calculated, Good	
Jan-01-2002 12:00:40	0	No Data, Bad	40	Calculated, Bad	Value1- Only Bad data in interval.
Jan-01-2002 12:00:45	0	No Data, Bad	40	Calculated, Good	
Jan-01-2002 12:00:50	50	Raw, Good	50	Calculated, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	0	No Data, Bad	

Case 12.3. Requesting data with no good end bounding value.
Start: Jan-01-2002 12:01:20 **End**: Jan-01-2002 12:01:40 **Interval**: 00:00:05

Timestamp	Historian 1	Historian 2	Notes

	Value	Quality	Value	Quality	
Jan-01-2002 12:01:20	80	Raw, Good	70	Calculated Good	
Jan-01-2002 12:01:25	0	No Data, Bad	80	Calculated Good	
Jan-01-2002 12:01:30	90	Raw, Good	90	Raw, Good	
Jan-01-2002 12:01:35	0	No Data, Bad	0	No Data, Bad	

Case 12.4. Requesting data with no good start bounding value.
Start: Jan-01-2002 12:00:00 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:00	0	No Data, Bad	10	Calculated Good	
Jan-01-2002 12:00:05	0	No Data, Bad	0	No Data, Bad	
Jan-01-2002 12:00:10	10	Raw, Good	0	No Data, Bad	
Jan-01-2002 12:00:15	0	No Data, Bad	0	No Data, Bad	

Case 12.5. Partial Interval.
Start: Jan-01-2002 12:00:05 **End**: Jan-01-2002 12:00:35 **Interval**: 00:00:16

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:05	10	Raw, Good	0	No Data, Bad	
Jan-01-2002 12:00:21	30	Partial, Good	20	Partial, Good	

2.9.2.13. MAXIMUM ACTUAL TIME

This is the same as the minimum actual time aggregate, except that the value is the maximum raw value within the interval [s,e). Note that if the same maximum exists at more than one timestamp, the oldest one is retrieved.
Unless otherwise indicated, qualities are good, raw.

Case 13.1. Requesting data with good bounding value.
Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Notes
	Value	Quality	
Jan-01-2002 12:00:10	10	Raw, Good	
Jan-01-2002 12:00:15	0	No Data, Bad	No raw data in interval, do not interpolate

Timestamp	Historian 2		Notes
	Value	Quality	
Jan-01-2002 12:00:10	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:00:15	0	No Data, Bad	No raw data in interval, do not interpolate

Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	Historian 1		Notes
	Value	Quality	
Jan-01-2002 12:00:35	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:00:40	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:00:45	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:00:50	50	Raw, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	No raw data in interval, do not interpolate

Timestamp	Historian 2	Notes

	Value	**Quality**	
Jan-01-2002 12:00:39	30	Raw, Good	
Jan-01-2002 12:00:42	40	Raw, Bad	Only Bad data in interval
Jan-01-2002 12:00:48	40	Raw, Good	
Jan-01-2002 12:00:52	50	Raw, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	No raw data in interval, do not interpolate

Case 13.2. Requesting data with no good end bounding value.
Start: Jan-01-2002 12:01:20 **End**: Jan-01-2002 12:01:40 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:01:20	80	Raw, Good	
Jan-01-2002 12:01:25	0	No Data, Bad	No raw data in interval, do not interpolate
Jan-01-2002 12:01:30	90	Raw, Good	
Jan-01-2002 12:01:35	0	No Data, Bad	

Timestamp	**Historian 2**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:01:23	70	Raw, Good	
Jan-01-2002 12:01:26	80	Raw, Good	
Jan-01-2002 12:01:30	90	Raw, Good	
Jan-01-2002 12:01:35	0	No Data, Bad	

Case 13.3. Requesting data with no good start bounding value.
Start: Jan-01-2002 12:00:00 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:00	0	No Data, Bad	
Jan-01-2002 12:00:05	0	No Data, Bad	
Jan-01-2002 12:00:10	10	Raw, Good	
Jan-01-2002 12:00:15	0	No Data, Bad	

Timestamp	**Historian 2**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:02	10	Raw, Good	
Jan-01-2002 12:00:05	0	No Data, Bad	
Jan-01-2002 12:00:10	0	No Data, Bad	
Jan-01-2002 12:00:15	0	No Data, Bad	

Case 13.4. Partial Interval.
Start: Jan-01-2002 12:00:05 **End**: Jan-01-2002 12:00:35 **Interval**: 00:00:16

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:10	10	Raw, Good	
Jan-01-2002 12:00:30	30	Partial, Good	

Timestamp	**Historian 2**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:05	0	No Data, Bad	

Jan-01-2002 12:00:28	25	Partial, Good	

2.9.2.14. MAXIMUM

This aggregate is the same as the minimum, except the value is the maximum raw value within the interval [s,e).

Unless otherwise indicated, qualities are good, calculated.

Case 14.1. Requesting data with good bounding value.

Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:10	10	Raw, Good	0	No Data, Bad	
Jan-01-2002 12:00:15	0	No Data, Bad	0	No Data, Bad	

Case 14.2. Requesting data with good bounding value with bad data in the interval.

Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:35	0	No Data, Bad	30	Calculated, Good	
Jan-01-2002 12:00:40	0	No Data, Bad	40	Calculated, Bad	Only Bad data in interval.
Jan-01-2002 12:00:45	0	No Data, Bad	40	Calculated, Good	
Jan-01-2002 12:00:50	50	Raw, Good	50	Calculated, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	0	No Data, Bad	

Case 14.3. Requesting data with no good end bounding value.

Start: Jan-01-2002 12:01:20 **End**: Jan-01-2002 12:01:40 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:01:20	80	Raw, Good	70	Calculated Good	
Jan-01-2002 12:01:25	0	No Data, Bad	80	Calculated Good	
Jan-01-2002 12:01:30	90	Raw, Good	90	Raw, Good	
Jan-01-2002 12:01:35	0	No Data, Bad	0	No Data, Bad	

Case 14.4. Requesting data with no good start bounding value.

Start: Jan-01-2002 12:00:00 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:00	0	No Data, Bad	10	Calculated Good	
Jan-01-2002 12:00:05	0	No Data, Bad	0	No Data, Bad	
Jan-01-2002 12:00:10	10	Raw, Good	0	No Data, Bad	
Jan-01-2002 12:00:15	0	No Data, Bad	0	No Data, Bad	

Case 14.5. Partial Interval.

Start: Jan-01-2002 12:00:05 **End**: Jan-01-2002 12:00:35 **Interval**: 00:00:16

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:05	10	Raw, Good	0	No Data, Bad	
Jan-01-2002 12:00:21	30	Partial, Good	25	Partial, Good	

2.9.2.15. START

The start aggregate retrieves the first raw value within the interval [s,e), and returns that value with the timestamp at which that value occurs. If the value is non-good , than the quality of the aggregate will be uncertain/subnormal.
Unless otherwise indicated, qualities are good, raw.

Case 15.1. Requesting data with good bounding value.
Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:10	10	Raw, Good	
Jan-01-2002 12:00:15	0	No Data, Bad	Return timestamp of the interval

Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 2**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:10	0	No Data, Bad	Return timestamp of the interval
Jan-01-2002 12:00:15	0	No Data, Bad	Return timestamp of the interval

Case 15.2. Requesting data with good bounding value with bad data in the interval.
Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:35	0	No Data, Bad	
Jan-01-2002 12:00:40	40	Raw, Bad	Raw value (If Bad values are stored)
Jan-01-2002 12:00:45	0	No Data, Bad	
Jan-01-2002 12:00:50	50	Raw, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	

Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	**Historian 2**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:39	30	Raw, Good	First raw in :35-:40 at :39
Jan-01-2002 12:00:40	40	Raw, Bad	Raw value (If Bad values are stored)
Jan-01-2002 12:00:48	40	Raw, Good	First raw in :45-:50 at :48
Jan-01-2002 12:00:52	50	Raw, Good	First raw in :50-:55 at :52
Jan-01-2002 12:00:55	0	No Data, Bad	

Case 15.3. Partial Intervals.
Start: Jan-01-2002 12:00:05 **End**: Jan-01-2002 12:00:35 **Interval**: 00:00:16

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:10	10	Raw, Good	First raw in :05-:21 at :10
Jan-01-2002 12:00:30	30	Partial, Good	First raw in :21-:35 at :30

Start: Jan-01-2002 12:00:05 **End**: Jan-01-2002 12:00:35 **Interval**: 00:00:16

Timestamp	**Historian 2**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:25	0	No Data, Bad	No raw data in :05-:21 at :10

Jan-01-2002 12:00:25	20	Raw, Good	First raw in :21-:35 at :25

2.9.2.16. END

The end aggregate retrieves the last raw value within the interval [s,e), and returns that value with the timestamp at which that value occurs. If the value is non-good , than the quality of the aggregate will be uncertain/subnormal.

Unless otherwise indicated, qualities are good, raw.

Case 16.1. Requesting data with good bounding value.

Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:10	10	Raw, Good	Last raw in :10-:15 at :10
Jan-01-2002 12:00:15	0	No Data, Bad	Return timestamp of the interval.

Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 2**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:10	0	No Data, Bad	Return timestamp of the interval
Jan-01-2002 12:00:15	0	No Data, Bad	Return timestamp of the interval

Case 16.2. Requesting data with good bounding value with bad data in the interval.

Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:35	0	No Data, Bad	
Jan-01-2002 12:00:40	40	Raw, Bad	Raw value (If Bad values are stored)
Jan-01-2002 12:00:45	0	No Data, Bad	
Jan-01-2002 12:00:50	50	Raw, Good	
Jan-01-2002 12:00:55	0	No Data, Bad	

Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	**Historian 2**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:39	30	Raw, Good	Last raw in :35-:40 at :39
Jan-01-2002 12:00:40	40	Raw, Bad	Raw value (If Bad values are stored)
Jan-01-2002 12:00:48	40	Raw, Good	Last raw in :45-:50 at :48
Jan-01-2002 12:00:52	50	Raw, Good	Last raw in :50-:55 at :52
Jan-01-2002 12:00:55	0	No Data, Bad	

Case 16.3. Partial Intervals.

Start: Jan-01-2002 12:00:05 **End**: Jan-01-2002 12:00:35 **Interval**: 00:00:16

Timestamp	**Historian 1**		**Notes**
	Value	**Quality**	
Jan-01-2002 12:00:10	10	Raw, Good	Last raw in :05-:21 at :10
Jan-01-2002 12:00:30	30	Partial, Good	Last raw in :21-:35 at :30

Start: Jan-01-2002 12:00:05 **End**: Jan-01-2002 12:00:35 **Interval**: 00:00:16

Timestamp	Historian 2		Notes
	Value	Quality	
Jan-01-2002 12:00:25	0	No Data, Bad	No raw data in :05-:21 at :10
Jan-01-2002 12:00:28	25	Raw, Good	Last raw in :21-:35 at :28

2.9.2.17. DELTA

The delta aggregate retrieves the difference between the earliest and latest good raw values in an interval. If the last value is less than the first value, the result will be negative. If the last value is the same as the first value, or if the last value is also the first value at the same timestamp, the result will be zero. If the last value is greater than the first value, the result will be positive.

If any non-good values exist earlier or later than the earliest and latest good values, respectively, the aggregate is uncertain/subnormal.

All interval aggregates are returned with timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated.

2.9.2.18. REGSLOPE

A regression line is simply a “line-of-best-fit” across the interval. The method used to determine this will be server dependent.

If there are any non-good raw values in the interval, they are ignored, and the aggregate quality will be uncertain/subnormal.

All interval aggregates are returned with timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated.

2.9.2.19. REGCONST

The method used to determine this aggregate will be server dependent.

If there are any non-good raw values in the interval, they are ignored, and the aggregate quality will be uncertain/subnormal.

All interval aggregates are returned with timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated.

2.9.2.20. REGDEV

The method used to determine this aggregate will be server dependent.

If there are any non-good raw values in the interval, they are ignored, and the aggregate quality will be uncertain/subnormal.

All interval aggregates are returned with timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated.

2.9.2.21. RANGE

The range aggregate finds the difference between the raw maximum and raw minimum values in the interval. If only one value exists in the interval, the range is zero. Note that the range is always zero or positive.

If there are any non-good raw values in the interval, they are ignored, and the aggregate quality will be uncertain/subnormal.

All interval aggregates are returned with timestamp of the start of the interval. Unless otherwise indicated, qualities are good, calculated.

2.9.2.22. DURATION GOOD

The duration good aggregate looks at the quality of a bounding value of the interval to determine what the quality is at the beginning of the interval. If no bounding value exists, the quality is assumed to be bad at the start of the interval. This aggregate only considers truly Good values. Uncertain values are not considered good for purposes of calculating this aggregate.

Whenever a raw value x with quality q is encountered from beginning to end within an interval, the quality is considered to be q until the next value, y, is encountered, at which point the quality becomes that of y, and so on.

The time is returned in seconds. No returned value will ever be uncertain or subnormal.

Each interval's aggregate is returned with timestamp of the start of the interval. Qualities are good, calculated.

Case 22.1. Requesting data with good bounding value.

Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:10	5	Calculated, Good	5	Calculated, Good	
Jan-01-2002 12:00:15	5	Calculated, Good	5	Calculated, Good	

Case 22.2. Requesting data with good bounding value with bad data in the interval.

Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:35	5	Calculated, Good	5	Calculated, Good	Value2-Good from :35 to :39. Good :39 to :40
Jan-01-2002 12:00:40	0	Calculated, Good	2	Calculated, Good	Value2-Good from :40 to :42. Bad :42 to :45
Jan-01-2002 12:00:45	0	Calculated, Good	2	Calculated, Good	Value2-Bad from :45 to :48. Good :48 to :50
Jan-01-2002 12:00:50	5	Calculated, Good	5	Calculated, Good	
Jan-01-2002 12:00:55	5	Calculated, Good	5	Calculated, Good	

Case 22.3. Requesting data with no good end bounding value.

Start: Jan-01-2002 12:01:20 **End**: Jan-01-2002 12:01:40 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:01:20	5	Calculated, Good	2	Calculated, Good	Value2-Uncertain from :20 to :23. Good :23 to :25
Jan-01-2002 12:01:25	5	Calculated, Good	5	Calculated, Good	
Jan-01-2002 12:01:30	5	Calculated, Good	5	Calculated, Good	
Jan-01-2002 12:01:35	5	Calculated, Good	5	Calculated, Good	

Case 22.4. Requesting data with no good start bounding value.

Start: Jan-01-2002 12:00:00 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	Historian 1		Historian 2		Notes
	Value	Quality	Value	Quality	
Jan-01-2002 12:00:00	0	Calculated, Good	3	Calculated, Good	Value1-No bound, Bad from :00 to :05 Value2-Bad from :00 to :02. Good :02 to :05
Jan-01-2002 12:00:05	0	Calculated, Good	5	Calculated, Good	Value1-No bound, Bad from :05 to :10
Jan-01-2002 12:00:10	5	Calculated, Good	5	Calculated, Good	

Jan-01-2002 12:00:15	5	Calculated, Good	5	Calculated, Good	

Case 22.5. Requesting data with uncertain data in the interval.
Start: Jan-01-2002 12:01:00 **End**: Jan-01-2002 12:01:30 **Interval**: 00:00:00

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:01:00	20*	Calculated, Good	25*	Calculated, Good	Value1-Uncertain from :10 to :20 Value1-Uncertain from :12 to :17

* Uncertain data should not be counted as good.

2.9.2.23. DURATION BAD

The duration bad aggregate looks at the quality of a bounding value of the interval to determine what the quality is at the beginning of the interval. If no bounding value exists, the quality is assumed to be bad at the start of the interval. This aggregate only considers truly Bad values. Uncertain values are not considered bad for purposes of calculating this aggregate.

Whenever a raw value x with quality q is encountered from beginning to end within an interval, the quality is considered to be q until the next value, y, is encountered, at which point the quality becomes that of y, and so on.

The time is returned in seconds. No returned value will ever be uncertain or subnormal.

Each interval's aggregate is returned with timestamp of the start of the interval. Qualities are good, calculated.

Duration Bad is not simply the interval minus duration good, since the interval uncertain data.

Case 23.1. Requesting data with good bounding value.
Start: Jan-01-2002 12:00:10 **End**: Jan-01-2002 12:00:20 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:10	0	Calculated, Good	0	Calculated, Good	
Jan-01-2002 12:00:15	0	Calculated, Good	0	Calculated, Good	

Case 23.2. Requesting data with good bounding value with bad data in the interval.
Start: Jan-01-2002 12:00:35 **End**: Jan-01-2002 12:01:00 **Interval**: 00:00:05

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:00:35	0	Calculated, Good	0	Calculated, Good	
Jan-01-2002 12:00:40	5	Calculated, Good	3	Calculated, Good	
Jan-01-2002 12:00:45	5	Calculated, Good	3	Calculated, Good	
Jan-01-2002 12:00:50	0	Calculated, Good	0	Calculated, Good	
Jan-01-2002 12:00:55	0	Calculated, Good	0	Calculated, Good	

Case 23.3. Requesting data with uncertain data in the interval.
Start: Jan-01-2002 12:01:00 **End**: Jan-01-2002 12:01:30 **Interval**: 00:00:00

Timestamp	**Historian 1**		**Historian 2**		**Notes**
	Value	**Quality**	**Value**	**Quality**	
Jan-01-2002 12:01:00	0	Calculated, Good	0	Calculated, Good	

2.9.2.24. PERCENT GOOD

This aggregate performs the following calculation:
percent_good = duration_good / interval_length.

Where:

duration_good is the result from the DURATIONGOOD aggregate, calculated using the interval supplied to PERCENTGOOD call.

Interval_length is the interval of the aggregates.

The time is returned in seconds. No returned value will ever be uncertain or subnormal.
Each interval’s aggregate is returned with timestamp of the start of the interval. Qualities are good, calculated.
The interval_length is the entire sample interval, regardless of quality.

2.9.2.25. PERCENT BAD

This aggregate performs the following calculation:
percent_bad = duration_bad / interval_length.

Where:

duration_good is the result from the DURATIONBADaggregate, calculated using the interval supplied to PERCENTBAD call.

Interval_length is the interval of the aggregates.

The time is returned in seconds. No returned value will ever be uncertain or subnormal.
Each interval’s aggregate is returned with timestamp of the start of the interval. Qualities are good, calculated.
The interval_length is the entire sample interval, regardless of quality.

2.9.2.26. WORST QUALITY

This aggregate returns the worst quality of the raw values in the interval. That is, bad qualities are worse than uncertain, which are worse than good. No distinction is made between the specific reasons for the quality.
This aggregate returns the worst OPC DA quality as the value of the aggregate.
The timestamp is always the start of the interval. The quality is always good, calculated.

2.9.2.27. ANNOTATIONS

This aggregate returns a count of all annotations.

3. OPC-HDA Quick Reference

3.1. Custom Interface

Note: This section does not show additional standard enumerators used by this interface.

3.1.1. IOPCCommon

HRESULT SetLocaleID (dwLcid)

Description Set the default LocaleID for this server/client session. This LocaleID will be used by the GetErrorString method on this interface. It should also be used as the 'default' LocaleID by any other server functions that are affected by LocaleID. Other OPC interfaces may provide additional LocaleID capability by allowing this LocaleID to be overridden either via a parameter to a method or via a property on a child object.

HRESULT GetLocaleID (pdwLcid)

Description Return the default LocaleID for this server/client session.

HRESULT QueryAvailableLocaleIDs (pdwCount, ppdwLcid)

Description Return the available LocaleIDs for this server/client session.

HRESULT GetErrorString(dwError, pszString)

Description Returns the error string for a server specific error code.

HRESULT SetClientName (pszName)

Description Allows the client to optionally register a client name with the server.

3.1.2. IOPCHDA_Server

HRESULT GetItemAttributes(pdwCount , ppdwAttrID, ppszAttrName, ppszAttrDesc, ppvtAttrDataType)

Description This function returns the item attributes supported by the server. The OPC defined attribute types are defined in section (5.2). Vendor specific attributes are also supported. The vendor supplied attributes are made available to allow the client to access and display vendor specific information. Attribute data types are intended to allow query filtering when browsing item ids.

HRESULT GetAggregates(pdwCount , ppdwAggrID, ppszAggrName, ppszAggrDesc)

Description This function returns the list of aggregates supported by the server. The OPC defined aggregates are defined in section 5.3.3. Vendor specific aggregates are also supported. The vendor supplied aggregates are made available to allow the client to use all the functions available to their specific server. If no aggregates are supported by the server, all pointers are NULL.

HRESULT GetHistorianStatus(pwStatus, pftCurrentTime, pftStartTime, pwMajorVersion, pwMinorVersion, pwBuildNumber, pdwMaxReturnValues, ppszStatusString, ppszVendorInfo)

Description This function returns the information on the current status of the server. The start time is optional and may be returned as a NULL pointer.

HRESULT GetItemHandles(dwCount, pszItemID, phClient, pphServer, ppErrors)
Description This function returns associations between server handles and client handles for specific HDA items.

HRESULT ReleaseItemHandles(dwCount, phServer, ppErrors)
Description This function releases associations between server handles and client handles for specific HDA items.

HRESULT ValidateItemIDs(dwCount, pszItemID, ppErrors)
Description This function validates that specific HDA item IDs are known to the server.

HRESULT CreateBrowse(dwCount, pdwAttrID, pOperator, vFilter, pphBrowser, ppErrors)
Description This function returns a pointer to an OPCHDA_BROWSER interface.

3.1.3. IOPCHDA_Browser

HRESULT GetEnum(dwBrowseType, ppIEnumString)
Description This function returns a pointer to an IENUM string enumerator for a list of leaves, branches, or item IDs, depending on the browse type requested.

HRESULT ChangeBrowsePosition(dwBrowseDirection, szString)
Description This function provides a way to move up or down relative to the current position, or directly to a given position in a hierarchy.

HRESULT GetItemID (szNode, pszItemID)
Description This function provides a way to get an item identification.

HRESULT GetBranchPosition (pszBranchPos)
Description This function provides the current browse position in the hierarchy.

3.1.4. IOPCHDA_SyncRead

HRESULT ReadRaw (htStartTime, htEndTime, dwNumValues, bBounds, dwNumItems, phServer, ppItemValues, ppErrors)
Description This function reads the values, qualities, and timestamps from the history database for the specified time domain for one or more items in a group.

HRESULT ReadProcessed (htStartTime, htEndTime, ftResampleInterval, dwNumItems, phServer, haAggregate, ppItemValues, ppErrors)
Description This function computes aggregate values, qualities, and timestamps from data in the history database for the specified time domain for one or more items. This is an optional method on the interface.

HRESULT ReadAtTime (dwNumTimeStamps, ftTimeStamps, dwNumItems, phServer, ppItemValues, ppErrors)
Description This function reads the values and qualities from the history database for the specified timestamps for one or more items. This is an optional method on the interface.

HRESULT ReadModified(htStartTime, htEndTime, dwNumValues, dwNumItems, phServer, ppItemValues, ppErrors)
Description The purpose of this function is to read values from history that have been

modified/replaced. If ReadRaw, ReadProcessed, or ReadAtTime has returned a quality of OPCHDA_EXTRADATA, indicating that there are values which have been superseded, this function will allow you to see those values which were superseded. Only values that have been modified/replaced or deleted are read by this function. This is an optional method on the interface.

HRESULT ReadAttribute (htStartTime, htEndTime, hServer, dwNumAttributes, pdwAttributeIDs, ppAttributeValues, ppErrors)

Description This function reads the attribute values and timestamps from the history database for the specified time domain for an item. If the current values for the attributes are desired, htStartTime should be set to "NOW" and htEndTime should be NULL.

3.1.5. IOPCHDA_SyncUpdate (optional)

HRESULT QueryCapabilities(pCapabilities)

Description This function specifies which update methods the server supports. It is a required method for all servers which support the OPCHDA SyncUpdate interface.

HRESULT Insert(dwNumItems, phServer, ftTimeStamps, vDataValues, pdwQualities, ppErrors)

Description This function inserts values and qualities into the history database at the specified timestamps for one or more items. This is an optional method on the interface.

HRESULT Replace(dwNumItems, phServer, ftTimeStamps, vDataValues, pdwQualities, ppErrors)

Description This function replaces the values and qualities in the history database at the specified timestamps for one or more items. This is an optional method on the interface.

HRESULT InsertReplace (dwNumItems, phServer, ftTimeStamps, vDataValues, pdwQualities, ppErrors)

Description This function will insert or replace the values and qualities in the history database for the specified timestamps for one or more items. If the item has a value at the specified timestamp, the new value and quality will replace the old one. If there is no value at that timestamp, the function will insert the new data. This is an optional method on the interface.

HRESULT DeleteRaw (htStartTime, htEndTime, dwNumItems, phServer, ppErrors)

Description This function deletes the values, qualities, and timestamps from the history database for the specified time domain for one or more items in a group. This is an optional method on the interface.

HRESULT DeleteAtTime (dwNumItems, phServer, ftTimeStamps, ppErrors)

Description This function deletes the values and qualities in the history database for the specified timestamps for one or more items in a group. This is an optional method on the interface.

3.1.6. IOPCHDA_SyncAnnotations (optional)

HRESULT QueryCapabilities(pCapabilities)

Description This function specifies which update methods the server supports. It is a required method for all servers which support the OPCHDA SyncAnnotations interface.

HRESULT Read(htStartTime, htEndTime, dwNumItems, phServer, ppAnnotationValues, ppErrors)

Description This function reads the annotations from the history database in the specified time domain for the specified item IDs. This is a required method for all servers which support the OPCHDA SyncAnnotations interface.

HRESULT Insert(dwNumItems, phServer, ftTimeStamps, ppAnnotationValues, ppErrors)

Description This function inserts annotations into the history database. This is an optional method on the interface.

3.1.7. IOPCHDA_AsyncRead (optional)

HRESULT ReadRaw (dwTransactionID, htStartTime, htEndTime, dwNumValues, bBounds, dwNumItems, phServer, pdwCancelID, ppErrors)

Description This function reads the values, qualities, and timestamps from the history database for the specified time domain for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnReadComplete method.

HRESULT AdviseRaw(dwTransactionID, htStartTime, ftUpdateInterval, dwNumItems, phServer, pdwCancelID, ppErrors)

Description This function reads the values, qualities, and timestamps from the history database from the specified start time at the update interval for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnDataChange method. This is an optional method on the interface.

HRESULT ReadProcessed (dwTransactionID, htStartTime, htEndTime, ftResampleInterval, dwNumItems, phServer, haAggregate, pdwCancelID, ppErrors)

Description This function computes aggregate values, qualities, and timestamps from data in the history database for the specified time domain for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnReadComplete method. This is an optional method on the interface.

HRESULT AdviseProcessed (dwTransactionID, htStartTime, ftResampleInterval, dwNumItems, phServer, haAggregate, dwNumIntervals, pdwCancelID, ppErrors)

Description This function computes the aggregate values, qualities, and timestamps from the history database from the specified start time at the interval for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnDataChange method. This is an optional method on the interface.

HRESULT ReadAtTime (dwTransactionID, dwNumTimeStamps, ftTimeStamps, dwNumItems, phServer, pdwCancelID, ppErrors)

Description This function reads the values and qualities from the history database for the specified timestamps for one or more items in a group. The results are returned via the client's IOPCHDA_DataCallback::OnReadComplete method. This is an optional method on the interface.

HRESULT ReadModified (dwTransactionID, htStartTime, htEndTime, dwNumValues, dwNumItems, phServer, pdwCancelID, ppErrors)

Description This function reads the values, qualities, timestamps, user ID, and timestamp of modification from the history database for the specified time domain for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnReadModifiedComplete method. The purpose of this function is to read values from history that have been modified/replaced. If ReadRaw, ReadProcessed, or ReadAtTime has returned a quality of OPCHDA_EXTRADATA, indicating that there are values which have been superseded, this function will allow you to see those values which were superseded. Only values that have been modified/replaced or deleted are read by this function. This is an optional method on the interface.

HRESULT ReadAttribute (dwTransactionID, htStartTime, htEndTime, hServer, dwNumAttributes, dwAttributeIDs, pdwCancelID, ppErrors)
Description This function reads the attribute values and timestamps from the history database for the specified time domain for an item. The results are returned via the client's IOPCHDA_DataCallback::OnReadAttributeComplete method. This is an optional method on the interface.

HRESULT Cancel(dwCancelID)
Description This function cancels the outstanding operation. The actual implementation is server specific, but the server will respond via the client's IOPCHDA_DataCallback::OnCancelComplete method unless a FAILED error code is returned from the call.

3.1.8. IOPCHDA_AsyncUpdate (optional)

HRESULT QueryCapabilities(pCapabilities)
Description This function specifies which update methods the server supports. It is a required method for all servers which support the OPCHDA AsyncUpdate interface.

HRESULT Insert(dwTransactionID, dwNumItems, phServer, ftTimeStamps, vDataValues, pdwQualities, pdwCancelID, ppErrors)
Description This function inserts values and qualities into the history database for the specified timestamps for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method. This is an optional method on the interface.

HRESULT Replace (dwTransactionID, dwNumItems, phServer, ftTimeStamps, vDataValues, pdwQualities, pdwCancelID, ppErrors)
Description This function replaces values and qualities in the history database at the specified timestamps for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method. This is an optional method on the interface.

HRESULT InsertReplace(dwTransactionID, dwNumItems, phServer, ftTimeStamps, vDataValues, pdwQualities, pdwCancelID, ppErrors)
Description This function inserts or replaces values and qualities at the specified timestamps for one or more items. If the item has a value at the specified timestamp, the new value and quality will replace the old one. If there is no value at that timestamp, the function will insert the new data. The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method. This is an optional method on the interface.

HRESULT DeleteRaw (dwTransactionID, htStartTime, htEndTime, dwNumItems, phServer, pdwCancelID, ppErrors)
Description This function deletes the values, qualities, and timestamps from the history database

for the specified time domain for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method. This is an optional method on the interface.

HRESULT DeleteAtTime (dwTransactionID, dwNumItems, phServer, ftTimeStamps, pdwCancelID, ppErrors)
Description This function deletes the values and qualities in the history database for the specified timestamps for one or more items. The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method. This is an optional method on the interface.

HRESULT Cancel(dwCancelID)
Description This function cancels the outstanding operation. The actual implementation is server specific, but the server will respond via the client's IOPCHDA_DataCallback::OnCancelComplete method unless a FAILED error code is returned from the call.

3.1.9. IOPCHDA_AsyncAnnotations (optional)

HRESULT QueryCapabilities(pCapabilities)
Description This function specifies which annotation methods the server supports. It is a required method for all servers which support the OPCHDA AsyncAnnotations interface.

HRESULT Read(dwTransactionID, htStartTime, htEndTime, dwNumItems, phServer, pdwCancelID, ppErrors)
Description This function reads the annotations from the history database in the specified time domain for the specified item IDs. This function is intended to read annotations entered by users to document observations for a value at a specified timestamp. The results are returned via the client's IOPCHDA_DataCallback::OnReadAnnotations method.

HRESULT Insert(dwTransactionID, dwNumItems, phServer, ftTimeStamps, pAnnotationValues, pdwCancelID, ppErrors)
Description This function inserts annotations into the history database. This function is intended to insert annotations by users to document observations for a value at a specified timestamp. The results are returned via the client's IOPCHDA_DataCallback::OnInsertAnnotations method. This is an optional method on the interface.

HRESULT Cancel(dwCancelID)
Description This function cancels the outstanding operation. The actual implementation is server specific, but the server shall respond via the client's IOPCHDA_DataCallback::OnCancelComplete method unless a FAILED error code is returned from the call.

3.1.10. IOPCHDA_Playback (optional)

HRESULT ReadRawWithUpdate(dwTransactionID, htStartTime, htEndTime, dwNumValues, ftUpdateDuration, ftUpdateInterval, dwNumItems, phServer, pdwCancelID, ppErrors)
Description This operation will initially retrieve data from the start time to the end time. After the initial response it will periodically (at the ftUpdateInterval) respond with an amount of

data identified by ftUpdateDuration. The end time of the initial response is used as the start time for the first update. After that, the end time of the last update is used as the start time for the next update.

HRESULT ReadProcessedWithUpdate(dwTransactionID, htStartTime, htEndTime, ftResampleInterval, dwNumIntervals, ftUpdateInterval, dwNumItems, phServer, haAggregate, pdwCancelID, ppErrors)
Description This operation will initially retrieve data from the start time to the end time. After the initial response it will periodically (at the ftUpdateInterval) respond with a dwNumIntervals amount of data divided into ftResampleInterval sized bins. The end time of the initial response is used as the start time for the first update. After that, the end time of the last update is used as the start time for the next update. This is an optional method on the interface.

HRESULT Cancel(dwCancelID)
Description This function cancels the outstanding operation. The actual implementation is server specific, but the server will respond via the OPCHDA_CancelComplete callback unless a FAILED error code is returned from the call.

3.1.11. IConnectionPointContainer (required if any Async interface is supported)

HRESULT EnumConnectionPoints(ppEnum)
Description Create an enumerator for the Connection Points supported between the OPCHDA server and the Client.

HRESULT FindConnectionPoint(riid, ppCP)
Description Find a particular connection point between the OPCHDA server and the Client.

3.1.12. IOPCHDA_DataCallback

HRESULT OnDataChange(dwTransactionID, hrStatus, dwNumItems, pItemValues, phrErrors)
Description This method is provided by the client to handle notifications from the OPCHDA server resulting from calls to OPCHDA_AsyncRead::AdviseRaw and OPCHDA_AsyncRead::AdviseProcessed.

HRESULT OnReadComplete(dwTransactionID, hrStatus, dwNumItems, pItemValues, phrErrors)
Description This method is provided by the client to handle returned data from OPCHDA_AsyncRead::ReadRaw, OPCHDA_AsyncRead::ReadProcessed, and OPCHDA_AsyncRead::ReadAtTime.

HRESULT OnReadModifiedComplete (dwTransactionID, hrStatus, dwNumItems, pItemValues, phrErrors)
Description This method is provided by the client to handle returned data from OPCHDA_AsyncRead::ReadModified.

HRESULT OnReadAttributeComplete(dwTransactionID, hrStatus, hClient, dwNumItems, pAttributeValues, phrErrors)
Description This method is provided by the client to handle returned data from OPCHDA_AsyncRead::ReadAttribute.

HRESULT OnReadAnnotations(dwTransactionID, hrStatus, dwNumItems, pAnnotationValues, phrErrors)

Description This method is provided by the client to handle returned data from OPCHDA_AsyncReadAnnotations::Read.

HRESULT OnInsertAnnotations (dwTransactionID, hrStatus, dwCount, phClients, phrErrors)

Description This method is provided by the client to handle notifications from the server on completion of OPCHDA_AsyncAnnotations::Insert.

HRESULT OnPlayback (dwTransactionID, hrStatus, dwNumItems, ppItemValues, phrErrors)

Description This method is provided by the client to handle notifications from the OPCHDA server resulting from calls to OPCHDA_Playback::ReadRawWithUpdate and OPCHDA_Playback::ReadProcessedWithUpdate.

HRESULT OnUpdateComplete (dwTransactionID, hrStatus, dwCount, phClients, phrErrors)

Description This method is provided by the client to handle notifications from the server on completion of OPCHDA_AsyncUpdate::Insert, OPCHDA_AsyncUpdate::Replace, OPCHDA_AsyncUpdate::InsertReplace, OPCHDA_AsyncUpdate::DeleteRaw, and OPCHDA_AsyncUpdate::DeleteAtTime.

HRESULT OnCancelComplete(dwCancelID)

Description This method is provided by the client to handle notifications from the server on completion of Async Cancel.

4. OPC-HDA Custom Interface

4.1. Overview of the OPC HDA Custom Interface

The OPC HDA custom interface objects include the following custom objects:

- OPCHDAServer
  - IOPCHDA_SyncRead
  - IOPCHDA_SyncUpdate
  - IOPCHDA_SyncAnnotations
  - IOPCHDA_AsyncRead
  - IOPCHDA_AsyncUpdate
  - IOPCHDA_AsyncAnnotations
  - IOPCHDA_Playback
- OPCHDABrowser
  - IOPCHDA_Browser
- OPCHDAClient
  - IOPCHDA_DataCallback

The interfaces and behaviors of these objects are described in detail in this chapter. Developers of OPC HDA servers are required to implement the OPC HDA objects by providing the functionality defined in this chapter.

This chapter also references and defines expected behavior for the standard OLE interfaces that OPC HDA servers and clients are required to implement when building OPC compliant components.

Also, standard and custom Enumerator objects are created, and interfaces to these objects are returned. In general the enumerator objects and interfaces are described briefly here since their behavior is well defined by OLE.

The OPC specification follows the preferred approach that enumerators are created and returned from methods on objects rather than through QueryInterface. The enumerators are as follows:

- Historical Data Address Space Enumerator - (see IOPCHDA_Browser::GetEnum)

Also you will note that in some cases lists of things are returned via enumerators and in other cases as simple lists of items. Our choice depends on the expected number of items returned. ‘Large’ lists are best returned through enumerators while ‘small’ lists are more easily and efficiently returned via explicit lists.

4.2. General Information

This section provides general information about the OPC HDA interfaces, and some background information about how the designers of OPC expected these interfaces to be implemented and used.

4.2.1. Ownership of memory

Per the COM specification, clients must free all memory associated with ‘out’ or ‘in/out’ parameters. This includes memory that is pointed to by elements within any structures. This is very important for client writers to understand, otherwise they will experience memory leaks that are difficult to find. See the IDL files to determine which parameters are out parameters. The recommended approach is for a client to create a subroutine that is used for freeing each type of structure properly.

Independent of success/failure, the server must always return well-defined values for ‘out’ parameters. Releasing the allocated resources is the client’s responsibility.

Note: If the error result is any FAILED error such as E_OUTOFMEMORY , the OPC HDA server shall return NULL for all `out' pointers (this is standard COM behavior). This rule also applies to the error arrays (ppErrors) returned by many of the functions below. In general, a robust OPC client should check each ‘out’ or ‘in/out’ pointer for NULL prior to freeing it.

In general , the guidelines for who has what rights and responsibilities are:

[in] something* means "The client will pass the address of a something that he allocated (by any means he wishes) and the server may look at it but may not change it."

[out] something* means "The client will pass the address of a something that he allocated (by any means he wishes) and the server may not look at it, the server can only write to it."

[in,out] something* means "The client will pass the address of a something that he allocated (by any means he wishes) and the server may both look at and change it."

[in] something** is not used.

[out] something** means "The client will pass the address of a (something*), allocated by any means he wishes, and the server will use CoTaskMemAlloc to allocate a new "something" and store its address there."

[in,out] something** means "The client will allocate a "something" via CoTaskMemAlloc and pass the address of a pointer to it. [The pointer variable can be allocated anywhere.] The server may free the "something*" via CoTaskMemFree and allocate a new "something" via CoTaskMemAlloc. The server will place the address of the allocated memory into the parameter and return it to the client."

4.2.2. Standard Interfaces

Per the COM specification, all methods must be implemented on each required interface.

Per the COM specification, any optional interfaces that are supported must have all functions within that interface implemented, even if the implementation is only a stub implementation returning E_NOTIMPL.

4.2.3. Null Strings and Null Pointers

Both of these terms are used below. They are NOT the same thing. A NULL Pointer is an invalid pointer (0) which will cause an exception if used. A NULL String is a valid (non zero) pointer to a 1 character array where that character is a NULL (i.e. 0). If a NULL string is returned from a method as an [out] parameter (or as an element of a structure) it must be freed, otherwise the memory containing the NULL will be lost. Also note that a NULL pointer cannot be passed for an [in,string] argument due to COM marshalling restrictions. In this case a pointer to a NULL string shall be passed to indicate an omitted parameter.

4.2.4. Returned Arrays

You will note the syntax **size_is(,dwCount)** in the IDL used in combination with pointers to pointers. This indicates that the returned item is a pointer to an actual array of the indicated type, rather than a pointer to an array of pointers to items of the indicated type. This simplifies marshaling , creation, and access of the data by the server and client.

4.2.5. Asynchronous vs. Synchronous Interfaces

There are two ways for a client to obtain data from a server.

- It can perform a synchronous read (simple and reasonably efficient). This may be appropriate for fairly simple clients that are reading relatively small amounts of data and where maximum efficiency is not a concern. A client that operates in this way is willing to block and wait for the results. When a large amount of data is requested this could require some time. This method is appropriate for reports or other non-interactive reads, but would be very poor for an interactive display.
- It can 'subscribe' to data using the Async methods, which is more complex but very efficient. This is the recommended behavior for interactive clients because it will minimize display lockups. The client would be free to process other interactions while waiting for the data to return.

4.2.6. Errors and return codes

The OPC specification describes interfaces and corresponding behavior that an OPC HDA server implements, and an OPC client application depends on.   A list of OPC Specific errors and return codes is contained in the summary of OPC error codes section in this specification. For each method described below a list of all possible OPC error codes as well as the **most common** OLE error codes is included. It is likely that clients will encounter additional error codes such as RPC and Security related codes in practice and they should be prepared to deal with them.

In some cases, it is also allowed for a server to return Vendor Specific error codes. Such codes can be passed to GetErrorString method. This is discussed in more detail later.

In all cases 'E' error codes will indicate FAILED type errors, and 'S' error codes will indicate at least partial success, minimally indicating that more information is available in the ppErrors array. The server may or may not return data when returning an 'S' error code, but it must always return a ppErrors array if the pointer to one is provided in the call. If any ppErrors code returned to the client is not S_OK, the server must return S_FALSE to indicate to the client that it should examine the ppErrors array for more information.

For all methods of all interfaces, if a FAILED code is returned from a call, the client should expect that all output values are invalid, and the server should return NULL pointers for all "out" parameters. This is standard COM behavior.   For Asynchronous interfaces, if a FAILED code is returned from a call, or if S_FALSE is returned and the ppErrors codes for the individual items are all FAILED codes, then there will be no callback.

In general, a client should always check each "out" or "in/out" pointer for a NULL value before freeing it.

4.2.7. IUnknown

The server must provide a standard IUnknown Interface. Since this is a well defined interface it is not discussed in detail. See the OLE Programmer's reference for additional information. This interface must be provided, and all functions implemented as required by Microsoft.

4.3. IOPCCommon

This is an Required Interface

Other OPC Servers such as alarms and events share this interface design. It provides the ability to set and query a LocaleID which would be in effect for the particular client/server session. That is, as with a Group definition, the actions of one client do not affect any other clients.

A quick reference for this interface is provided below. A more detailed discussion can be found in the OPC Common Definitions and Interfaces document.

```
HRESULT SetLocaleID (
      [in] LCID dwLcid
      );

   HRESULT GetLocaleID (
      [out] LCID *pdwLcid
      );

   HRESULT QueryAvailableLocaleIDs (
      [out] DWORD *pdwCount,
      [out, sizeis(, *pdwCount)] LCID **ppdwLcid
      );

   HRESULT GetErrorString(
      [in] HRESULT dwError,
      [out, string] LPWSTR *ppString
      );

   HRESULT SetClientName (
      [in, string] LPCWSTR szName
      );
```

4.4. Synchronous Interfaces

Synchronous operations require the client software to wait until the server has fulfilled the request and returned the data. Synchronous operations that may require significant time for the server to fulfill have corresponding asynchronous operations that may be cancelled.

4.4.1. IOPCHDA_Server

This is an Required Interface

4.4.1.1. IOPCHDA_Server::GetItemAttributes

A Required Method

```
HRESULT GetItemAttributes(
      [out]                         DWORD *pdwCount,
      [out, size_is(,*pdwCount)]    DWORD **ppdwAttrID,
      [out, size_is(,*pdwCount),string] LPWSTR **ppszAttrName,
      [out, size_is(,*pdwCount),string] LPWSTR **ppszAttrDesc,
      [out, size_is(,*pdwCount)]    VARTYPE
         **ppvtAttrDataType
      );
```

Description

This function returns the item attributes supported by the server. The OPC defined attribute types are defined in section 5.2. Vendor specific attributes also are supported. The vendor supplied attributes are made available to allow the client to access and display vendor specific information. Attribute data types are intended to allow query filtering when browsing item ids. If no attributes are supported by the server, the function shall return a count of 0 and NULL pointers.

Parameters	Description
pdwCount	The number of item attributes returned.
ppdwAttrID	The attribute identification index number.
ppszAttrName	The name of the attribute.
ppszAttrDesc	A description of the attribute.
ppvtAttrDataType	The variant data type of the attribute.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

4.4.1.2. IOPCHDA_Server::GetAggregates

A Required Method

```
HRESULT GetAggregates(
      [out]                           DWORD *pdwCount,
      [out, size_is(,*pdwCount)]    DWORD **ppdwAggrID,
      [out, size_is(,*pdwCount), string] LPWSTR
         **ppszAggrName,
      [out, size_is(,*pdwCount), string] LPWSTR
         **ppszAggrDesc
      );
```

Description

This function returns the list of aggregates supported by the server. The OPC defined aggregates are defined in section 5.3.3. Vendor specific aggregates also are supported. The vendor supplied aggregates are made available to allow the client to use all the functions available to their specific server. If no aggregates are supported, the function shall return a count of 0 and NULL pointers.

Parameters	Description
pdwCount	The number of aggregate descriptions returned.
ppdwAggrID	The aggregate identification index number.
ppszAggrName	The name of the aggregate.
ppszAggrDesc	A description of the aggregate.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

4.4.1.3. IOPCHDA_Server::GetHistorianStatus

A Required Method

```
HRESULT GetHistorianStatus(
      [out]          OPCHDA_ SERVERSTATUS       *pwStatus,
      [out]          FILETIME   **pftCurrentTime,
      [out]          FILETIME   **pftStartTime,
      [out]          WORD       *pwMajorVersion,
      [out]          WORD       *pwMinorVersion,
      [out]          WORD       *pwBuildNumber,
      [out]          DWORD      *pdwMaxReturnValues,
      [out,string]   LPWSTR     *ppszStatusString,
      [out,string]   LPWSTR     *ppszVendorInfo
      );
```

Description

This function returns the information on the current status of the server. The start time is optional and may be returned as a NULL pointer.

Parameters	**Description**
pwStatus	The current status of the historian. See values defined below.
pftCurrentTime	The current time at the historian location.
pftStartTime	The time when the historian was last started.
pwMajorVersion	The major version identification of the historian.
pwMinorVersion	The minor version identification of the historian.
pwBuildNumber	The build number identification of the historian
pdwMaxReturnValues	The maximum number of values that can be returned by the server on a per item basis. A value of 0 indicates that the server forces no limit on the number of values it can return.
ppszStatusString	A string explaining historian status when the pwStatus value is OPCHDA_INDETERMINATE.
ppszVendorInfo	A vendor specific informational string.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

4.4.1.4. IOPCHDA_Server::GetItemHandles

A Required Method

```
HRESULT GetItemHandles(
     [in] DWORD   dwCount,
     [in, size_is(dwCount)] LPWSTR *pszItemID,
     [in, size_is(dwCount)] OPCHANDLE *phClient,
     [out, size_is(,dwCount)] OPCHANDLE **pphServer,
     [out, size_is(,dwCount)] HRESULT **ppErrors
     );
```

Description

Given a list of ItemIDs and client handles, this function returns the server handles for each item. The returned server handles must be used in all requests to read or update history. The supplied client handles are included in the returns of all read and update requests.

Parameters	**Description**
dwCount	The number of item handles being requested.
pszItemID	An array of null terminated strings that uniquely identify the OPC HDA items.
phClient	The handle of the client to be associated with the item.
pphServer	The returned handle of the server used to refer to this item.
ppErrors	The status of association of the client to the server.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.
S_FALSE	The function was partially successful. See the ppErrors to determine success of individual associations.

ppError Codes

Return Code	**Description**
S_OK	The operation was successful.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDITEMID	The ItemId was specified incorrectly.
OPC_E_UNKNOWNITEMID	The item does not exist in the server address space.
E_FAIL	The association was unsuccessful.

4.4.1.5. IOPCHDA_Server::ReleaseItemHandles

A Required Method

```
HRESULT ReleaseItemHandles(
     [in] DWORD   dwCount,
     [in, size_is(dwCount)] OPCHANDLE *phServer,
     [out, size_is(,dwCount)] HRESULT **ppErrors
     );
```

Description

This function releases associations between server handles and client handles for specific HDA items.

Parameters	Description
dwCount	The number of item handles being released.
phServer	The server handles of the items to be released.
ppErrors	The status of operations.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.
S_FALSE	The function was partially successful. See the ppErrors to determine success of individual association releases.

ppError Codes

Return Code	Description
S_OK	The operation was successful.
OPC_E_INVALIDHANDLE	The server handle does not exist.
E_FAIL	The release failed.

4.4.1.6. IOPCHDA_Server::ValidateItemIDs

A Required Method

```
HRESULT ValidateItemIDs(
     [in]                          DWORD dwCount,
     [in, size_is(dwCount)] LPWSTR *pszItemID,
     [out, size_is(,dwCount)] HRESULT **ppErrors
     );
```

Description

This function validates that specific HDA item IDs are known to the server.

Parameters	Description
dwCount	The number of item handles being validated.
pszItemID	An array of null terminated strings that uniquely

	identify the OPC HDA items.
ppErrors	The status of validation.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.
S_FALSE	The function was partially successful. See the ppErrors to determine success of individual validations.

ppError Codes

Return Code	Description
S_OK	The operation was successful.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_UNKNOWNITEMID	The item does not exist in the server address space.
OPC_E_INVALIDITEMID	The item ID specification is syntactically incorrect.
E_FAIL	The validation was unsuccessful.

4.4.1.7. IOPCHDA_Server::CreateBrowse

A Required Method

```
HRESULT CreateBrowse(
      [in] DWORD              dwCount,
      [in, size_is(dwCount)]  DWORD *pdwAttrID,
      [in, size_is(dwCount)]  OPCHDA_OPERATORCODES
        *pOperator,
      [in, size_is(dwCount)]  VARIANT    *vFilter,
      [out] IOPCHDA_Browser   **pphBrowser,
      [out, size_is(,dwCount)]     HRESULT    **ppErrors
      );
```

Description

This function returns a pointer to an OPCHDA_BROWSER interface. The filters will be applied to all method calls to this instance of the browser. The server is expected to validate the filter arrays. The server must support a single client having simultaneous access to multiple browse interfaces. Filtering is optional behavior for a server. If a server does not support filtering, or only supports filtering on some of the requested attributes, the server shall return an interface to a browser which is only filtered on the accepted attributes. A server which does not support filtering shall return a pointer to an unfiltered browser interface. Filter operations are additive. To successfully pass filter criteria, the item must successfully satisfy all of the filter criteria.

Implementation of filtering and browsing is server specific, however it is anticipated that servers with hierarchical name spaces may only apply filters to leaves, causing them to return branches which have no leaves which satisfy the criteria. It is anticipated that a client may create one browser to locate a particular area of the hierarchy, obtain a fully qualified branch name using GetBranchPosition, then pass that branch name to another browser which is using a different filter set.

Servers may optionally support wild cards for string filters. To represent a single character the “?” shall be used. To represent multiple characters the “*” shall be used.

Parameters	Description
dwCount	The number of attribute IDs in the filter.
pdwAttrID	The filter attribute IDs.
pOperator	The filter operators .
vFilter	The filter values.
pphBrowser	The returned browser interface.
ppErrors	The validity of the filtering inputs.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.
S_FALSE	The function was partially successful. See the ppErrors to determine success of individual filters. Note: a valid browser interface pointer is still returned.

ppError Codes

Return Code	Description
S_OK	The operation was successful.
OPC_W_NOFILTER	The server does not support this filter.
OPC_E_UNKNOWNATTRID	The server does not support this attribute.
OPC_E_INVALIDDATATYPE	The supplied value for the attribute is not a correct data type.
E_INVALIDARG	The supplied operator is invalid or unsupported with this attribute.
E_FAIL	The operation was unsuccessful.

Comments

A filter is defined by the three parameters pdwAttrID, pOperator and vFilter. The filter expression is true if the relationship of the value of the attribute to the filter value matches the filter operator. If multiple filter expressions are given, they must all be true for the item to be included.

4.4.2. IOPCHDA_Browser

This is an Required Interface

4.4.2.1. IOPCHDA_Browser::GetEnum

A Required Method

```
HRESULT GetEnum(
     [in] OPCHDA_ BROWSETYPE  dwBrowseType,
     [out] LPENUMSTRING **ppIEnumString
     );
```

Description

This function returns a pointer to an IENUM string enumerator for a list of leaves, branches, or ItemIDs, depending on the browse type requested. Whether a branch is an ItemID is undetermined and may be server dependent. The members of the enum set will be determined by the position of the browser in the server address space and the value of the filters when the browser interface was created. If no ItemIDs pass the filter criteria, the enum set is empty. Thus, a server which has a flat namespace would always return an empty enumerator when asked for a list of branches, and it would return the same list whether it was asked for leafs or ItemIDs, since all of its Items are, by definition, leafs.

Parameters	Description
dwBrowseType	The type of browse to perform.
ppIEnumString	Where to save the returned enumerator pointer. NULL if the HRESULT is other than S_OK or S_FALSE.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	There is nothing to enumerate. However, an enumerator is still returned and must be released.
OPC_E_MAXEXCEEDED	The maximum number of values returnable by the server was exceeded.
E_FAIL	The function was unsuccessful.

Comments

Items are anything which can have data values, and for which the server will return a fully qualified ItemID and a handle. Branches and leafs are mutually exclusive sets. Leafs are always Items, and a branch is an Item if the client can get a fully qualified ItemID for it, and thus ask for and receive a server handle for it.

4.4.2.2. IOPCHDA_Browser::ChangeBrowsePosition

A Required Method

```
HRESULT ChangeBrowsePosition(
      [in]          OPCHDA_BROWSEDIRECTION
         dwBrowseDirection,
      [in,string]   LPCWSTR         szString
      );
```

Description

This function provides a way to move up or down relative to the current position, or directly to a given position in a hierarchy.

Parameters	Description
dwBrowseDirection	The direction to move the browse interface.
szString	Indicates the branch name when moving down the hierarchy and the full path to a branch when moving directly to a position. Note: this parameter is ignored

	when moving up the hierarchy and should be set to an empty string. For OPCHDA_BROWSE_DIRECT, if an empty string is passed, the server shall move the browser to the root position.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

4.4.2.3. IOPCHDA_Browser::GetItemID

A Required Method

```
HRESULT GetItemID (
     [in,string]   LPCWSTR    szNode,
     [out,string]  LPWSTR     *pszItemID
     );
```

Description

This function provides a way to get a fully qualified item identification. This is required since the browsing functions return only the components or tokens that make up an ItemID and do not return the delimiters used to separate those tokens.

Parameters	Description
szNode	An item name from the Enum set returned by GetEnum as an OPCHDA_LEAF or OPCHDA_ITEMID
pszItemID	A pointer to the string which contains the fully qualified ItemID.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

Comments

This function returns the fully qualified ItemID for the OPCHDA_LEAF or OPCHDA_ITEMID in the Enum set obtained from the GetEnum method for the current browse position. This is an ID that can be passed to IOPCHDA_Server::GetItemHandles.

4.4.2.4. IOPCHDA_Browser::GetBranchPosition

A Required Method

```
HRESULT GetBranchPosition (
      [out,string] LPWSTR    *pszBranchPos
     );
```

Description

This function provides the current browse position in the hierarchy.

Parameters	Description
pszBranchPos	A pointer to a string which contains the fully qualified path to the current BRANCH or LEAF (ItemID) browse position.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

Comments

The fully qualified path obtained from this method can be used to set the browse position with the ChangeBrowsePosition method using the OPCHDA_BROWSE_DIRECT flag.

4.4.3. IOPCHDA_SyncRead

This is an Required Interface

4.4.3.1. IOPCHDA_SyncRead::ReadRaw

A Required Method

```
HRESULT ReadRaw (
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD    dwNumValues,
     [in] BOOL     bBounds,
     [in] DWORD    dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out, size_is(,dwNumItems)] OPCHDA_ITEM ** ppItemValues,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function reads the values, qualities, and timestamps from the history database for the specified time domain for one or more items. When bBounds is TRUE, the bounding values for the time domain are returned. This function is intended for use by clients wanting the actual data saved within the historian. The actual data may be compressed or may be all data collected for the item depending on the historian and the storage rules invoked when the item values were saved. The optional bounding values are provided to allow clients to interpolate values for the start and end times when trending the actual data on a display.

Parameters	Description
htStartTime	The beginning of the history period to be read. **Note**: the time structure is allocated and freed by the client.

htEndTime	The end of the history period to be read. Note: the time structure is allocated and freed by the client.
dwNumValues	The maximum number of values returned for any item over the time range. If only one time is specified, the time range must extend to return this number of values.
bBounds	True if bounding values should be returned.
dwNumItems	The number of items to be read.
phServer	The list of server item handles for the items to be read.
ppItemValues	Array of structures in which the item values are returned. The order of the structures in the array shall be the same as the order of the server item handles.
ppErrors	Array of HRESULTs indicating the success of the individual item reads. The errors correspond to the handles passed in phServer. This indicates whether the read succeeded in obtaining a defined value, quality and timestamp. NOTE that any FAILED error code indicates that the corresponding OPCHDA_ITEM struct is undefined.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
OPC_E_MAXEXCEEDED	The maximum number of values requested (dwNumValues) is greater than the server limit of maximum values returned.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	**Description**
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_S_MOREDATA	More data is available in the time range beyond the number of values requested.
OPC_S_NODATA	No data was found in the specified time range.
E_FAIL	The item read was unsuccessful.

Comments

The time domain of the request is defined by htStartTime, htEndTime, and dwNumValues; at least two of these must be specified. If htEndTime is less than htStartTime, or htEndTime and dwNumValues alone are specified, the data will be returned in reverse order, with later data coming first. If all three are specified, the call shall return up to dwNumValues results going from htStartTime to htEndTime, in either ascending or descending order depending on the relative values of htStartTime and htEndTime. If dwNumValues is 0, then all the values in the range are returned. A null value for OPCHDA_TIME (see section 5.3.4) is used to indicate htStartTime or htEndTime is not specified.

If either htStartTime or htEndTime is given in string (relative) format, the absolute time of the OPCHDA_TIME structure (ftTime) shall be set to the FILETIME which the relative time was translated to by the server.

It is specifically allowed for the htStartTime and the htEndTime to be identical. This allows the client to request just one value. It is specifically not allowed for the server to return E_INVALIDARG if the requested time domain is outside of the server's range. Such a case shall be treated as an interval in which no data exists.

If more than dwNumValues results exist within that time range, the ppErrors entry for that ItemID shall be OPC_S_MOREDATA. When OPC_S_MOREDATA is returned, clients wanting the next dwNumValues values should call ReadRaw again with the timestamp of the oldest value returned for the item as the new htStartTime and the original value of htEndTime unchanged (reverse htStartTime and htEndTime if reverse order is needed). Note that the second call will return a duplicate of the last value in the previous call.

If bounding values are requested and a non-zero dwNumValues was specified, any bounding values returned are included in the dwNumValues count. If dwNumValues is 1, then only the start bound is returned (the End bound if reverse order is needed). If dwNumValues is 2, then the data point, and the start bound is returned (the End bound if reverse order is needed).

When bounding values are requested and no bounding value is found, the corresponding array elements in the ppItemValues will have a quality of OPCHDA_NOBOUND, a timestamp equal to the start or end time, as appropriate, and a VARIANT with a value of VT_EMPTY. How far back or forward to look in history for bounding values is server dependent.

For cases where only one of htStartTime or htEndTime, and a non-zero dwNumValues is specified, then the last value in history is considered the End bound (the Start bound if reverse order is needed).

For an interval in which no data exists, if bounding values are not requested or are not found, the corresponding ppErrors shall be OPC_S_NODATA, and the OPCHDA_Item shall have a dwCount of 0. If bounding values are requested and one or both exist, the ppError return is S_OK and the bounding value(s) are returned. And, of course, if any ppError code is not S_OK, the HRESULT returned to the client must be S_FALSE.

4.4.3.2. IOPCHDA_SyncRead::ReadProcessed

This method was changed between v1.0 and v1.1 of the standard, to pass the haAggregate as a DWORD rather than an ENUM, to allow vendors to specify their own aggregates. Servers and clients build with v1.0 of the standard will work with those built with v1.1, but v1.0 clients may not be compatible with v1.1 servers which return vendor-specified aggregates.

An Optional Method

```
HRESULT ReadProcessed (
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] FILETIME ftResampleInterval,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] DWORD * haAggregate,
     [out, size_is(,dwNumItems)] OPCHDA_ITEM ** ppItemValues,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function computes aggregate values, qualities, and timestamps from data in the history database for the specified time domain for one or more items. The time domain is divided into subintervals of duration ftResampleInterval. The specified haAggregate is calculated for each subinterval beginning with htStartTime by using the data within the next ftResampleInterval.

This function is intended to provide values calculated with respect to the resample interval. For example, this function can provide hourly statistics such as Maximum, Minimum, Average, etc. for each item during the specified time domain when ftResampleInterval is 1 hour.

Parameters	**Description**
htStartTime	The beginning of the history period to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be read. Note: the time structure is allocated and freed by the client.
ftResampleInterval	Interval between returned values.
dwNumItems	The number of items to be read.
phServer	The list of server item handles for the items to be read.
haAggregate	The calculation to be performed on the raw data to create the values to be returned.
ppItemValues	Array of structures in which the item values are returned. The order of the structures in the array shall be the same as the order of the server item handles.
ppErrors	Array of HRESULTs indicating the success of the individual item reads. The errors correspond to the handles passed in phServer. This indicates whether the read succeeded in obtaining defined values, qualities and timestamps. NOTE any FAILED error code indicates that the contents of the corresponding

	OPCHDA_ITEM structure are UNDEFINED.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened
OPC_E_MAXEXCEEDED	The maximum number of values returnable by the server was exceeded. The resample interval is too small for the size of the time domain.
E_INVALIDARG	An Invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The Item was read successfully.
OPC_S_NODATA	No data was found in the specified time range.
OPC_S_EXTRADATA	There is more data available than was returned. (Used for MinimumActualTime and MaximumActualTime when there is more than one timestamp for the value.)
OPC_E_NOT_AVAIL	The requested aggregate is not available from the provided item.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
E_FAIL	The Item read was unsuccessful.

Comments

The domain of the request is defined by htStartTime, htEndTime, and htResampleInterval. If htStartTime or htEndTime is given in string (relative) format, the value returned shall be the FILETIME to which that value was translated by the server. All three must be specified. If htEndTime is less than htStartTime, the data shall be returned in reverse order, with later data coming first. If htStartTime and htEndTime are the same, the server shall return E_INVALIDARG, as there is no meaningful way to interpret such a case.

The values used in computing the aggregate for each subinterval shall include any value that falls exactly on the timestamp beginning the subinterval, but shall not include any value that falls directly on the timestamp ending the subinterval. Thus, each value shall be included only once in the calculation. If the time domain is in reverse order, we consider the later timestamp to be the one beginning the subinterval, and the earlier timestamp to be the one ending it. Note that this means that simply swapping the start and end times will not result in getting the same values back in reverse order, as the subintervals being requested in the two cases are not the same.

If the last subinterval computed is not a complete subinterval (the time domain of the request is not evenly divisible by the resample interval), the last aggregate returned shall be based upon that incomplete subinterval, and the quality of the aggregate shall be OPCHDA_PARTIAL.

For MinimumActualTime and MaximumActualTime, if more than one instance of the value exists within a subinterval, which instance (time stamp) of the value returned is server dependent. In any case, the server may set the OPCHDA_EXTRADATA quality flag to let the caller know that there are other timestamps with that value.

To obtain multiple aggregates for the same item, include the server item handle in the list of items for each desired aggregate.

If htResampleInterval is 0, the server shall create one aggregate value for the entire time range. This allows aggregates over large periods of time. A value with a timestamp equal to htEndTime will be excluded from that aggregate, just as it would be excluded from a subinterval with that ending time.

The timestamp returned with the aggregate shall be the time at the beginning of the interval, except where the aggregate specifies a different value. Also, the quality returned with the aggregate shall be GOOD (see the OPC Data Access Standard) if all values upon which the aggregate is based have a quality of GOOD. If any of those values have any other quality, the quality of the aggregate shall be Sub-Normal (0x010110xx).

If no data exists for a given Item in any subinterval in the time domain, the server shall return OPC_S_NODATA in the ppErrors array for that Item, and the corresponding ppItemValues structure shall have a dwCount of 0.

If data does exist in at least one subinterval for that item, the server shall return a timestamp, quality, and value for each subinterval in the time domain. For each subinterval for which there is no data, the server shall return a value of VT_EMPTY and a quality of OPCHDA_NODATA for that subinterval, with the appropriate timestamp. If the timestamp for the aggregate is based upon the data, the timestamp returned for OPCHDA_NODATA shall be that of the beginning of the interval.

Note: Vendor-defined aggregates may have different behavior with respect to whether trailing edge values are included in a subinterval. It is expected that server vendors will document the behavior of their vendor-specific aggregates clearly so that clients will know what values are included in each aggregate.

4.4.3.3. IOPCHDA_SyncRead::ReadAtTime

An Optional Method

```
HRESULT ReadAtTime (
      [in] DWORD dwNumTimeStamps,
      [in, size_is(dwNumTimeStamps)] FILETIME *ftTimeStamps,
      [in] DWORD dwNumItems,
      [in, size_is(dwNumItems)] OPCHANDLE * phServer,
      [out, size_is(,dwNumItems)] OPCHDA_ITEM ** ppItemValues,
      [out, size_is(,dwNumItems)] HRESULT ** ppErrors
      );
```

Description

This function reads the values and qualities from the history database for the specified timestamps for one or more items. This function is intended to provide values to correlate with other values with a known timestamp. For example, the values of sensors when lab samples were collected.

Parameters	**Description**
dwNumTimeStamps	The number of timestamps specified.
ftTimeStamps	The timestamps for the requested data.
dwNumItems	The number of items to be read.

phServer	The list of server item handles for the items to be read.
ppItemValues	Array of structures in which the item values are returned. The order of the structures in the array shall be the same as the order of the server item handles.
ppErrors	Array of HRESULTs indicating the success of the individual item reads. The errors correspond to the handles passed in phServer. This indicates whether the read succeeded in obtaining a defined value, quality and timestamp. NOTE that any FAILED error code indicates that the corresponding OPCHDA_ITEM struct is undefined.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_INVALIDARG	An Invalid parameter was passed.
E_NOTIMPL	This server does not support this function.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_S_NODATA	No data was found for the item.
E_FAIL	The item read was unsuccessful.

Comments

The order of the values and qualities returned shall match the order of the time stamps supplied in the request.

When no value exists for a specified timestamp, a value shall be interpolated from the surrounding values to represent the value at the specified timestamp. The interpolation will follow the same rules as the standard Intpolated aggregate as outlined in Section 2.9

The OPCHDA_ITEM structure will return OPCHDA_NOAGGREGATE in the haAggregate field.

If a value is found for the specified timestamp, the server will set the OPCHDA_RAW bit in the quality. If the value is interpolated from the surrounding values, the server will set the OPCHDA_INTERPOLATED bit in the quality.

4.4.3.4. IOPCHDA_SyncRead::ReadModified

An Optional Method

```
HRESULT ReadModified(
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD dwNumValues,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out, size_is(,dwNumItems)] OPCHDA_MODIFIEDITEM
       ** ppItemValues,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function reads the values, qualities, timestamps, user ID, and timestamp of the modification from the history database for the specified time domain for one or more items.

The purpose of this function is to read values from history that have been modified/replaced. If ReadRaw, ReadProcessed, or ReadAtTime has returned a quality of OPCHDA_EXTRADATA, indicating that there are values which have been superseded, this function reads those values which were superseded. Only values that have been modified/replaced or deleted are read by this function.

Parameters	**Description**
htStartTime	The beginning of the history period to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be read. Note: the time structure is allocated and freed by the client.
dwNumValues	The maximum number of values returned for any item over the time range. If only one time is specified, this number specifies the extent of the time range.
dwNumItems	The number of items to be read.
phServer	The list of server item handles for the items to be read.
ppItemValues	Array of structures in which the item values are returned. The order of the structures in the array shall be the same as the order of the server item handles.
ppErrors	Array of HRESULTs indicating the success of the individual item reads. The errors correspond to the handles passed in phServer. This indicates whether the read succeeded in obtaining a defined value, quality and time stamp. NOTE that any FAILED error code indicates that the corresponding OPCHDA_MODIFIEDITEM struct is undefined.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_INVALIDARG	An Invalid parameter was passed.
E_NOTIMPL	This server does not support this function.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation..
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_S_MOREDATA	More data is available in the time range beyond the number of values requested.
OPC_S_NODATA	No data was found in the specified time range.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The item read was unsuccessful.

Comments

The domain of the request is defined by htStartTime, htEndTime, and dwNumValues; at least two of these must be specified. If htEndTime is less than htStartTime, or htEndTime and dwNumValues alone are specified, the data shall be returned in reverse order, with later data coming first. If all three are specified, the call shall return up to dwNumValues results going from StartTime to EndTime, in either ascending or descending order depending on the relative values of StartTime and EndTime. If more than dwNumValues results exist within that time range, the ppErrors entry for that ItemID shall be OPC_S_MOREDATA. If dwNumValues is 0, then all the values in the range are returned.

If a value has been modified multiple times, all values for the time are returned. This means that a timestamp can appear in the array more than once. The order of the returned values with the same timestamp should be from most recent to oldest modified value. It is server dependent whether multiple modifications are kept or only the most recent.

4.4.3.5. IOPCHDA_SyncRead::ReadAttribute

A Required Method

```
HRESULT ReadAttribute (
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] OPCHANDLE hServer,
     [in] DWORD dwNumAttributes,
     [in, size_is(dwNumAttributes)] DWORD *pdwAttributeIDs,
     [out, size_is(,dwNumAttributes)] OPCHDA_ATTRIBUTE
       ** ppAttributeValues,
     [out, size_is(,dwNumAttributes)] HRESULT ** ppErrors
     );
```

Description

This function reads the attribute values and timestamps from the history database for the specified time domain for an item. If the current values for the attributes are desired, htStartTime shall be set to "NOW" and htEndTime shall be NULL time.

This function is intended to be used to retrieve attributes that have changed to correlate the values of these attributes with the values of their data. For example, the recalibration of a sensor may have required the normal maximum and minimum attributes to be changed.

Parameters	**Description**
htStartTime	The beginning of the attribute read period. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the attribute read period. Note: the time structure is allocated and freed by the client.
hServer	The server item handle for the item to be read.
dwNumAttributes	The number of attributes to be read.
pdwAttributeIDs	The list of attribute IDs to be read.
ppAttributeValues	Array of structures in which the item attribute values are returned. The order of the structures in the array shall be the same as the order of attribute IDs.
ppErrors	Array of HRESULTs indicating the success of the individual attribute reads. The errors correspond to the attribute IDs passed in dwAttributeIDs. This indicates whether the read succeeded in obtaining a defined value for the requested attribute. NOTE any FAILED error code indicates that the corresponding attribute value is UNDEFINED.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
OPC_E_INVALIDHANDLE	The handle is invalid.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	**Description**
S_OK	The attribute was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDATTRID	The attribute ID is not valid.
E_FAIL	The attribute read was unsuccessful.
OPC_S_CURRENTVALUE	No history available for attribute.

Comments

If the only attribute values available for the item are the current values, these shall be returned and the ppError set to OPC_S_CURRENTVALUE.

Except for the case where current values are requested (htStartTime = NOW, htEndTime = NULL), the server shall always return a beginning bounding value. Thus, if the client requests attribute values for Jan1, 1997 to October 1, 1997, the server shall return a value for the attribute on Jan 1, 1997, rather than the first value returned being the first new value for the attribute after Jan 1, 1997. Likewise, the timestamp for that first value shall be Jan 1, 1997, regardless of when the attribute actually took that value. All other timestamps shall be for the time when the value of the attribute changed.

Note that while the client can query the server for the native datatype of an ItemID, the client cannot assume that all data sent from the server will be that datatype. The datatype of a given ItemID may have changed over the life of the Item, and thus clients should be able to handle receiving data of a different datatype than that returned from this call.

4.4.4. IOPCHDA_SyncUpdate

This is an Optional Interface

4.4.4.1. IOPCHDA_SyncUpdate::QueryCapabilities

This call uses an ENUM for the return parameter; this is incorrect for a bitmask value and precludes servers specifying more than one supported method.
In order to avoid changes to the IDL for this maintenance update, the correction for this is deferred until version 2.0

A Required Method

```
HRESULT QueryCapabilities(
     [out] OPCHDA_UPDATECAPABILITIES *pCapabilities
     );
```

Description

This function specifies the update methods that the server supports.

Parameters	Description
pCapabilities	The methods supported by the interface.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_INVALIDARG	An invalid parameter was passed.
E_NOTIMPL	This server does not support this function.
E_FAIL	The function was unsuccessful.

4.4.4.2. IOPCHDA_SyncUpdate::Insert

An Optional Method

```
HRESULT Insert(
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [in, size_is(dwNumItems)] VARIANT *vDataValues,
     [in, size_is(dwNumItems)] DWORD *pdwQualities,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function inserts values and qualities into the history database at the specified timestamps for one or more items.   If a value exists at the specified timestamp, the new value shall not be inserted; instead ppErrors shall indicate an error.

This function is intended to insert new values at the specified timestamps; e.g., the insertion of lab data to reflect the time of data collection.

Parameters	Description
dwNumItems	The number of items to be inserted.
phServer	The list of server item handles for the items to be inserted.
ftTimeStamps	Array of the time stamps for the new values.
vDataValues	Array of structures which contain the new item values.
pdwQualities	Array of the quality flags of the new values. These are the Data Access Quality flags, not the HDA quality flags.
ppErrors	Array of HRESULTs indicating the success of the individual item. The errors correspond to the handles passed in phServer. This indicates whether the insert succeeded.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was inserted successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_E_DATAEXISTS	Unable to insert – data already present.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The Item update was unsuccessful.

Comments

The phServer, ftTimeStamps, vValues and pdwQualities are arrays of size numItems. To insert a value for a number of different items at a single time, then ftTimeStamp array would have the same time for each item. To insert a stream of values, timestamps and qualities for a single item, set the size of the item array to the number of values to be inserted and put the same ItemID in each element.

4.4.4.3. IOPCHDA_ SyncUpdate::Replace

An Optional Method

```
HRESULT Replace(
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [in, size_is(dwNumItems)] VARIANT *vDataValues,
     [in, size_is(dwNumItems)] DWORD *pdwQualities,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function replaces the values and qualities in the history database at the specified timestamps for one or more items. If no value exists at the specified timestamp, the new value shall not be inserted; instead ppErrors shall indicate an error.

This function is intended to replace existing values at the specified timestamp; e.g., correct lab data that was improperly processed, but inserted into the history database.

Parameters	Description
dwNumItems	The number of items to be replaced.

phServer	The list of server item handles for the items to be replaced.
ftTimeStamps	Array of the time stamps for the new values.
vDataValues	Array of structures which contain the new item values.
pdwQualities	Array of the quality flags of the new values. These are the Data Access Quality flags, not the HDA quality flags.
ppErrors	Array of HRESULTs indicating the success of the individual item. The errors correspond to the handles passed in phServer. This indicates whether the edit succeeded in replacing a defined value, quality and timestamp.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was updated successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_E_NODATAEXISTS	Unable to replace – no data exists.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The Item update was unsuccessful.

Comments

The phServer, ftTimeStamps, vValues and pdwQualities are arrays of size numItems. To replace the values for a number of different items at a single time, then ftTimeStamp array would have the same time for each item. To replace a stream of values, timestamps and qualities for a single item, set the size of the item array to the number of values to be replaced and put the same ItemID in each element.

4.4.4.4. IOPCHDA_ SyncUpdate::InsertReplace

An Optional Method

```
HRESULT InsertReplace (
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [in, size_is(dwNumItems)] VARIANT *vDataValues,
     [in, size_is(dwNumItems)] DWORD *pdwQualities,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function inserts or replaces values and qualities in the history database for the specified timestamps for one or more items. If the item has a value at the specified timestamp, the new value and quality will replace the old one. If there is no value at that timestamp, the function will insert the new data. The function runs to completion before returning.

This function is intended to unconditionally insert/replace values and qualities; e.g., correction of values for bad sensors.

Parameters	Description
dwNumItems	The number of items to be edited.
phServer	The list of server item handles for the items to be edited.
ftTimeStamps	Array of the time stamps for the new values.
vDataValues	Array of structures which contain the new item values.
pdwQualities	Array of the quality flags of the new values. These are the Data Access Quality flags, not the HDA quality flags.
ppErrors	Array of HRESULTs indicating the success of the individual item. The errors correspond to the handles passed in phServer. This indicates whether the edit succeeded in inserting/replacing a defined value, quality and timestamp.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was updated successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_S_INSERTED	The requested insert occurred.
OPC_S_REPLACED	The requested replace occurred.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The Item update was unsuccessful.

Comments

The phServer, ftTimeStamps, vValues and pdwQualities are arrays of size numItems. To set values and qualities for a number of different items at a single time, then ftTimeStamp array would have the same time for each item. To set a stream of values, timestamps and qualities for a single item, set the size of the item array to the number of values to be inserted/replaced and put the same ItemID in each element.

S_OK as a ppError return code for an individual value is allowed when the HDA server is unable to say whether there was already a value at that timestamp. If the HDA server can determine whether the new value replaces a value that was already there, it should use OPC_S_INSERTED or OPC_S_REPLACED to return that information.

4.4.4.5. IOPCHDA_ SyncUpdate::DeleteRaw

An Optional Method

```
HRESULT DeleteRaw (
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out, size_is(,dwNumItems)] HRESULT **ppErrors
     );
```

Description

This function deletes the values, qualities, and timestamps from the history database for the specified time domain for one or more items.

This function is intended to be used to delete data that has been accidentally entered into the history database; e.g., deletion of data from a source with incorrect timestamps.

Parameters	Description
htStartTime	The beginning of the history period to be deleted. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be deleted. Note: the

	time structure is allocated and freed by the client.
dwNumItems	The number of items to be deleted
phServer	The list of server item handles for the items to be deleted.
ppErrors	Array of HRESULTs indicating the success of the individual item deletes. The errors correspond to the handles passed in phServer. This indicates whether the delete succeeded in removing the specified items. NOTE: any FAILED error code indicates that the corresponding item was not completely deleted.

HRESULT Return Codes

Return Code	Description
S_OK	The item values were deleted successfully.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was deleted successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_S_NODATA	No values to delete for the item in the specified time range.
E_FAIL	The item delete was unsuccessful.

Comments

If no data is found in the time range for a particular item, a success status of S_FALSE is returned and the error code for that item is OPC_S_NODATA.

4.4.4.6. IOPCHDA_ SyncUpdate::DeleteAtTime

An Optional Method

```
HRESULT DeleteAtTime (
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [out, size_is(,dwNumItems)] HRESULT **ppErrors
     );
```

Description

This function deletes the values and qualities in the history database for the specified timestamps for one or more items.

This function is intended to be used to delete specific data from the history database; e.g., lab data that is incorrect and cannot be correctly reproduced.

Parameters	Description
dwNumItems	The number of items to be deleted.
phServer	The list of server item handles for the items to be deleted.
ftTimeStamps	The timestamps for the data to be deleted.
ppErrors	Array of HRESULTs indicating the success of the individual item deletes. The errors correspond to the timestamps passed in phServer.

HRESULT Return Codes

Return Code	Description
S_OK	The item values were deleted successfully.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was deleted successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_S_NODATA	No values matching times given to delete.
E_FAIL	The item delete was unsuccessful.

4.4.5. IOPCHDA_SyncAnnotations

This is an Optional Interface

4.4.5.1. IOPCHDA_SyncAnnotations::QueryCapabilities

This call uses an ENUM for the return parameter; this is incorrect for a bitmask value and precludes servers specifying more than one supported method.
In order to avoid changes to the IDL for this maintenance update, the correction for this is deferred until version 2.0

A Required Method

```
HRESULT QueryCapabilities(
     [out] OPCHDA_ANNOTATIONCAPABILITIES *pCapabilities
     );
```

Description

This function specifies which update methods the server supports. It is a required method for all servers which support the OPCHDA SyncAnnotations interface.

Parameters	Description
pCapabilities	The methods supported by the interface.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

4.4.5.2. IOPCHDA_SyncAnnotations::Read

A Required Method

```
HRESULT Read(
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD    dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out, size_is(,dwNumItems)] OPCHDA_ANNOTATION
       ** ppAnnotationValues,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function reads the annotations from the history database in the specified time domain for the specified item IDs.

This function is intended to read annotations for an item at specified timestamps.

Parameters	Description
htStartTime	The beginning of the history period to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be read. Note: the time structure is allocated and freed by the client.
dwNumItems	The number of annotation items to be read.
phServer	The list of server item handles for the annotation items to be read.
ppAnnotationValues	Array of structures in which the annotation values are returned. The order of the structures in the array shall be the same as the order of server item handles.
ppErrors	Array of HRESULTs indicating the success of the individual annotation reads. The errors correspond to the handles passed in phServer. This indicates whether the read succeeded in obtaining a defined annotation item. NOTE any FAILED error code indicates that the corresponding Annotation structure is undefined.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
OPC_S_NODATA	No data was found in the specified time range.
E_FAIL	The item read was unsuccessful.

Comments

The time domain of the request is defined by htStartTime and htEndTime. If htEndTime is less than htStartTime the data shall be returned in reverse order, with later data coming first.

If either htStartTime or htEndTime is given in string (relative) format, the absolute time of the OPCHDA_TIME structure (ftTime) shall be set to the FILETIME which the relative time was translated to by the server.

OPC_S_NODATA is returned only if no annotations exist over the time domain.

4.4.5.3. IOPCHDA_SyncAnnotations:: Insert

An Optional Method

```
HRESULT Insert(
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [in, size_is(dwNumItems)] OPCHDA_ANNOTATION
       *pAnnotationValues,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function inserts annotations into the history database.

This function is intended to insert annotations by users to document observations for a value at a specified timestamp.

Parameters	Description
dwNumItems	The number of annotation items to be inserted.
phServer	The list of server item handles for the annotation items to be inserted.

ftTimeStamps	Array of time stamps for the annotations to be inserted.
pAnnotationValues	Array of structures containing the annotation values to be inserted.
ppErrors	Array of HRESULTs indicating the success of the individual annotation inserts. The errors correspond to the handles passed in phServer.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The annotation was inserted successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
E_FAIL	The item insert was unsuccessful.

4.5. Asynchronous Interfaces

Asynchronous operations allow a client to send a request to a server without waiting for the server to fill the request and return the data. Each operation has an associated transaction ID (created by the client) which is returned with the data during the callback to the client. Asynchronous methods for OPC HDA servers are implemented using IConnectionPoint. This allows the client to establish different callbacks to handle different types of data transfers. While there is some information given on IConnectionPoint later in this document, it is advisable to read the Microsoft™ documentation.

It is anticipated that some servers will not support all of the asynchronous interfaces specified here. However, all servers must support IConnectPointContainer, and any server which supports any asynchronous interface must support the IOPCHDA_DataCallback ConnectionPoint. If a server does not support a specific interface, it need not implement the means to send a callback to the matching callback routine in the client's IOPCHDA_DataCallback object.

The client provides a TransactionID to differentiate one call from another, if it needs to do so. Since the response to an async call can actually arrive before the call completes, the client should store this TransactionID before making the call, so the callback routine will have access to the TransactionID. Conversely, the CancelID is generated by the server, and is used to cancel async requests if the client wishes to do so.

4.5.1. IOPCHDA_AsyncRead

This is an Optional Interface

4.5.1.1. IOPCHDA_AsyncRead::ReadRaw

A Required Method

```
HRESULT ReadRaw (
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD dwNumValues,
     [in] BOOL bBounds,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors);
```

Description

This function reads the values, qualities, and timestamps from the history database for the specified time domain for one or more items. When bBounds is TRUE, the bounding values for the time domain are returned. This function is intended for use by clients wanting the actual data saved within the historian. The actual data may be compressed or may be all data collected for the item depending on the historian and the storage rules invoked when the item values were saved. The optional bounding values are provided to allow clients to interpolate values for the start and end times when trending the actual data on a display.

The results are returned via the client's IOPCHDA_DataCallback::OnReadComplete method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The beginning of the history period to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be read. Note: the time structure is allocated and freed by the client.
dwNumValues	The maximum number of values returned for any item over the time range. If only one time is specified, the time range must extend to return this number of values.
bBounds	True if bounding values should be returned.
dwNumItems	The number of items to be read.
phServer	The list of server item handles for the items to be read.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
OPC_E_MAXEXCEEDED	The maximum number of values requested (dwNumValues) is greater than the server limit of maximum values returned.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comments

The time domain of the request is defined by htStartTime and htEndTime. If htEndTime is less than htStartTime, the data shall be returned in reverse order, with later data coming first. Unlike the synchronous method, if dwNumValues is non-zero, the function continues sending data in blocks of size dwNumValues until all requested data has been sent. The CancelID can be used to cancel the request.

If either htStartTime or htEndTime is given in string (relative) format, the absolute time of the OPCHDA_TIME structure (ftTime) shall be set to the FILETIME which the relative time was translated to by the server. A null value for OPCHDA_TIME (see section 5.3.4) is used to indicate htStartTime or htEndTime is not specified.

The callback shall contain data for all ItemIDs in the request except those for which a FAILED error code was returned.

See the discussion at IOPCHDA_SyncRead:ReadRaw for specifics of what a server should return to the client in various situations.

4.5.1.2. IOPCHDA_AsyncRead::AdviseRaw

An Optional Method

```
HRESULT AdviseRaw(
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in] FILETIME ftUpdateInterval,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function reads the values, qualities, and timestamps from the history database from the specified start time at the update interval for one or more items.

This function is intended to be used to update the client software with new data as it becomes available; e.g., update a trend with new data on a periodic basis.

The results are returned via the client's IOPCHDA_DataCallback::OnDataChange method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The beginning of the history period to be read. Note: the time structure is allocated and freed by the client.
ftUpdateInterval	Update interval to send new data
dwNumItems	The number of items to be read.
phServer	The list of server item handles for the items to be read.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.
OPC_S_UNSUPPORTEDRATE	The requested update interval is not supported by the server.

ppError Codes

Return Code	**Description**
S_OK	The item was read successfully.
E_INVALIDARG	An Invalid parameter was passed.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comments

The request will be for all data from the htStartTime into the future, as it is collected, reported at the rate specified by the ftUpdateInterval. Reporting will continue until the request is canceled. Caution should be used in specifying start times prior to the present, as data which is already available will be returned unthrottled, with ftUpdateInterval worth of data in each response. Once all data which has already been collected has been sent, new data will be sent for every ftUpdateInterval.

If there is no new data, the server shall still send a response with an entry for each Item, with a zero dwCount and a ppErrors code of OPC_S_NODATA for any item for which there was no data. This way a client can be sure that the interval has been processed.

This function uses the ftUpdateInterval to throttle the rate of data return.

No annotations will be identified in an advise.

See the discussion at IOPCHDA_SyncRead:ReadRaw for specifics of what a server should return to the client in various situations.

4.5.1.3. IOPCHDA_AsyncRead::ReadProcessed

This method was changed between v1.0 and v1.1 of the standard, to pass the haAggregate as a DWORD rather than an ENUM, to allow vendors to specify their own aggregates.   Servers and clients build with v1.0 of the standard will work with those built with v1.1, but v1.0 clients may not be compatible with v1.1 servers which return vendor-specified aggregates.

An Optional Method

```
HRESULT ReadProcessed (
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] FILETIME ftResampleInterval,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] DWORD * haAggregate,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function computes aggregate values, qualities, and timestamps from data in the history database for the specified time domain for one or more items. The time domain is divided into subintervals of duration ftResampleInterval. The specified haAggregate is calculated for each subinterval beginning with htStartTime by using the data within the next ftResampleInterval.

This function is intended to provide values calculated with respect to the resample interval. For example, this function can provide hourly statistics such as Maximum, Minimum, Average, et. al. for each item during the specified time domain when ftResampleInterval is 1 hour.

The results are returned via the client's IOPCHDA_DataCallback::OnReadComplete method.

Parameters	Description
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The beginning of the history period to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be read. Note: the time structure is allocated and freed by the client.
ftResampleInterval	Interval between returned values.

dwNumItems	The number of items to be read.
phServer	The list item handles for the items to be read from the server.
haAggregate	The list of aggregate values to be returned.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
OPC_E_MAXEXCEEDED	The maximum number of values returnable by the server was exceeded.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comments

The domain of the request is defined by htStartTime, htEndTime, and htResampleInterval. If htStartTime or htEndTime is given in string (relative) format, the value returned shall be the FILETIME to which that value was translated by the server. All three must be specified. If htEndTime is less than htStartTime, the data shall be returned in reverse order, with later data coming first.

For MinimumActualTime and MaximumActualTime, if more than one instance of the value exists within a subinterval, which instance (time stamp) of the value is returned is server dependent. In any case, the server may set the OPCHDA_EXTRADATA quality flag to let the caller know that there are other timestamps with that value.

If htResampleInterval is 0, the server shall create one aggregate value for the entire time range. This allows aggregates over large periods of time.

See the discussion at IOPCHDA_SyncRead:ReadProcessed for specifics of what a server should return to the client in various situations.

4.5.1.4. IOPCHDA_AsyncRead::AdviseProcessed

This method was changed between v1.0 and v1.1 of the standard, to pass the haAggregate as a DWORD rather than an ENUM, to allow vendors to specify their own aggregates. Servers and clients build with v1.0 of the standard will work with those built with v1.1, but v1.0 clients may not be compatible with v1.1 servers which return vendor-specified aggregates.

An Optional Method

```
HRESULT AdviseProcessed (
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in] FILETIME ftResampleInterval,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] DWORD * haAggregate,
     [in] DWORD dwNumIntervals,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function computes the aggregate values, qualities, and timestamps from the history database from the specified start time at the interval for one or more items.

This function is intended to be used to update the client software with new data as it becomes available; e.g., update a trend with new data on a periodic basis.

The results are returned via the client's IOPCHDA_DataCallback::OnDataChange method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The beginning of the history to be read. Note: the time structure is allocated and freed by the client.
ftResampleInterval	Interval between returned values.
dwNumItems	The number of items to be read.
phServer	The list server item handles for the items to be read.
haAggregate	The list of aggregate values to be returned.
dwNumIntervals	Number of resample intervals between updates.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.
OPC_S_UNSUPPORTEDRATE	The requested resample interval is not supported by the server.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comments

The request will be for all data from the htStartTime into the future, as it is collected, reported at the rate specified by: (dwNumIntervals* ftResampleInterval). The ftResampleInterval determines the subintervals to which the specified functions will be applied. Beginning with htStartTime and selecting the data within the next ftResampleInterval, the values specified by haAggregate will be determined for each subinterval. Reporting shall continue until the request is canceled. Caution should be used in specifying start times prior to the present, as data which is already available will be returned unthrottled, with dwNumIntervals worth of data in each response. Once all data which has already been collected has been sent, new data shall be sent as soon as a full dwNumIntervals worth of data is available.

If there is no new data for a (dwNumIntervals* ftResampleInterval) period, the server shall still send a response, with empty pointers for the arrays and dwCount = 0. This will allow the client to be sure that the connection is still active.

For MinimumActualTime and MaximumActualTime, if more than one instance of the value exists within a subinterval, which instance (time stamp) of the value returned is server dependent. In any case, the server may set the OPCHDA_EXTRADATA quality flag to let the caller know that there are other timestamps with that value.

See the discussion at IOPCHDA_SyncRead:ReadProcessed for specifics of what a server should return to the client in various situations.

4.5.1.5. IOPCHDA_AsyncRead::ReadAtTime

An Optional Method

```
HRESULT ReadAtTime (
     [in] DWORD dwTransactionID,
     [in] DWORD dwNumTimeStamps,
     [in, size_is(dwNumTimeStamps)] FILETIME *ftTimeStamps,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function reads the values and qualities from the history database for the specified timestamps for one or more items. This function is intended to provide values to correlate with other values with a known timestamp. For example, the values of sensors when lab samples were collected.

The results are returned via the client's IOPCHDA_DataCallback::OnReadComplete method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
dwNumTimeStamps	The number of time stamps specified.
ftTimeStamps	The timestamps for the requested data.
dwNumItems	The number of items to be read.
phServer	The list of server item handles for the items to be read.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comments

When no value exists for a specified timestamp, a value shall be interpolated from the surrounding values to represent the value at the specified timestamp. The interpolation will follow the same rules as the standard Intpolated aggregate as outlined in Section 2.9 .

The OPCHDA_ITEM structure will return OPCHDA_NOAGGREGATE in the haAggregate field.

If a value is found for the specified timestamp, the server will return OPCHDA_RAW in the quality. If the value is interpolated from the surrounding values, the server will return OPCHDA_INTERPOLATED in the quality.

4.5.1.6. IOPCHDA_AsyncRead::ReadModified

An Optional Method

```
HRESULT ReadModified (
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD dwNumValues,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function reads the values, qualities, timestamps, user ID, and timestamp of the modification from the history database for the specified time domain for one or more items.

The purpose of this function is to read values from history that have been modified/replaced (a value was returned with a quality of OPCHDA_EXTRADATA, indicating that there were other values for that item/timestamp which had been superseded).

The results are returned via the client's IOPCHDA_DataCallback::OnReadModifiedComplete method.

Parameters	Description
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The beginning of the history period to be read. Note:

	the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be read. Note: the time structure is allocated and freed by the client.
dwNumValues	The maximum number of values returned for any item over the time range. If only one time is specified, this number specifies the extent of the time range.
dwNumItems	The number of items to be read.
phServer	The list of server item handles for the items to be read.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comments

The time domain of the request is defined by htStartTime and htEndTime. If htEndTime is less than htStartTime, the data shall be returned in reverse order, with later data coming first. Unlike the synchronous method, if dwNumValues is non-zero, the function continues sending data in blocks of size dwNumValues until all requested data has been sent. The CancelID can be used to cancel the request.

If a value has been modified multiple times, all values for the time are returned. This means that a time stamp can appear in the array more than once. The order of the returned values with the same time stamp should be from most recent to oldest modified value. It is server dependent whether it keeps multiple modifications or only the most recent.

In asynchronous ReadModified, unlike in synchronous, if all three parameters (htStartTime, htEndTime & dwNumValues) are specified, the function continues sending data in blocks of size dwNumValues until all requested data has been sent. The CancelID which can be used to cancel the request.

4.5.1.7. IOPCHDA_AsyncRead::ReadAttribute

A Required Method

```
HRESULT ReadAttribute (
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] OPCHANDLE hServer,
     [in] DWORD dwNumAttributes,
     [in, size_is(dwNumAttributes)] DWORD * dwAttributeIDs,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumAttributes)] HRESULT ** ppErrors
     );
```

Description

This function reads the attribute values and timestamps from the history database for the specified time domain for an item.

This function is intended to be used to retrieve attributes that have changed to correlate the values of these attributes with the values of their data. For example, the recalibration of a sensor may have required the normal maximum and minimum attributes to be changed.

The results are returned via the client's IOPCHDA_DataCallback::OnReadAttributeComplete method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The beginning of the attribute history period to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the attribute history period to be read. Note: the time structure is allocated and freed by the client.
hServer	The server item handle for the item to be read
dwNumAttributes	The number of attributes to be read.
dwAttributeIDs	The list of attribute IDs to be read
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding dwAttributeID was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened
OPC_E_INVALIDHANDLE	The handle is invalid.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDATTRID	The attribute ID is not valid.
E_FAIL	The attribute read was unsuccessful.
OPC_S_CURRENTVALUE	No history available for attribute.

Comments

If the only attribute values available for the item are the current values, these shall be returned and the ppError set to OPC_S_CURRENTVALUE.

Except for the case where current values are requested (htStartTime = NOW, htEndTime = NULL time), the server shall always return a beginning bounding value. Thus, if the client requests attribute values for Jan1, 1997 to October 1, 1997, the server shall return a value for the attribute on Jan 1, 1997, rather than the first value returned being the first new value for the attribute after Jan 1, 1997. Likewise, the timestamp for that first value shall be Jan 1, 1997, regardless of when the attribute actually took that value. All other timestamps shall be for the time when the value of the attribute changed.

Note that while the client can query the server for the native datatype of an ItemID, the client cannot assume that all data sent from the server will be that datatype. The datatype of a given ItemID may have changed over the life of the Item, and thus clients should be able to handle receiving data of a different datatype than that returned from this call.

4.5.1.8. IOPCHDA_AsyncRead::Cancel

A Required Method

```
HRESULT Cancel(
     [in] DWORD dwCancelID
     );
```

Description

This function cancels the outstanding operation. The actual implementation is server specific, but the server shall respond via the client's IOPCHDA_DataCallback::OnCancelComplete method unless a FAILED error code is returned from the call. If a FAILED error code is returned, there will be no callback to the client's IOPCHDA_DataCallback::OnCancelComplete method.

Parameters	Description
dwCancelID	The server-generated cancelID which was returned from the original method call.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_INVALIDARG	The client has not established a connection via the OPCHDA_CancelComplete ConnectionPoint.
E_FAIL	The function was unsuccessful. The CancelID does not match any outstanding operation on the server.

4.5.2. IOPCHDA_AsyncUpdate

This is an Optional Interface

4.5.2.1. IOPCHDA_AsyncUpdate::QueryCapabilities

**This call uses an ENUM for the return parameter; this is incorrect for a bitmask value and precludes servers specifying more than one supported method.
In order to avoid changes to the IDL for this maintenance update, the correction for this is deferred until version 2.0**

A Required Method

```
HRESULT QueryCapabilities(
      [out] OPCHDA_UPDATECAPABILITIES*pCapabilities
      );
```

Description

This function specifies the update methods that the server supports.

Parameters	Description
pCapabilities	The methods supported by the interface.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

4.5.2.2. IOPCHDA_AsyncUpdate::Insert

An Optional Method

```
HRESULT Insert(
     [in] DWORD dwTransactionID,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [in, size_is(dwNumItems)] VARIANT *vDataValues,
     [in, size_is(dwNumItems)] DWORD *pdwQualities,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function inserts values and qualities into the history database for the specified timestamps for one or more items. If a value exists at the specified timestamp, the new value shall not be inserted; instead ppErrors shall indicate an error.

This function is intended to insert new values at the specified timestamps; e.g., the insertion of lab data to reflect the time of data collection.

The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
dwNumItems	The number of items to be inserted.
phServer	The list of server item handles for the items to be inserted.
ftTimeStamps	Array of the time stamps for the new values.
vDataValues	Array of structures which contain the item values.
pdwQualities	Array of the quality flags of the new values. These are the Data Access Quality flags, not the HDA quality flags.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was inserted successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

4.5.2.3. IOPCHDA_AsyncUpdate::Replace

An Optional Method

```
HRESULT Replace (
     [in] DWORD dwTransactionID,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [in, size_is(dwNumItems)] VARIANT *vDataValues,
     [in, size_is(dwNumItems)] DWORD *pdwQualities,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function replaces values and qualities in the history database at the specified timestamps for one or more items. If no value exists at the specified timestamp, the new value shall not be inserted; instead ppErrors shall indicate an error.

This function is intended to replace existing values at the specified timestamp; e.g., correct lab data that was improperly processed, but inserted into the history database.

The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method.

Parameters	Description
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
dwNumItems	The number of items to be replaced.
phServer	The list of server item handles for the items to be replaced.
ftTimeStamps	Array of the time stamps for the new values.
vDataValues	Array of structures which contain the item values.
pdwQualities	Array of the quality flags of the new values. These are the Data Access Quality flags, not the HDA quality flags.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was replaced successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

4.5.2.4. IOPCHDA_AsyncUpdate::InsertReplace

An Optional Method

```
HRESULT InsertReplace(
     [in] DWORD dwTransactionID,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [in, size_is(dwNumItems)] VARIANT *vDataValues,
     [in, size_is(dwNumItems)] DWORD *pdwQualities,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function inserts or replaces values and qualities at the specified timestamps for one or more items. If the item has a value at the specified timestamp, the new value and quality shall replace the old one. If there is no value at that timestamp, the function shall insert the new data.

This function is intended to unconditionally insert/replace values and qualities; e.g., correction of values for bad sensors.

The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method.

Parameters	Description
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
dwNumItems	The number of items to be inserted or replaced.
phServer	The list of server item handles for the items to be inserted or replaced.
ftTimeStamps	Array of the time stamps for the new values.
vDataValues	Array of structures which contain the item values.
pdwQualities	Array of the quality flags of the new values. These are

	the Data Access Quality flags, not the HDA quality flags.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comments

When the OnUpdateComplete call is sent to the client, S_OK as a ppError return code for an individual value is allowed when the HDA server is unable to say whether there was already a value at that timestamp. If the HDA server can determine whether the new value replaces a value that was already there, it should use OPC_S_INSERTED or OPC_S_REPLACED to return that information.

4.5.2.5. IOPCHDA_AsyncUpdate::DeleteRaw

An Optional Method

```
HRESULT DeleteRaw (
     [in] DWORD dwTransactionID,
     [in,out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD dwNumItems,
     [in, size_is (dwNumItems)] OPCHANDLE * phServer,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT **ppErrors
     );
```

Description

This function deletes the values, qualities, and timestamps from the history database for the specified time domain for one or more items.

This function is intended to be used to delete data that has been accidentally entered into the history database; e.g., deletion of data from a source with incorrect timestamps.

The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method.

Parameters	Description
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The beginning of the history period to be deleted. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be deleted. Note: the time structure is allocated and freed by the client.
dwNumItems	The number of items to be deleted.
phServer	The list of server item handles for the items to be deleted.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The item values were deleted successfully.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comment

4.5.2.6. IOPCHDA_AsyncUpdate::DeleteAtTime

An Optional Method

```
HRESULT DeleteAtTime (
     [in] DWORD dwTransactionID,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)]     OPCHANDLE * phServer,
     [in, size_is(dwNumItems)]     FILETIME ftTimeStamps,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT **ppErrors
     );
```

Description

This function deletes the values and qualities in the history database for the specified timestamps for one or more items.

This function is intended to be used to delete specific data from the history database; e.g., lab data that is incorrect and cannot be correctly reproduced.

The results are returned via the client's IOPCHDA_DataCallback::OnUpdateComplete method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
dwNumItems	The number of items to be deleted.
phServer	The list of server item handles for the items to be deleted.
ftTimeStamps	The timestamps for the data to be deleted.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	**Description**
S_OK	The item values were deleted successfully.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	**Description**
S_OK	The item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

4.5.2.7. IOPCHDA_AsyncUpdate::Cancel

A Required Method

```
HRESULT Cancel(
      [in] DWORD dwCancelID
      );
```

Description

This function cancels the outstanding operation. The actual implementation is server specific, but the server shall respond via the client's IOPCHDA_DataCallback::OnCancelComplete method.

Parameters	Description
dwCancelID	The server-generated cancelID which was returned from the original method call.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_INVALIDARG	The client has not established a connection via the OPCHDA_CancelComplete ConnectionPoint.
E_FAIL	The function was unsuccessful. The CancelID does not match any outstanding operation on the server.

4.5.3. IOPCHDA_AsyncAnnotations

4.5.3.1. IOPCHDA_ AsyncAnnotations::QueryCapabilities

This call uses an ENUM for the return parameter; this is incorrect for a bitmask value and precludes servers specifying more than one supported method.
In order to avoid changes to the IDL for this maintenance update, the correction for this is deferred until version 2.0

A Required Method

```
HRESULT QueryCapabilities(
     [out] OPCHDA_ANNOTATIONCAPABILITIES *pCapabilities
     );
```

Description

This function specifies the methods that the server supports.

Parameters	Description
pCapabilities	The methods supported by the interface.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_FAIL	The function was unsuccessful.

Comments

While a part of the AsyncAnnotations interface, this method will actually run to completion before returning.

4.5.3.2. IOPCHDA_AsyncAnnotations::Read

A Required Method

```
HRESULT Read(
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function reads the annotations from the history database in the specified time domain for the specified item IDs.

This function is intended to read annotations for an item at specified timestamps.

The results are returned via the client's IOPCHDA_DataCallback::OnReadAnnotations method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The beginning of the history period to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The end of the history period to be read. Note: the time structure is allocated and freed by the client.
dwNumItems	The number of annotation items to be read.
phServer	The list of server item handles for the annotation items to be read.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating the success of the individual annotation reads. The errors correspond to the handles passed in phServer. This indicates whether the read succeeded in obtaining a defined annotation item. NOTE any FAILED error code indicates that the corresponding Annotation structure is undefined.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The item was read successfully.
E_INVALIDARG	An Invalid parameter was passed.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

Comments

The time domain of the request is defined by htStartTime and htEndTime. If htEndTime is less than htStartTime the data shall be returned in reverse order, with later data coming first.

If either htStartTime or htEndTime is given in string (relative) format, the absolute time of the OPCHDA_TIME structure (ftTime) shall be set to the FILETIME which the relative time was translated to by the server.

OPC_S_NODATA is returned only if no values are returned.

The order of the data returned shall match the order of the ItemIDs in the request.

4.5.3.3. IOPCHDA_AsyncAnnotations::Insert

An Optional Method

```
HRESULT Insert(
     [in] DWORD dwTransactionID,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
     [in, size_is(dwNumItems)] OPCHDA_ANNOTATION
       *pAnnotationValues,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function inserts annotations into the history database.

This function is intended to insert annotations by users to document observations for a value at a specified timestamp.

The results are returned via the client's IOPCHDA_DataCallback::OnInsertAnnotations method.

Parameters	Description
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
dwNumItems	The number of annotation items to be inserted.
phServer	The list of server item handles for the annotation items to be inserted.
ftTimeStamps	Array of time stamps for the annotations to be inserted.
pAnnotationValues	Array of structures containing the annotation values to be inserted.

pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating the success of the individual annotation inserts. The errors correspond to the handles passed in phServer.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The annotation was inserted successfully.
E_INVALIDARG	An Invalid parameter was passed.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.

4.5.3.4. IOPCHDA_AsyncAnnotations::Cancel

A Required Method

```
HRESULT Cancel(
     [in] DWORD dwCancelID
     );
```

Description

This function cancels the outstanding operation. The actual implementation is server specific, but the server shall respond via the client's IOPCHDA_DataCallback::OnCancelComplete method.

Parameters	Description
dwCancelID	The server-generated cancelID which was returned from the original method call.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
E_INVALIDARG	The client has not established a connection via the OPCHDA_CancelComplete ConnectionPoint.
E_FAIL	The function was unsuccessful. The CancelID does not match any outstanding operation on the server.

4.6. Playback Interface

4.6.1. IOPCHDA_Playback

This is an Optional Interface

This interface supports the playback functionality of a History server. This provides the capability to get an initial set of data from the History server and then get continual updates of historical data. This is different than the Asynchronous Advise methods in that those methods are centered around the current time. The playback interface supports methods that retrieval data from the past and then supply updates from stored data. Typically the updates are sent at a rate that is more frequent than the time the data was stored. For example, the request could be to send 10 minutes worth of data every minute.

4.6.1.1. IOPCHDA_Playback::ReadRawWithUpdate

A Required Method

```
HRESULT ReadRawWithUpdate(
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] DWORD dwNumValues,
     [in] FILETIME ftUpdateDuration,
     [in] FILETIME ftUpdateInterval,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This function initially retrieves data from the start time to the end time. After the initial response it periodically (every ftUpdateInterval) responds with an ftUpdateDuration amount of data. The time of the last value returned in the initial response is used as the start time for the first update. After that, the time of the last value returned in an update is used as the start time for the next update.

This function is intended to be used to playback raw history data. By controlling the update interval, the data can be displayed on trends in real time, in slower motion, or faster than real time.

The results are returned via the client's IOPCHDA_DataCallback::OnPlayback method.

Parameters	**Description**
dwTransactionID	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The earliest time of the history to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The latest time of the history to be read. The end time must be greater than the start time, otherwise INVALID_PARMS is returned. Note: the time structure is allocated and freed by the client.

dwNumValues	The maximum number of values returned for any item over the time range. If only one time is specified, this number specifies the extent of the time range.
ftUpdateDuration	The amount of time the update covers in.
ftUpdateInterval	The interval to send data for updates.
dwNumItems	The number of items to be read.
phServer	The list of server item handles for the items to be read.
pdwCancelID	Place to return a Server generated ID to be used in case the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating the success of the individual item reads. Indicates only whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
OPC_E_MAXEXCEEDED	The maximum number of values returnable by the server was exceeded.
E_INVALIDARG	An Invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The Item was read successfully.
S_NODATA	The function found no data to return.
E_INVALIDARG	An Invalid parameter was passed.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
E_FAIL	The Item read was unsuccessful.

Comments

Playback is only supported in the forward direction. The domain of the initial request is defined by htStartTime, htEndTime, and dwNumValues The value of htStartTime must be defined. If htEndTime is not specified, the request shall be for all data from the htStartTime for the requested number of values. Then further data shall be sent according to the ftUpdateDuration and ftUpdateInterval from the time of the last value returned.

If either the htStartTime or htEndTime is given in string (relative) format, the absolute time of the OPCHDA_TIME structure (ftTime) will be set to the FILETIME the relative time was translated to by the server.

This request continues sending data in blocks of dwNumvals until all requested data has been sent, returns transaction ID which can be used to cancel the request, and uses the update rate on the group to throttle the rate of block returns.

The dwNumValues defines the maximum number of values for any item which will be returned in a single callback. This could be for the initial set of data or any subsequent updates (notice therefore that an update may require more than one callback).

Implementation of the operation is server dependent.

4.6.1.2. IOPCHDA_Playback::ReadProcessedWithUpdate

This method was changed between v1.0 and v1.1 of the standard, to pass the haAggregate as a DWORD rather than an ENUM, to allow vendors to specify their own aggregates. Servers and clients build with v1.0 of the standard will work with those built with v1.1, but v1.0 clients may not be compatible with v1.1 servers which return vendor-specified aggregates.

An Optional Method

```
HRESULT ReadProcessedWithUpdate(
     [in] DWORD dwTransactionID,
     [in, out] OPCHDA_TIME *htStartTime,
     [in, out] OPCHDA_TIME *htEndTime,
     [in] FILETIME ftResampleInterval,
     [in] DWORD dwNumIntervals,
     [in] FILETIME ftUpdateInterval,
     [in] DWORD dwNumItems,
     [in, size_is(dwNumItems)] OPCHANDLE * phServer,
     [in, size_is(dwNumItems)] DWORD * haAggregate,
     [out] DWORD *pdwCancelID,
     [out, size_is(,dwNumItems)] HRESULT ** ppErrors
     );
```

Description

This operation initially retrieves data from the start time to the end time. After the initial response it periodically (every ftUpdateInterval) responds with dwNumIntervals worth of data divided into ftResampleInterval sized bins. The time of the last value returned in the initial response is used as the start time for the first update. After that, the time of the last value returned in an update is used as the start time for the next update.

This function is intended to be used to playback processed history data. By controlling the update interval, the data can be displayed on trends in real time, in slower motion, or faster than real time.

The results are returned via the client's IOPCHDA_DataCallback::OnPlayback method.

Parameters	**Description**
dwTransaction	An identifier created by the client and passed to the server in this call. The server shall return this identifier along with the results of this call.
htStartTime	The earliest time of the history to be read. Note: the time structure is allocated and freed by the client.
htEndTime	The latest time of the history to be read. Note: the time structure is allocated and freed by the client.
ftResampleInterval	Time between return values.
dwNumIntervals	The number of ResampleIntervals in an update.
ftUpdateInterval	The interval to send data for updates.
dwNumItems	The number of items to be read.
phServer	The list of processed server items to be retrieved.
haAggregate	The list of processed values to be returned.
pdwCancelID	Place to return a Server generated ID to be used in case

	the operation needs to be canceled.
ppErrors	Array of HRESULTs indicating the success of the individual item reads. Indicates only whether the corresponding server handle was valid.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
S_FALSE	The function was partially successful. See the ppErrors to determine what happened.
OPC_E_MAXEXCEEDED	The maximum number of values returnable by the server was exceeded.
E_NOTIMPL	This server does not support this function.
E_INVALIDARG	An Invalid parameter was passed.
E_FAIL	The function was unsuccessful.

ppError Codes

Return Code	Description
S_OK	The Item was read successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_INVALIDHANDLE	The handle is invalid.
E_FAIL	The Item read was unsuccessful.

Comments

The domain of the initial request is defined by htStartTime, htEndTime, and ftResampleInterval. If htStartTime or htEndTime is given in string (relative) format, the value returned will be the FILETIME to which that value was translated by the server. All three must be specified. htEndTime must be greater than htStartTime.

The ftResampleInterval determines how many subintervals the complete interval is divided into. The specified function is calculated at each subinterval beginning with htStartTime and selecting the data within the next ftResampleInterval, a value will be calculated according to the haAggregate at each subinterval.

For MinimumActualTime and MaximumActualTime used with aggregate values, if more than one instance of the value exists within a time range, which instance (time stamp) of the value is returned is server dependent. In any case, the server may set the OPCHDA_EXTRADATA quality flag to let the caller know that there are other timestamps with that value.

The domain of updates is defined by the time of the last value returned, the ftResampleInterval and dwNumIntervals.

A ftResampleInterval of 0 is illegal resulting in a return status of E_INVALIDARG. If only an initial set of data is desired, the dwNumIntervals should be set to 0 The request must still be cancelled.

The ftUpdateInterval can not be less than the ftResampleInterval.

The order of the data returned will match the order of the ItemIDs in the request.

4.6.1.3. IOPCHDA_Playback::Cancel

A Required Method

```
HRESULT Cancel(
      [in] DWORD dwCancelID
      );
```

Description

This function cancels the outstanding operation. The actual implementation is server specific, but the server shall respond via the OPCHDA_CancelComplete callback.

Parameters	**Description**
dwCancelID	The server-generated cancelID which was returned from the original method call.

HRESULT Return Codes

Return Code	**Description**
S_OK	The function was successful.
E_INVALIDARG	The client has not established a connection via the OPCHDA_CancelComplete ConnectionPoint.
E_FAIL	The function was unsuccessful. The CancelID does not match any outstanding operation on the server.

4.7. IConnectionPointContainer Interface

This is a Required Interface if the Async Interface is supported

4.7.1. IConnectionPointContainer

The general principles of ConnectionPoints are not discussed here as they are covered very clearly in the Microsoft Documentation. The reader is assumed to be familiar with this technology. Likewise the details of the IEnumConnectionPoints, IConnectionPoint and IEnumConnections interfaces are well defined by Microsoft and are not discussed here.

4.7.1.1. IConnectionPointContainer::EnumConnectionPoints

```
HRESULT EnumConnectionPoints(
      [out] IEnumConnectionPoints **ppEnum
      );
```

Description

Create an enumerator for the Connection Points supported between the OPCHDA server and the Client.

Parameters	**Description**
ppEnum	Where to save the pointer to the connection point

	enumerator. See the Microsoft documentation for a discussion of IEnumConnectionPoints.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
For other codes see the OLE programmers reference	

Comments

OPCHDA Servers must return an enumerator that includes IOPCHDA_DataCallback. Additional vendor specific callbacks are also allowed.

4.7.1.2. IConnectionPointContainer::FindConnectionPoint

```
HRESULT FindConnectionPoint(
      [in]     REFIID               riid,
      [out]    IConnectionPoint     **ppCP
      );
```

Description

Find a particular connection point between the OPCHDA server and the Client.

Parameters	Description
riid	The IID of the Connection Point. (e.g. IID_IOPCHDA_DataCallBack)
ppCP	Where to store the Connection Point. See the Microsoft documentation for a discussion of IConnectionPoint.

HRESULT Return Codes

Return Code	Description
S_OK	The function was successful.
For other codes see the OLE programmers reference	

Comments

OPCHDA servers must support IID_IOPCHDA_DataCallback. Additional vendor specific callbacks are also allowed.

4.8. Client Interfaces

In order to use connection points, the client must create an object which supports both the IUnknown interface and all callback interfaces which the client wishes to use. The client would pass a pointer to the IUnknown interface (NOT the callback interface) to the Advise method of the proper

IConnectionPoint in the server (as obtained from IConnectionPointContainer:: FindConnectionPoint or EnumConnectionPoints). The Server shall call QueryInterface on the client object to obtain the specific callback interface. Note that the transaction must be performed in this way in order for the interface marshalling to work properly for Local or Remote servers.

The methods which **must** be implemented by the client are noted as required methods. Note that for all Asynchronous methods, items for which a FAILED ppErrors code was returned shall not appear in the callback, and if all ppErrors returned for a call were FAILED, there shall be no callback, even if the HRESULT returned from the call was not a FAILED code. This is to allow servers to return useful information in the ppErrors array without requiring a callback that will not have any further useful information to deliver.

4.8.1. IOPCHDA_DataCallback

This is a Required Interface

4.8.1.1. IOPCHDA_DataCallback::OnDataChange

This is a Required Method

```
HRESULT OnDataChange(
      [in] DWORD                 dwTransactionID,
      [in] HRESULT               hrStatus,
      [in] DWORD                 dwNumItems,
      [in, size_is(dwNumItems)] OPCHDA_ITEM *pItemValues,
      [in, size_is(dwNumItems)] HRESULT        *phrErrors
      );
```

Description

This method is provided by the client to handle notifications from the OPCHDA server resulting from calls to OPCHDA_AsyncRead::AdviseRaw and OPCHDA_AsyncRead::AdviseProcessed.

Parameters	**Description**
dwTransactionID	The client-generated TransactionID passed with the originating call
hrStatus	S_OK if all phrErrors are S_OK, S_FALSE otherwise.
dwNumItems	The number of items that were read.
pItemValues	The array of structures in which the item values are returned.
phrErrors	A list of HRESULTS for the items.

HRESULT Return Codes

Return Code	**Description**
S_OK	The client must always return S_OK.

phrErrors Return Codes

Return Code	Description
S_OK	The returned data for this item is GOOD.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_MAXEXCEEDED	The maximum number of values returnable by the server was exceeded.
OPC_S_EXTRADATA	There is more data available than was returned. (Used for MinimumActualTime and MaximumActualTime when there is more than one timestamp for the value.)
OPC_S_NODATA	No data has changed but the update interval has passed.
E_FAIL	The item read was unsuccessful.

Comments

Note that item values must be well defined regardless of the contents of the **phrErrors** field.

4.8.1.2. IOPCHDA_DataCallback::OnReadComplete

This is a Required Method

```
HRESULT OnReadComplete(
     [in] DWORD              dwTransactionID,
     [in] HRESULT            hrStatus,
     [in] DWORD              dwNumItems,
     [in, size_is(dwNumItems)] OPCHDA_ITEM *pItemValues,
     [in, size_is(dwNumItems)] HRESULT        *phrErrors);
```

Description

This method is provided by the client to handle returned data from OPCHDA_AsyncRead::ReadRaw, OPCHDA_AsyncRead::ReadProcessed, and OPCHDA_AsyncRead::ReadAtTime.

Parameters	Description
dwTransactionID	The client-generated TransactionID passed with the originating call
hrStatus	S_OK if all phrErrors are S_OK, S_FALSE otherwise.
dwNumItems	The number of items that were read.
pItemValues	The array of structures in which the item values are returned.
phrErrors	A list of HRESULTS for the items.

HRESULT Return Codes

Return Code	Description
S_OK	The client must always return S_OK.

phrErrors Return Codes

Return Code	Description
S_OK	The returned data for this item is GOOD.

OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_S_NODATA	The function found no data to return.
OPC_S_EXTRADATA	There is more data available than was returned. (Used for MinimumActualTime and MaximumActualTime when there is more than one timestamp for the value.)
OPC_S_MOREDATA	More data is available in the time range beyond the number of values requested. (This return code is only valid in a response to a ReadRaw method call.)
E_FAIL	The item read was unsuccessful.

Comments

Note that item values must be well defined regardless of the contents of the **phrErrors** field. This means that the pItemValues array will exist and will have dwNumItems members. If the phrErrors field indicates no data for the member, the pItemValues entry will have dwCount of 0 and NULL pointers for the Timestamps, Qualities, and Data. The Client handle and AggregateID must still be valid.

Note that a given client handle or aggregate type or timestamp may appear multiple times in an array.

4.8.1.3. IOPCHDA_DataCallback::OnReadModifiedComplete

This is a Required Method

```
HRESULT OnReadModifiedComplete (
      [in] DWORD         dwTransactionID,
      [in] HRESULT       hrStatus,
      [in] DWORD         dwNumItems,
      [in, size_is(dwNumItems)] OPCHDA_MODIFIEDITEM
        *pItemValues,
      [in, size_is(dwNumItems)] HRESULT   *phrErrors
      );
```

Description

This method is provided by the client to handle returned data from OPCHDA_AsyncRead::ReadModified.

Parameters	**Description**
dwTransactionID	The client-generated TransactionID passed with the originating call
hrStatus	S_OK if all phrErrors are S_OK, S_FALSE otherwise.
dwNumItems	The number of items that were read.
pItemValues	The array of structures in which the item values are returned.
phrErrors	A list of HRESULTS for the items.

HRESULT Return Codes

Return Code	Description
S_OK	The client must always return S_OK.

phrErrors Return Codes

Return Code	Description
S_OK	The returned data for this item is GOOD.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_S_NODATA	No data was found in the specified time range.
OPC_S_MOREDATA	More data is available in the time range beyond the number of values requested.
E_FAIL	The item read was unsuccessful.

Comments

Note that item values must be well defined regardless of the contents of the **phrErrors** field.

Also note that a given client handle or timestamp may appear multiple times in an array.

4.8.1.4. IOPCHDA_DataCallback::OnReadAttributeComplete

This is a Required Method

```
HRESULT OnReadAttributeComplete(
     [in] DWORD         dwTransactionID,
     [in] HRESULT       hrStatus,
     [in] OPCHANDLE     hClient,
     [in] DWORD         dwNumItems,
     [in, size_is(dwNumItems)] OPCHDA_ATTRIBUTE
       *pAttributeValues,
     [in, size_is(dwNumItems)] HRESULT   *phrErrors
     );
```

Description

This method is provided by the client to handle returned data from OPCHDA_AsyncRead::ReadAttribute.

Parameters	Description
dwTransactionID	The client-generated TransactionID passed with the originating call
hrStatus	S_OK if all phrErrors are S_OK, S_FALSE otherwise.
hClient	The client handle for the item.
dwNumItems	The number of items that were read.
pAttributeValues	The array of structures in which the attribute values are returned.

phrErrors	A list of HRESULTS for the attributes.

HRESULT Return Codes

Return Code	Description
S_OK	The client must always return S_OK.

phrErrors Return Codes

Return Code	Description
S_OK	The returned data for this item is GOOD.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_S_CURRENTVALUE	No history available for attribute.
E_FAIL	The item read was unsuccessful.

Comments

Note that attribute values must be well defined regardless of the contents of the **phrErrors** field.

4.8.1.5. IOPCHDA_DataCallback::OnReadAnnotations

This is a Required Method

```
HRESULT OnReadAnnotations(
     [in] DWORD                         dwTransactionID,
     [in] HRESULT                       hrStatus,
     [in] DWORD                         dwNumItems,
     [in, size_is(dwNumItems)] OPCHDA_ANNOTATION
       *pAnnotationValues,
     [in, size_is(dwNumItems)] HRESULT   *phrErrors
     );
```

Description

This method is provided by the client to handle returned data from OPCHDA_AsyncReadAnnotations::Read.

Parameters	Description
dwTransactionID	The client-generated TransactionID passed with the originating call
hrStatus	S_OK if all phrErrors are S_OK, S_FALSE otherwise.
dwNumItems	The number of items that were read.
pAnnotationValues	The array of structures in which the annotation values are returned.
phrErrors	A list of HRESULTS for the items.

HRESULT Return Codes

Return Code	Description
S_OK	The client must always return S_OK.

phrErrors Return Codes

Return Code	Description
S_OK	The returned data for this item is GOOD.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_S_NODATA	No data was found in the specified time range.
OPC_S_MOREDATA	More data is available in the time range beyond the number of values requested. (This return code is only valid in a response to a ReadRaw method call.)
E_FAIL	The item read was unsuccessful.

Comments

Note that annotation values must be well defined regardless of the contents of the **phrErrors** field.

4.8.1.6. IOPCHDA_DataCallback::OnInsertAnnotations

This is a Required Method

```
HRESULT OnInsertAnnotations (
     [in] DWORD          dwTransactionID,
     [in] HRESULT        hrStatus,
     [in] DWORD          dwCount,
     [in, size_is(dwCount)] OPCHANDLE    *phClients,
     [in, size_is(dwCount)] HRESULT      *phrErrors
     );
```

Description

This method is provided by the client to handle notifications from the server on completion of OPCHDA_AsyncAnnotations::Insert.

Parameters	Description
dwTransactionID	The client-generated TransactionID passed with the originating call
hrStatus	S_OK if all phrErrors are S_OK, S_FALSE otherwise.
dwCount	The number of items in the arrays.
phClients	A pointer to an array of client handles.
phrErrors	A list of HRESULTS for the items.

HRESULT Return Codes

Return Code	Description
S_OK	The client must always return S_OK

phrErrors Return Codes

Return Code	Description
S_OK	The item was updated successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The Item update was unsuccessful.

Comments

NOTE that items for which an error was returned in the initial request shall NOT be returned here, i.e. the returned list may be ‘sparse’ and also its order is not specified.

4.8.1.7. IOPCHDA_DataCallback::OnPlayback

This is a Required Method

```
HRESULT OnPlayback (
     [in] DWORD              dwTransactionID,
     [in] HRESULT            hrStatus,
     [in] DWORD              dwNumItems,
     [in, size_is(dwNumItems)] OPCHDA_ITEM * pItemValues,
     [in, size_is(dwNumItems)] HRESULT        *phrErrors
     );
```

Description

This method is provided by the client to handle notifications from the OPCHDA server resulting from calls to OPCHDA_Playback::ReadRawWithUpdate and OPCHDA_Playback::ReadProcessedWithUpdate.

Parameters	Description
dwTransactionID	The client-generated TransactionID passed with the originating call
hrStatus	S_OK if all phrErrors are S_OK, S_FALSE otherwise.
dwNumItems	The number of items that were read.
ppItemValues	The array of structures in which the values are returned.
phrErrors	A list of HRESULTS for the items.

HRESULT Return Codes

Return Code	Description
S_OK	The client must always return S_OK.

phrErrors Return Codes

Return Code	Description
S_OK	The returned data for this item is GOOD.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_S_EXTRADATA	More than one piece of data that may be hidden exists at same timestamp.
OPC_S_NODATA	No data has changed but the update interval has passed.
E_FAIL	The item read was unsuccessful.

Comments

Note that values, timestamps and qualities must all be well defined regardless of the contents of the **phrErrors** field.

4.8.1.8. IOPCHDA_DataCallback::OnUpdateComplete

This is a Required Method

```
HRESULT OnUpdateComplete (
     [in] DWORD         dwTransactionID,
     [in] HRESULT       hrStatus,
     [in] DWORD         dwCount,
     [in, size_is(dwCount)] OPCHANDLE   *phClients,
     [in, size_is(dwCount)] HRESULT     *phrErrors
     );
```

Description

This method is provided by the client to handle notifications from the server on completion of OPCHDA_AsyncUpdate::Insert, OPCHDA_AsyncUpdate::Replace, OPCHDA_AsyncUpdate::InsertReplace, OPCHDA_AsyncUpdate::DeleteRaw, and OPCHDA_AsyncUpdate::DeleteAtTime.

Parameters	Description
dwTransactionID	The client-generated TransactionID passed with the originating call
hrStatus	S_OK if all phrErrors are S_OK, S_FALSE otherwise.
dwCount	The number of items in the arrays.
phClients	A pointer to an array of client handles.
phrErrors	A list of HRESULTS for the items.

HRESULT Return Codes

Return Code	Description
S_OK	The client must always return S_OK

phrErrors **Return Codes**

Return Code	Description
S_OK	The item was updated successfully.
OPC_E_BADRIGHTS	Insufficient rights for this operation.
OPC_E_DATAEXISTS	Unable to insert – data already present.
OPC_E_NODATAEXISTS	Unable to replace – no data exists.
OPC_S_NODATA	No values to delete for the item in the specified time range.
OPC_S_INSERTED	The requested insert occurred.
OPC_S_REPLACED	The requested replace occurred.
E_INVALIDARG	An invalid parameter was passed.
E_FAIL	The Item update was unsuccessful.

Comments

NOTE that items for which an error was returned in the initial request shall NOT be returned here. I.e. the returned list may be 'sparse'. However, the order of the returned list must match the order of the parameters to the update call, to permit the client to match the phrErrors codes to the actual updates which were requested. This is necessary because the client may apply several updates to the same item within one call, and the only way to know which updates did not succeed is by the order of the phrErrors array..

4.8.1.9. IOPCHDA_DataCallback::OnCancelComplete

```
HRESULT OnCancelComplete(
      [in] DWORD          dwCancelID
      );
```

Description

This method is provided by the client to handle notifications from the server on completion of Async Cancel.

Parameters	Description
dwCancelID	The client-generated TransactionID passed with the originating call

HRESULT Return Codes

Return Code	Description
S_OK	The client must always return S_OK

Comments

This Callback occurs only after an Async Cancel. Note that if the Cancel Request returned S_OK then the client can expect to receive this callback. If the Cancel request Failed then the client should NOT receive this callback

5. Description of Data Types, Parameters and Structures

5.1. OPCHDA_QUALITY

The values for OPCHDA_QUALITY were changed between v1.0 and v1.1 of the standard, to actually define 32 bits, with bits 15-0 zeroed. This allows them to be used as bitmasks, as intended, against the actual 32-bit quality field. Specifically, servers may return a quality that has information for both Data Access quality and information for HDA quality, i.e. 0x000100c0.

OPCHDA_QUALITY values identify quality values **specific** to retrieval of historical data. Quality values related to general data access are specified in the specification OPC Data Access Automation Specification 2.0, OPC Foundation 1998. This specification supports the data access quality flags in addition to those specified in this section. The HDA quality flags have no impact on the DA quality flags; the DA quality flags should never be changed due to the value of the HDA quality bits.

bits 31 – 16 History Data Access Quality

bits 15 – 0 Data Access Flags

Quality Values	**Description**	**Value**	**Associated DA Quality**
OPCHDA_EXTRADATA	More than one piece of data that may be hidden exists at same timestamp.	0x00010000	Good, Bad, Quest.
OPCHDA_INTERPOLATED	Interpolated data value.	0x00020000	Good, Bad, Quest.
OPCHDA_RAW	Raw data value.	0x00040000	Good, Bad, Quest.
OPCHDA_CALCULATED	Calculated data value, as would be returned from a ReadProcessed call.	0x00080000	Good, Bad, Quest.
OPCHDA_NOBOUND	No data found to provide upper or lower bound value.	0x00100000	Bad
OPCHDA_NODATA	No data collected. Archiving not active (for item or all items).	0x00200000	Bad
OPCHDA_DATALOST	Collection started / stopped / lost.	0x00400000	Bad
OPCHDA_CONVERSION	Scaling / conversion error.	0x00800000	Bad, Quest.
OPCHDA_PARTIAL	Aggregate value is for an incomplete interval.	0x01000000	Good, Bad, Quest.

Comments

OPCHDA_NOBOUND is intended to be used when bounding values are requested but not available. The server returns an empty place holder (value NULL, timestamp that of the start time or end time, as appropriate) with a quality of OPCHDA_NOBOUND.
For Aggregate values, the quality for each returned aggregate shall be GOOD (from the Data Access standard, 110000xx) if the quality for all values used in the aggregate was GOOD. If the quality of any value used in computing the aggregate was not GOOD, the quality returned shall be Sub-Normal (010110xx).

In the case where interpolated data is requested, and there is an actual raw value for that timestamp, the server should return OPCHDA_RAW as the quality of that value.

5.2. OPCHDA ITEM ATTRIBUTES

This indicates the attribute IDs for the history data. The precise meaning of each attribute may be server specific. Attributes not supported by the server shall return OPC_E_INVALIDATTRID in the error code for that attribute. Additional attributes may be defined by vendors. Server specific attributes must be defined with values beginning at 0x80000000. The OPC foundation reserves all attribute IDs from 0 to 0x7fffffff.

The IOPCHDA_Server::GetAttributes method shall return the attributes supported by the server, with a AttributeID, AttributeName, AttributeDescription, and AttributeDataType for each attribute. The AttributeDataType is included to enable the client to specify filter values when browsing the server's ItemIDs.

General attributes:

AttrID	Name - Description	Data Type	Value
OPCHDA_DATA_TYPE	**Data Type -**Specifies the data type for the item. See the definition of a VARIANT for valid values (VT_R4, etc.)	VT_I2	0x01
OPCHDA_DESCRIPTION	**Description** - Describes the item.	VT_BSTR	0x02
OPCHDA_ENG_UNITS	**Eng Units** - Specifies the label to use in displays to define the units for the item (e.g., kg/sec).	VT_BSTR	0x03
OPCHDA_STEPPED	**Stepped** - Specifies whether data from the history repository should be displayed as interpolated (sloped lines between points) or stepped (vertically-connected horizontal lines between points) data. Value of 0 indicates interpolated.	VT_BOOL	0x04
OPCHDA_ARCHIVING	**Archiving** - Indicates whether historian is recording data for this item (0 means no).	VT_BOOL	0x05
OPCHDA_DERIVE_EQUATION	**Derive Equation** - Specifies the equation to be used by a derived item to calculate its value. This is a free-form string.	VT_BSTR	0x06

OPCHDA_NODE_NAME	**Node Name** - Specifies the machine which is the source for the item. This is intended to be the broadest category for defining sources. For an OPC Data Access Server source, this is the nodename or IP address of the server. For non-OPC sources, the meaning of this field is server-specific.	VT_BSTR	0x07
OPCHDA_PROCESS_NAME	**Process Name** - Specifies the process which is the source for the item. This is intended to the second-broadest category for defining sources. For an OPC DA server, this would be the registered server name. For non-OPC sources, the meaning of this field is server-specific.	VT_BSTR	0x08
OPCHDA_SOURCE_NAME	**Source Name** - Specifies the name of the item on the source. For an OPC DA server, this is the ItemID. For non-OPC sources, the meaning of this field is server-specific.	VT_BSTR	0x09
OPCHDA_SOURCE_TYPE	**Source Type** - Specifies what sort of source produces the data for the item. For an OPC DA server, this would be "OPC". For non-OPC sources, the meaning of this field is server-specific.	VT_BSTR	0x0a
OPCHDA_NORMAL_MAXIMUM	**Normal Maximum** - Specifies the upper limit for the normal value range for the item. OPCHDA_NORMAL_MAXIMUM is used for trend display default scaling and exception deviation limit calculations. OPCHDA_ NORMAL _MAXIMUM should be the normal high value for the item.	VT_R8	0x0b
OPCHDA_NORMAL_MINIMUM	**Normal Minimum** - Specifies the lower limit for the normal value range for the item. OPCHDA_ NORMAL _MINIMUM is used for trend display default scaling and exception deviation limit calculations. OPCHDA_ NORMAL _MINIMUM should be the normal low value for the item.	VT_R8	0x0c

OPCHDA_ITEMID	**ItemID** - Specifies the item id. This is used to allow filtering in the CreateBrowse method, therefore the intention is to return only the leaf portion of an ItemID, not the fully qualified ItemID which would be returned from a GetItemID call.	VT_BSTR	0x0d

Attributes which affect how the data is historized:

Attributes	Description	Data Type	Value
OPCHDA_MAX_TIME_INT	**Max Time Interval** - Specifies the maximum interval between data points in the history repository regardless of their value change. A new value shall be stored in history whenever OPCHDA_MAX_TIME_INT seconds have passed since the last value stored for the item. Note that the binary value inside the VARIANT maps to FILETIME, such that .Hi equates to .dwHighDateTime and .Lo equates to .dwLowDateTime.	VT_CY	0x0e
OPCHDA_MIN_TIME_INT	**Min Time Interval** - Specifies the minimum interval between data points in the history repository regardless of their value change. A new value shall be not be stored in history unless OPCHDA_MIN_TIME_INT seconds have passed since the last value stored for the item. Note that the binary value inside the VARIANT maps to FILETIME, such that .Hi equates to .dwHighDateTime and .Lo equates to .dwLowDateTime.	VT_CY	0x0f
OPCHDA_EXCEPTION_DEV	**Exception Deviation** - Specifies the minimum amount that the data for the item must change in order for the change to be reported to the history database. See OPCHDA_EXCEPTION_DEV_TYPE for the specific meaning of this field.	VT_R8	0x10

OPCHDA_EXCEPTION_DEV_TYPE	**Exception Dev Type** - Specifies whether the OPCHDA_EXCEPTION_DEV is given as an absolute value, percent of span, or percent of value. The span is defined as OPCHDA_HIGH_ENTRY_LIMIT - OPCHDA_LOW_ENTRY_LIMIT.	VT_I2	0x11
OPCHDA_HIGH_ENTRY_LIMIT	**High Entry Limit** - Specifies the highest valid value for the item. A value for the item that is above OPCHDA_HIGH_ENTRY_LIMIT cannot be entered into history. This is the top of the span.	VT_R8	0x12
OPCHDA_LOW_ENTRY_LIMIT	**Low Entry Limit** - Specifies the lowest valid value for the item. A value for the item that is below OPCHDA_LOW_ENTRY_LIMIT cannot be entered into history. This is the zero for the span.	VT_R8	0x13

5.3. Structures and Masks

5.3.1. OPCHDA_ITEM

This structure was changed between v1.0 of the standard and v1.1 of the standard. Rather than passing the Aggregate as an ENUM, it must be passed as a DWORD, to allow vendors to use vendor-specific aggregate values.

Servers and clients build with v1.0 of the standard will work with those built with v1.1, but v1.0 clients may not be compatible with v1.1 servers which return vendor-specified aggregates.

```
typedef struct {
    OPCHANDLE                        hClient;
    DWORD                            haAggregate;
    DWORD                            dwCount;
    [size_is(dwCount)] FILETIME      *pftTimeStamps;
    [size_is(dwCount)] DWORD         *pdwQualities;
    [size_is(dwCount)] VARIANT       *pvDataValues;
} OPCHDA_ITEM;
```

Member	**Description**
hClient	The client provided handle for this item

haAggregate	The aggregate which was applied to retrieve the data. For the IOPCHDA_SyncRead::ReadRaw and IOPCHAD_SyncRead::ReadAtTime, this should be OPCHDA_NOAGGREGATE.
dwCount	Count of the number of data values returned for the item.
ftTimeStamps	UTC TimeStamps for this item's values. This field may be NULL if timestamps were not requested in the call.
pdwQualities	The qualities of the data for this item.
vDataValues	The values for the item.

5.3.2. OPCHDA_EDITTYPE

This indicates the way in which the history data is to be edited.

EditHistory Values	Description
OPCHDA_INSERT	Insert data into history. If data already exists at the timestamp specified, the operation may optionally fail.
OPCHDA_REPLACE	Replace data in history. If data does not exist at the timestamp specified, the operation may optionally fail.
OPCHDA_INSERTREPLACE	Insert or replace the data in history, depending on whether data already exists or not.
OPCHDA_DELETE	Delete data from history.

5.3.3. OPCHDA_AGGREGATE

This indicates the aggregate to be used when retrieving processed history. The precise meaning of each aggregate may be server specific. Aggregates not supported by the server shall return E_INVALIDARG in the error code for that aggregate. Additional aggregates may be defined by vendors. Server specific aggregates must be defined with values beginning at 0x80000000. The OPC foundation reserves all aggregates IDs from 0 to 0x7fffffff.

Aggregate Value	Description
OPCHDA_INTERPOLATIVE	Do not retrieve an aggregate. This is used for retrieving interpolated values.
OPCHDA_TOTAL	Retrieve the totalized value (time integral) of the data over the resample interval.
OPCHDA_AVERAGE	Retrieve the average data over the resample interval.
OPCHDA_TIMEAVERAGE	Retrieve the time weighted average data over the resample interval.
OPCHDA_COUNT	Retrieve the number of raw values over the resample interval.
OPCHDA_STDEV	Retrieve the standard deviation over the resample interval.
OPCHDA_MINIMUMACTUALTIME	Retrieve the minimum value in the resample interval and the timestamp of the minimum value.
OPCHDA_MINIMUM	Retrieve the minimum value in the resample interval.
OPCHDA_MAXIMUMACTUALTIME	Retrieve the maximum value in the resample interval and the timestamp of the maximum value.
OPCHDA_MAXIMUM	Retrieve the maximum value in the resample interval.
OPCHDA_START	Retrieve the value at the beginning of the resample interval. The time stamp is the time stamp of the beginning of the interval.
OPCHDA_END	Retrieve the value at the end of the resample interval. The time

	stamp is the time stamp of the end of the interval.
OPCHDA_DELTA	Retrieve the difference between the first and last value in the resample interval.
OPCHDA_REGSLOPE	Retrieve the slope of the regression line over the resample interval.
OPCHDA_REGCONST	Retrieve the intercept of the regression line over the resample interval. This is the value of the regression line at the start of the interval.
OPCHDA_REGDEV	Retrieve the standard deviation of the regression line over the resample interval.
OPCHDA_VARIANCE	Retrieve the variance over the sample interval .
OPCHDA_RANGE	Retrieve the difference between the minimum and maximum value over the sample interval.
OPCHDA_DURATIONGOOD	Retrieve the duration (in seconds) of time in the interval during which the data is good.
OPCHDA_DURATIONBAD	Retrieve the duration (in seconds) of time in the interval during which the data is bad.
OPCHDA_PERCENTGOOD	Retrieve the percent of data (1 equals 100 percent) in the interval which has good quality.
OPCHDA_PERCENTBAD	Retrieve the percent of data (1 equals 100 percent) in the interval which has bad quality.
OPCHDA_WORSTQUALITY	Retrieve the worst quality of data in the interval.
OPCHDA_ANNOTATIONS	Retrieve the number of annotations in the interval.

Comment

The implementation of these standard aggregate types is as outlined in section 2.9Aggregates. If vendors require custom functionality in the aggregates, those aggregates should be written as custom aggregates.

5.3.4. OPCHDA_TIME

```
typedef struct {
    BOOL              bString;
    [string] LPWSTRszTime;
    FILETIME          ftTime;
} OPCHDA_TIME;
```

Member	Description
bString	Flag indicating if the time is in string (relative time) format (TRUE) or FILETIME (absolute) format (FALSE).
szTime	String format for the time.
ftTime	FILETIME format for the time.

For the szTime, the time is considered to be a relative time local to the server. This means that all times are given in UTC time, compute from the current time on the server's local clock. The format for the relative time is:

keyword+/-offset+/-offset…

where keyword and offset are as specified in the table below. Whitespace is ignored. The time string must begin with a keyword. Each offset must be preceded by a signed integer that specifies the number and direction of the offset. If the integer preceding the offset is unsigned, the value of the preceding sign is assumed (beginning default sign is positive). The keyword refers to the beginning of the specified time period. DAY means the timestamp at the beginning of the current day (00:00 hours, midnight), MONTH means the timestamp at the beginning of the current month, etc.

For example, "DAY -1D+7H30M" could represent the start time for data request for a daily report beginning at 7:30 in the morning of the current day (DAY = the first timestamp for today, -1D would make it the first timestamp for yesterday, +7H would take it to 7 a.m. yesterday, +30M would make it 7:30 a.m. yesterday (the + on the last term is carried over from the last term).

Similarly, "MO-1D+5h" would be 5 a.m. on the last day of the previous month, "NOW-1H15M" would be an hour and fifteen minutes ago, and "YEAR+3MO" would be the first timestamp of April 1 this year.

Resolving relative timestamps is based upon what Microsoft has done with Excel, thus for various questionable time strings, we have these results:

10-Jan-2001 + 1 MO = 10-Feb-2001

29-Jan-1999 + 1 MO = 28-Feb-1999

31-Mar-2002 + 2 MO = 30-May-2002

29-Feb-2000 + 1 Y = 28-Feb-2001

In handling a gap in the calendar (due to different numbers of days in the month, or in the year), when one is adding or subtracting months or years:

Month: if the answer falls in the gap, it is backed up to the same time of day on the last day of the month.

Year: if the answer falls in the gap (February 29), it is backed up to the same time of day on February 28.

Note that the above does not hold for cases where one is adding or subtracting weeks or days, but only when adding or subtracting months or years, which may have different numbers of days in them.

The null value for time is bString=TRUE and an empty time string. When string times are sent to the server, the server shall return the FILETIME to which that string resolved. When bString=FALSE, the time string is an empty string.

Note that all keywords and offsets are specified in uppercase.

Keyword	**Offset**	**Description**
NOW		The current UTC time as calculated on the server.
SECOND	S	The start of the current second.
MINUTE	M	The start of the current minute.
HOUR	H	The start of the current hour.
DAY	D	The start of the current day.
WEEK	W	The start of the current week.
MONTH	MO	The start of the current month.
YEAR	Y	The start of the current year.

Offset	Description
S	Offset from time in seconds.
M	Offset from time in minutes.
H	Offset from time in hours.
D	Offset from time in days.
W	Offset from time in weeks.
MO	Offset from time in months.
Y	Offset from time in years.

5.3.5. OPCHDA_ATTRIBUTE

```
typedef struct {
    OPCHANDLE                        hClient;
    DWORD                            dwNumValues;
    DWORD                            dwAttributeID
    [size_is (dwNumValues)] FILETIME                 *ftTimeStamps;
    [size_is (dwNumValues)] VARIANT                  *vAttributeValues;
} OPCHDA_ATTRIBUTE;
```

Member	Description
hClient	The client provided handle for this item
dwNumValues	Count of the number of attribute values returned for the attribute.
dwAttributeID	AttributeID of this value.
ftTimeStamps	UTC TimeStamps for this attribute's values.
vAttributeValues	Array of values for the attribute.

Comment
The return from the call is an array of these structures, one for each AttributeID specified in the call. The timestamp is that of the time when the attribute was set to the specified value, except for the first value returned: as stated earlier, the first value returned shall be the value of the attribute at the start time of the specified interval, and thus the timestamp for that value should be the start time of the interval.

5.3.6. OPCHDA_MODIFIEDITEM

```
typedef struct {
    OPCHANDLE                              hClient;
    DWORD                                  dwCount;
    [size_is(dwCount)] FILETIME            *pftTimeStamps;
    [size_is(dwCount)] DWORD               *pdwQualities;
    [size_is(dwCount)] VARIANT             *pvDataValues;
    [size_is(dwCount)] FILETIME            *pftModificationTime;
    [size_is(dwCount)] OPCHDA_EDITTYPE     *pEditType;
    [size_is(dwCount)] LPWSTR              *szUser;
} OPCHDA_MODIFIEDITEM;
```

Member	Description
hClient	The client provided handle for this item
dwNumValues	Count of the number of data items returned for the item.
pftTimeStamps	UTC TimeStamps for this item's values. This field may be NULL if timestamps were not requested in the call.
pdwQualities	The qualities of the data for this item.
pvDataValues	The values for the item.
pftModificationTime	The time the modification was made. Support for this field is optional. A NULL pointer shall be returned if it is not implemented.
pEditType	The modification type for the item.
szUser	The name of the user that made the modification. Support for this field is optional. A NULL pointer shall be returned if it is not implemented.

5.3.7. OPCHDA_ANNOTATION

```
typedef struct {
    OPCHANDLE                       hClient;
    DWORD                           dwNumValues;
    [size_is (dwNumValues)]                 FILETIME        *ftTimeStamps;
    [size_is (dwNumValues), string]         LPWSTR          *szAnnotation;
    [size_is (dwNumValues)]                 FILETIME        *ftAnnotationTime;
    [size_is (dwNumValues), string]         LPWSTR          *szUser;
} OPCHDA_ANNOTATION;
```

Member	Description
hClient	The client provided handle for this item
dwNumValues	Count of the number of annotations returned for the item.
ftTimeStamp	UTC TimeStamps for the annotations.
szAnnotation	The array of annotations.
ftAnnotationTime	The time the annotation was added. This will probably be different than the ftTimeStamp.
szUser	The name of the user that added the annotation.

5.3.8. OPCHDA_OPERATORCODES

```
typedef enum {OPCHDA_EQUAL =1,
        OPCHDA_LESS,
        OPCHDA_LESSEQUAL,
        OPCHDA_GREATER,
        OPCHDA_GREATEREQUAL,
        OPCHDA_NOTEQUAL
        } OPCHDA_OPERATORCODES
```

Member	Description
OPCHDA_EQUAL	Attribute value equals filter value.
OPCHDA_LESS	Attribute value is less than filter value.
OPCHDA_LESSEQUAL	Attribute value is less than or equal to filter.
OPCHDA_GREATER	Attribute value is greater than filter value.
OPCHDA_GREATEREQUAL	Attribute value is greater than or equal to filter value.
OPCHDA_NOTEQUAL	Attribute value is not equal to filter value.

5.3.9. OPCHDA_UPDATECAPABILITIES

This uses an ENUM for the return parameter; this is incorrect for a bitmask value and precludes servers specifying more than one supported method.
In order to avoid changes to the IDL for this maintenance update, the correction for this is deferred until version 2.0

Identifies the capabilities of the update interfaces. The values of the enumeration are combined to form a mask when the capabilities are queried.

```
typedef enum {OPCHDA_INSERTCAP = 0x01,
OPCHDA_REPLACECAP= 0x02,
OPCHDA_INSERTREPLACECAP= 0x04,
OPCHDA_DELETERAWCAP= 0x08,
OPCHDA_DELETEATTIMECAP= 0x10
} OPCHDA_ UPDATECAPABILITIES
```

5.3.10. OPCHDA_ANNOTATIONCAPABILITIES

This uses an ENUM for the return parameter; this is incorrect for a bitmask value and precludes servers specifying more than one supported method.
In order to avoid changes to the IDL for this maintenance update, the correction for this is deferred until version 2.0

Identifies the capabilities of the annotation interfaces. The values of the enumeration are combined to form a mask when the capabilities are queried.

```
 typedef enum {OPCHDA_READANNOTATIONCAP = 0x01,
OPCHDA_INSERTANNOTATIONCAP = 0x02
} OPCHDA_ ANNOTATIONCAPABILITIES
```

5.3.11. OPCHDA_BROWSETYPE

```
typedef enum { OPCHDA_BRANCH =1,
        OPCHDA_LEAF,
        OPCHDA_FLAT,
        OPCHDA_ITEMS
        } OPCHDA_ BROWSETYPE
```

Member	Description
OPCHDA_ BRANCH	Returns only nodes that can have children. These may or may not be items.
OPCHDA_LEAF	Returns only nodes that cannot have children. These are always items.
OPCHDA_FLAT	Returns everything at and below this level including all children of children, all the way to the end, as **fully qualified ItemIDs** – basically 'pretends' that the address space at this level and below is FLAT. This parameter is ignored for FLAT address space.
OPCHDA_ITEMS	Returns all items at the current browse position. This means all objects at the current level which are valid objects to send to IOPCHDA_Server::GetItemHandles. Note: this browse type will normally be used instead of OPCHDA_LEAF to guarantee that all items are displayed.

There is not a browse type which will return all objects at the current level. The set of objects which are returned from a call for OPCHDA_BRANCH and the set returned from a call for OPCHDA_LEAF, together, are the set of all the objects at the current level. The set of objects returned for OPCHDA_ITEMS may be the same set as that returned for OPCHDA_LEAF, if there are no branches which may have an ItemID, or it may be a superset of OPCHDA_LEAF. In no case may the set returned from OPCHDA_ITEMS be smaller than that returned for OPCHDA_LEAF.

The ItemIDs returned from a call for OPCHDA_FLAT will be fully qualified ItemIDs which can be used in a call to IOPCHDA_Server::GetItemHandles. The names returned for the other types are short names, which can be used in a subsequent call to IOPCHDA_Browser::ChangeBrowsePosition or IOPCHDA_Browser::GetItemID, but which are not expected to be fully qualified ItemIDs suitable for IOPCHDA_Server::GetItemHandles. While servers are allowed to use the fully qualified ItemID as the short name, clients must assume that any name returned from GetEnum will need to be passed to GetItemID in order to obtain the fully qualified ItemID.

5.3.12. OPCHDA_BROWSEDIRECTION

```
typedef enum { OPCHDA_BROWSE_UP =1,
          OPCHDA_BROWSE_DOWN,
          OPCHDA_BROWSE_DIRECT
          } OPCHDA_BROWSEDIRECTION
```

Member	Description
OPCHDA_BROWSE_UP	Move the browse position up to the parent branch of the current position.
OPCHDA_BROWSE_DOWN	Move the browse position down to the branch indicated by szString from the current position. Note: szString must contain only the name of a branch that is a child of the current position. It cannot move multiple branches.
OPCHDA_BROWSE_DIRECT	Move the browse position to the fully qualified branch indicated by szString. Note: this move is relative to the root, not the current position. If the position string is an empty string, the browser shall move to the root.

5.3.13. OPCHDA_SERVERSTATUS

```
typedef enum { OPCHDA_UP =1,
        OPCHDA_DOWN,
        OPCHDA_INDETERMINATE
        } OPCHDA_ SERVERSTATUS
```

Member	Description
OPCHDA_UP	The historian is running.
OPCHDA_DOWN	The historian is not running.
OPCHDA_INDETERMINATE	The status of the historian is indeterminate. See the szStatusString for further information.

6. Component Categories Registration

During the registration process, each OPC History Data Server must register itself with the Component Categories Manager, a Microsoft supplied system COM object. OPC History Data Clients will query the Components Category Manager to enumerate the CLSIDs of all registered OPC History Data Servers.

Given below is the category GUID for OPC History Data Access servers.

“OPC History Data Access Servers Version 1.0:

CATID_OPCHDAServer10 = {7DE5B060-E089-11d2-A5E6-000086339399};

Note: At this time the Component Categories Manager stores its information in the registry, however this will change in the near future. Please use the Component Categories Manager API to access this information rather than using the registry directly.

6.1. Server Registration

To Register with the Component Categories Manager, a server should first register the OPC defined Category ID (CATID) and the OPC defined Category Description by calling ICatRegister:: RegisterCategories(), and then register its own CLSID as an implementation of the CATID with a call to ICatRegister:: RegisterClassImplCategories().

To get an interface pointer to ICatRegister, call CoCreateInstance() as in this example:

```
#include <comcat.h>

CoCreateInstance(CLSID_StdComponentCategoriesMgr, NULL, CLSCTX_INPROC_SERVER,
IID_ICatRegister, (void**)&pcr);
```

Here is how the sample server registers and un-registers the component categories:

```
EXTERN_C const GUID CATID_OPCHDAServer10;
// This is defined in opchda_cats.c

// Create the Component Catagories
void CreateOPCHDACat(void)
{

  HRESULT hr, hr2;
  ICatRegister *pCat;

  // Get the Catagories Interface
  //
  hr = CoCreateInstance (CLSID_StdComponentCategoriesMgr, NULL,
         CLSCTX_INPROC_SERVER, IID_ICatRegister,
         (void **)&pCat);
  if (SUCCEEDED(hr))
  {
         CATEGORYINFO Catlist[1];
         // Build the catagory info
         //
         Catlist[0].catid = CATID_OPCHDAServer10;
         Catlist[0].lcid = 0x0409;
         wcscpy(Catlist[0].szDescription, L"OPC Historical Data Access Servers
Version 1.0");
```

```
          // And register the Category
          //
          hr2 = pCat->RegisterCategories(
                 1, Catlist);

          if (FAILED(hr2)) MessageBox(NULL, "CreateOPCHDACat:RegisterCatagories
Failed", NULL, MB_OK);

          pCat->Release();

    } else MessageBox(NULL, "CreateOPCDACat:CoCreateInstance Failed", NULL, MB_OK);
}


void RegOPCHDACat(GUID clsid)
{

  HRESULT hr, hr2;
  ICatRegister *pCat;

  // Get the Categories Interface
  //
  hr = CoCreateInstance (CLSID_StdComponentCategoriesMgr, NULL,
          CLSCTX_INPROC_SERVER, IID_ICatRegister,
          (void **)&pCat);
  if (SUCCEEDED(hr))
  {
          // Register the categories as being "implemented" by
          // the passed clsid.
          //
          CATID rgcatid[1] ;
          rgcatid[0] = CATID_OPCHDAServer10;
          hr2 = pCat->RegisterClassImplCategories(clsid, 1, rgcatid);

          if(FAILED(hr2))MessageBox(NULL, "RegOPCHDACat:RegisterClassImplCatagories
Failed", NULL, MB_OK);

          pCat->Release();

    } else MessageBox(NULL, "RegOPCDACat:CoCreateInstance Failed", NULL, MB_OK);
}
```

6.2. Client Enumeration

Editor's Note: This section will change if the TSC adopts the proposed DCOM aware remote OPC browse server.

To get a list of CLSIDs of all OPC History Servers registered with the Component Categories Manager, the client calls ICatInformation::EnumClassesOfCategories() to return an enumerator interface, IEnumCLSID as in this code snippet:

```
ICatInformation* pcr = NULL ;
HRESULT hr = S_OK ;

hr = CoCreateInstance(CLSID_StdComponentCategoriesMgr,
                NULL, CLSCTX_INPROC_SERVER, IID_ICatInformation, (void**)&pcr);

IEnumCLSID* pEnumCLSID;

CLSID catid = IID_OPCHDAServerCATID;
pcr->EnumClassesOfCategories(1, &catid, 1, &catid, &pEnumCLSID);

// get 10 at a time for efficiency
unsigned long c;
CLSID clsids[10];

while (SUCCEEDED(hr = pEnumCLSID->Next(10, clsids, &c)))
{
  for( unsigned long i = 0; i < c; i++ )
  {
```

```
             // clsid[i] is a CLSID that implements the component category ...
                    .
                    .
                    .
      }
    }
```

7. Appendix A – Historical Data Access IDL Specification

The current files require MIDL compiler 3.00.15 or later and the WIN NT 4.0 release SDK.

Use the command line MIDL //Oicf opcda.idl.

The resulting **OPCHDA.H** file should be **included** in all clients and servers.

The resulting **OPCHDA_I.C** file defines the interface IDs and should be **linked** into all clients and servers.

NOTE: This IDL file and the Proxy/Stub generated from it should NEVER be modified in any way. If you add vendor specific interfaces to your server (which is allowed) you must generate a SEPARATE vendor specific IDL file to describe only those interfaces and a separate vendor specific ProxyStub DLL to marshall only those interfaces.

Note: See the OPC Overview document (OPCOVW.DOC) for a listing and disucssion of OPCCOMN.IDL.

```
// OPCHDA.IDL
// REVISION:  08/26/2001 04:00 PM (CST)
// VERSIONINFO    1.2.0.0
//

import "oaidl.idl" ;

typedef enum tagOPCHDA_SERVERSTATUS {
    OPCHDA_UP =1,
      OPCHDA_DOWN,
      OPCHDA_INDETERMINATE
      } OPCHDA_SERVERSTATUS;

typedef enum tagOPCHDA_BROWSEDIRECTION {
      OPCHDA_BROWSE_UP =1,
      OPCHDA_BROWSE_DOWN,
      OPCHDA_BROWSE_DIRECT
      } OPCHDA_BROWSEDIRECTION;

typedef enum tagOPCHDA_BROWSETYPE {
      OPCHDA_BRANCH =1,
      OPCHDA_LEAF,
      OPCHDA_FLAT,
      OPCHDA_ITEMS
      } OPCHDA_BROWSETYPE;


typedef enum tagOPCHDA_ANNOTATIONCAPABILITIES {
      OPCHDA_READANNOTATIONCAP = 0x01,
      OPCHDA_INSERTANNOTATIONCAP = 0x02
      } OPCHDA_ANNOTATIONCAPABILITIES;


typedef enum tagOPCHDA_UPDATECAPABILITIES {
      OPCHDA_INSERTCAP = 0x01,
      OPCHDA_REPLACECAP= 0x02,
      OPCHDA_INSERTREPLACECAP= 0x04,
      OPCHDA_DELETERAWCAP= 0x08,
      OPCHDA_DELETEATTIMECAP= 0x10
      } OPCHDA_UPDATECAPABILITIES;

typedef enum tagOPCHDA_OPERATORCODES {
      OPCHDA_EQUAL =1,
      OPCHDA_LESS,
      OPCHDA_LESSEQUAL,
      OPCHDA_GREATER,
      OPCHDA_GREATEREQUAL,
      OPCHDA_NOTEQUAL
      } OPCHDA_OPERATORCODES;


typedef enum tagOPCHDA_EDITTYPE {
      OPCHDA_INSERT = 1,
      OPCHDA_REPLACE,
      OPCHDA_INSERTREPLACE,
      OPCHDA_DELETE
      } OPCHDA_EDITTYPE;


typedef enum tagOPCHDA_AGGREGATE {
      OPCHDA_NOAGGREGATE = 0,
      OPCHDA_INTERPOLATIVE,
      OPCHDA_TOTAL,
      OPCHDA_AVERAGE,
      OPCHDA_TIMEAVERAGE,
      OPCHDA_COUNT,
      OPCHDA_STDEV,
      OPCHDA_MINIMUMACTUALTIME,
      OPCHDA_MINIMUM,
      OPCHDA_MAXIMUMACTUALTIME,
      OPCHDA_MAXIMUM,
      OPCHDA_START,
      OPCHDA_END,
      OPCHDA_DELTA,
      OPCHDA_REGSLOPE,
      OPCHDA_REGCONST,
      OPCHDA_REGDEV,
      OPCHDA_VARIANCE,
      OPCHDA_RANGE,
      OPCHDA_DURATIONGOOD,
      OPCHDA_DURATIONBAD,
      OPCHDA_PERCENTGOOD,
      OPCHDA_PERCENTBAD,
      OPCHDA_WORSTQUALITY,
      OPCHDA_ANNOTATIONS
      } OPCHDA_AGGREGATE;


typedef DWORD OPCHANDLE;

typedef struct tagOPCHDA_ANNOTATION {
      OPCHANDLE         hClient;
      DWORD       dwNumValues;
      [size_is (dwNumValues)]       FILETIME    *ftTimeStamps;
      [size_is (dwNumValues), string]     LPWSTR      *szAnnotation;
      [size_is (dwNumValues)]       FILETIME    *ftAnnotationTime;
      [size_is (dwNumValues), string]     LPWSTR      *szUser;
} OPCHDA_ANNOTATION;


typedef struct tagOPCHDA_MODIFIEDITEM {
      OPCHANDLE               hClient;
      DWORD                   dwCount;
      [size_is(dwCount)] FILETIME               *pftTimeStamps;
      [size_is(dwCount)] DWORD                  *pdwQualities;
      [size_is(dwCount)] VARIANT                *pvDataValues;
      [size_is(dwCount)] FILETIME               *pftModificationTime;
      [size_is(dwCount)] OPCHDA_EDITTYPE  *pEditType;
      [size_is(dwCount)] LPWSTR                 *szUser;
} OPCHDA_MODIFIEDITEM;


typedef struct tagOPCHDA_ATTRIBUTE {
      OPCHANDLE         hClient;
      DWORD             dwNumValues;
      DWORD             dwAttributeID;
      [size_is (dwNumValues)] FILETIME    *ftTimeStamps;
      [size_is (dwNumValues)] VARIANT           *vAttributeValues;
} OPCHDA_ATTRIBUTE;


typedef struct tagOPCHDA_TIME {
      BOOL              bString;
      [string] LPWSTR   szTime;
      FILETIME          ftTime;
} OPCHDA_TIME;

typedef struct tagOPCHDA_ITEM {
      OPCHANDLE                     hClient;
      DWORD                               haAggregate;
      DWORD                         dwCount;
      [size_is(dwCount)] FILETIME   *pftTimeStamps;
      [size_is(dwCount)] DWORD      *pdwQualities;
      [size_is(dwCount)] VARIANT    *pvDataValues;
} OPCHDA_ITEM;



// AttributeID

cpp_quote("#define    OPCHDA_DATA_TYPE                0x01")
cpp_quote("#define    OPCHDA_DESCRIPTION        0x02")
cpp_quote("#define    OPCHDA_ENG_UNITS                0x03")
cpp_quote("#define    OPCHDA_STEPPED                  0x04")
cpp_quote("#define    OPCHDA_ARCHIVING                0x05")
cpp_quote("#define    OPCHDA_DERIVE_EQUATION    0x06")
cpp_quote("#define    OPCHDA_NODE_NAME                0x07")
cpp_quote("#define    OPCHDA_PROCESS_NAME       0x08")
cpp_quote("#define    OPCHDA_SOURCE_NAME        0x09")
cpp_quote("#define    OPCHDA_SOURCE_TYPE        0x0a")
cpp_quote("#define    OPCHDA_NORMAL_MAXIMUM           0x0b")
cpp_quote("#define    OPCHDA_NORMAL_MINIMUM           0x0c")
cpp_quote("#define    OPCHDA_ITEMID                   0x0d")

cpp_quote("#define    OPCHDA_MAX_TIME_INT             0x0e")
cpp_quote("#define    OPCHDA_MIN_TIME_INT             0x0f")
cpp_quote("#define    OPCHDA_EXCEPTION_DEV                  0x10")
cpp_quote("#define    OPCHDA_EXCEPTION_DEV_TYPE       0x11")
cpp_quote("#define    OPCHDA_HIGH_ENTRY_LIMIT         0x12")
cpp_quote("#define    OPCHDA_LOW_ENTRY_LIMIT          0x13")

// OPCHDA_QUALITY -- these are the high-order 16 bits, OPC DA Quality
// occupies low-order 16 bits

cpp_quote("#define    OPCHDA_EXTRADATA          0x00010000")
cpp_quote("#define    OPCHDA_INTERPOLATED 0x00020000")
cpp_quote("#define    OPCHDA_RAW                0x00040000")
cpp_quote("#define    OPCHDA_CALCULATED         0x00080000")
cpp_quote("#define    OPCHDA_NOBOUND            0x00100000")
cpp_quote("#define    OPCHDA_NODATA             0x00200000")
cpp_quote("#define    OPCHDA_DATALOST           0x00400000")
cpp_quote("#define    OPCHDA_CONVERSION         0x00800000")
cpp_quote("#define    OPCHDA_PARTIAL            0x01000000")


//****************************************************
//Interface Definitions
//

//****************************************************
// {1F1217B1-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b1, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);

[
  object,
  uuid(1F1217B1-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]
interface IOPCHDA_Browser : IUnknown
{
      HRESULT GetEnum(
      [in]  OPCHDA_BROWSETYPE dwBrowseType,
      [out] LPENUMSTRING            *ppIEnumString
      );


      HRESULT ChangeBrowsePosition(
      [in]        OPCHDA_BROWSEDIRECTION  dwBrowseDirection,
      [in,string] LPCWSTR                             szString
      );

      HRESULT GetItemID (
      [in,string]       LPCWSTR     szNode,
      [out,string]      LPWSTR      *pszItemID
      );


      HRESULT GetBranchPosition (
       [out,string] LPWSTR    *pszBranchPos
      );

}


//****************************************************
// {1F1217B0-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b0, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
  object,
  uuid(1F1217B0-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]
interface IOPCHDA_Server : IUnknown
{
      HRESULT GetItemAttributes(
      [out]                                           DWORD *pdwCount,
      [out, size_is(,*pdwCount)]                DWORD **ppdwAttrID,
      [out, size_is(,*pdwCount),string]   LPWSTR      **ppszAttrName,
      [out, size_is(,*pdwCount),string]   LPWSTR      **ppszAttrDesc,
      [out, size_is(,*pdwCount)]                VARTYPE
      **ppvtAttrDataType
      );

      HRESULT GetAggregates(
      [out]                                                 DWORD
      *pdwCount,
      [out, size_is(,*pdwCount)]                DWORD **ppdwAggrID,
      [out, size_is(,*pdwCount), string] LPWSTR **ppszAggrName,
      [out, size_is(,*pdwCount), string] LPWSTR **ppszAggrDesc
      );

      HRESULT GetHistorianStatus(
      [out]                   OPCHDA_SERVERSTATUS           *pwStatus,
      [out]                   FILETIME
      **pftCurrentTime,
      [out]                   FILETIME
      **pftStartTime,
      [out]                   WORD
      *pwMajorVersion,
      [out]                   WORD
      *pwMinorVersion,
      [out]                   WORD
      *pwBuildNumber,
      [out]                   DWORD
      *pdwMaxReturnValues,
      [out,string]      LPWSTR
      *ppszStatusString,
      [out,string]      LPWSTR
      *ppszVendorInfo
      );

      HRESULT GetItemHandles(
      [in]                                DWORD       dwCount,
      [in, size_is(dwCount)]        LPWSTR            *pszItemID,
      [in, size_is(dwCount)]        OPCHANDLE   *phClient,
      [out, size_is(,dwCount)]      OPCHANDLE   **pphServer,
      [out, size_is(,dwCount)]      HRESULT           **ppErrors
      );


      HRESULT ReleaseItemHandles(
      [in]                                DWORD       dwCount,
      [in, size_is(dwCount)]        OPCHANDLE   *phServer,
      [out, size_is(,dwCount)]      HRESULT           **ppErrors
      );


      HRESULT ValidateItemIDs(
      [in]                                DWORD dwCount,
      [in, size_is(dwCount)]        LPWSTR      *pszItemID,
      [out, size_is(,dwCount)]      HRESULT **ppErrors
      );

      HRESULT CreateBrowse(
      [in]                                DWORD
      dwCount,
      [in, size_is(dwCount)]        DWORD
      *pdwAttrID,
      [in, size_is(dwCount)]        OPCHDA_OPERATORCODES    *pOperator,
      [in, size_is(dwCount)]        VARIANT
      *vFilter,
      [out]                               IOPCHDA_Browser
      **pphBrowser,
      [out, size_is(,dwCount)]      HRESULT
      **ppErrors
      );
}



//****************************************************
// {1F1217B2-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b2, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
  object,
  uuid(1F1217B2-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]
interface IOPCHDA_SyncRead: IUnknown
{
HRESULT ReadRaw (
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD  dwNumValues,
[in] BOOL   bBounds,
[in] DWORD  dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out, size_is(,dwNumItems)] OPCHDA_ITEM ** ppItemValues,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT ReadProcessed (
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] FILETIME ftResampleInterval,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] DWORD* haAggregate,
[out, size_is(,dwNumItems)] OPCHDA_ITEM ** ppItemValues,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT ReadAtTime (
[in] DWORD dwNumTimeStamps,
[in, size_is(dwNumTimeStamps)] FILETIME *ftTimeStamps,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out, size_is(,dwNumItems)] OPCHDA_ITEM ** ppItemValues,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT ReadModified(
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD dwNumValues,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)]    OPCHANDLE                     *phServer,
[out, size_is(,dwNumItems)] OPCHDA_MODIFIEDITEM      ** ppItemValues,
[out, size_is(,dwNumItems)] HRESULT                        **ppErrors
);

HRESULT ReadAttribute (
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] OPCHANDLE hServer,
[in] DWORD dwNumAttributes,
[in, size_is(dwNumAttributes)]           DWORD
      *pdwAttributeIDs,
[out, size_is(,dwNumAttributes)]    OPCHDA_ATTRIBUTE
      **ppAttributeValues,
[out, size_is(,dwNumAttributes)]    HRESULT
      **ppErrors
);


}



//*****************************************************
// {1F1217B3-DEE0-11d2-A5E5-000086339399}
```

```
//DEFINE_GUID(<<name>>,
//0x1f1217b3, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
  object,
  uuid(1F1217B3-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]

interface IOPCHDA_SyncUpdate : IUnknown
{
HRESULT QueryCapabilities(
[out] OPCHDA_UPDATECAPABILITIES *pCapabilities
);

HRESULT Insert(
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
[in, size_is(dwNumItems)] VARIANT *vDataValues,
[in, size_is(dwNumItems)] DWORD *pdwQualities,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT Replace(
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
[in, size_is(dwNumItems)] VARIANT *vDataValues,
[in, size_is(dwNumItems)] DWORD *pdwQualities,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT InsertReplace (
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
[in, size_is(dwNumItems)] VARIANT *vDataValues,
[in, size_is(dwNumItems)] DWORD *pdwQualities,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT DeleteRaw (
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out, size_is(,dwNumItems)] HRESULT **ppErrors
);

HRESULT DeleteAtTime (
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
[out, size_is(,dwNumItems)] HRESULT **ppErrors
);
}
```

```
//****************************************************
// {1F1217B4-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b4, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
  object,
  uuid(1F1217B4-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]


interface IOPCHDA_SyncAnnotations : IUnknown
{
HRESULT QueryCapabilities(
[out] OPCHDA_ANNOTATIONCAPABILITIES *pCapabilities
);

HRESULT Read(
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD  dwNumItems,
[in, size_is(dwNumItems)]     OPCHANDLE               *phServer,
[out, size_is(,dwNumItems)] OPCHDA_ANNOTATION   **ppAnnotationValues,
[out, size_is(,dwNumItems)] HRESULT                   **ppErrors
);

HRESULT Insert(
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE             *phServer,
[in, size_is(dwNumItems)] FILETIME              *ftTimeStamps,
[in, size_is(dwNumItems)] OPCHDA_ANNOTATION     *pAnnotationValues,
[out, size_is(,dwNumItems)] HRESULT             **ppErrors
);
}



//****************************************************
// {1F1217B5-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b5, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
  object,
  uuid(1F1217B5-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]
interface IOPCHDA_AsyncRead : IUnknown
{
HRESULT ReadRaw (
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD dwNumValues,
[in] BOOL bBounds,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT AdviseRaw(
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in] FILETIME ftUpdateInterval,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT ReadProcessed (
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] FILETIME ftResampleInterval,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] DWORD* haAggregate,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT AdviseProcessed (
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in] FILETIME ftResampleInterval,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] DWORD* haAggregate,
[in] DWORD dwNumIntervals,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT ReadAtTime (
[in] DWORD dwTransactionID,
[in] DWORD dwNumTimeStamps,
[in, size_is(dwNumTimeStamps)] FILETIME *ftTimeStamps,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT ReadModified (
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD dwNumValues,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT ReadAttribute (
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] OPCHANDLE hServer,
[in] DWORD dwNumAttributes,
[in, size_is(dwNumAttributes)] DWORD * dwAttributeIDs,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumAttributes)] HRESULT ** ppErrors
);

HRESULT Cancel(
[in] DWORD dwCancelID
);

}

//****************************************************
// {1F1217B6-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b6, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
  object,
  uuid(1F1217B6-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]
interface IOPCHDA_AsyncUpdate : IUnknown
{
HRESULT QueryCapabilities(
[out] OPCHDA_UPDATECAPABILITIES *pCapabilities
);

HRESULT Insert(
[in] DWORD dwTransactionID,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
[in, size_is(dwNumItems)] VARIANT *vDataValues,
[in, size_is(dwNumItems)] DWORD *pdwQualities,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT Replace (
[in] DWORD dwTransactionID,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
[in, size_is(dwNumItems)] VARIANT *vDataValues,
[in, size_is(dwNumItems)] DWORD *pdwQualities,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT InsertReplace(
[in] DWORD dwTransactionID,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] FILETIME *ftTimeStamps,
[in, size_is(dwNumItems)] VARIANT *vDataValues,
[in, size_is(dwNumItems)] DWORD *pdwQualities,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT DeleteRaw (
[in] DWORD dwTransactionID,
[in,out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD dwNumItems,
[in, size_is (dwNumItems)] OPCHANDLE * phServer,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT **ppErrors
);

HRESULT DeleteAtTime (
[in] DWORD dwTransactionID,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)]     OPCHANDLE * phServer,
[in, size_is(dwNumItems)]     FILETIME *ftTimeStamps,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT **ppErrors
);

HRESULT Cancel(
[in] DWORD dwCancelID
);

}


//****************************************************
// {1F1217B7-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b7, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
  object,
  uuid(1F1217B7-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]
interface IOPCHDA_AsyncAnnotations: IUnknown
{
HRESULT QueryCapabilities(
[out] OPCHDA_ANNOTATIONCAPABILITIES *pCapabilities
);
```

```
HRESULT Read(
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT Insert(
[in] DWORD dwTransactionID,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)]     OPCHANDLE                      * phServer,
[in, size_is(dwNumItems)]     FILETIME
      *ftTimeStamps,
[in, size_is(dwNumItems)]     OPCHDA_ANNOTATION
      *pAnnotationValues,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT                          ** ppErrors
);

HRESULT Cancel(
[in] DWORD dwCancelID
);

}


//****************************************************
// {1F1217B8-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b8, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
  object,
  uuid(1F1217B8-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]
interface IOPCHDA_Playback : IUnknown
{
HRESULT ReadRawWithUpdate(
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] DWORD dwNumValues,
[in] FILETIME ftUpdateDuration,
[in] FILETIME ftUpdateInterval,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT ReadProcessedWithUpdate(
[in] DWORD dwTransactionID,
[in, out] OPCHDA_TIME *htStartTime,
[in, out] OPCHDA_TIME *htEndTime,
[in] FILETIME ftResampleInterval,
[in] DWORD dwNumIntervals,
[in] FILETIME ftUpdateInterval,
[in] DWORD dwNumItems,
[in, size_is(dwNumItems)] OPCHANDLE * phServer,
[in, size_is(dwNumItems)] DWORD* haAggregate,
[out] DWORD *pdwCancelID,
[out, size_is(,dwNumItems)] HRESULT ** ppErrors
);

HRESULT Cancel(
[in] DWORD dwCancelID
);

}

// {1F1217B9-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217b9, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);

[
  object,
  uuid(1F1217B9-DEE0-11d2-A5E5-000086339399),
  pointer_default(unique)
]
interface IOPCHDA_DataCallback : IUnknown
{
HRESULT OnDataChange(
[in] DWORD              dwTransactionID,
[in] HRESULT                  hrStatus,
[in] DWORD              dwNumItems,
[in, size_is(dwNumItems)] OPCHDA_ITEM *pItemValues,
[in, size_is(dwNumItems)] HRESULT         *phrErrors
);

HRESULT OnReadComplete(
[in] DWORD              dwTransactionID,
[in] HRESULT                  hrStatus,
[in] DWORD              dwNumItems,
[in, size_is(dwNumItems)] OPCHDA_ITEM *pItemValues,
[in, size_is(dwNumItems)] HRESULT         *phrErrors
);

HRESULT OnReadModifiedComplete (
[in] DWORD        dwTransactionID,
[in] HRESULT            hrStatus,
[in] DWORD        dwNumItems,
[in, size_is(dwNumItems)] OPCHDA_MODIFIEDITEM   *pItemValues,
[in, size_is(dwNumItems)] HRESULT                     *phrErrors
);

HRESULT OnReadAttributeComplete(
[in] DWORD        dwTransactionID,
[in] HRESULT            hrStatus,
[in] OPCHANDLE    hClient,
[in] DWORD        dwNumItems,
[in, size_is(dwNumItems)] OPCHDA_ATTRIBUTE            *pAttributeValues,
[in, size_is(dwNumItems)] HRESULT                     *phrErrors
);

HRESULT OnReadAnnotations(
[in] DWORD                          dwTransactionID,
[in] HRESULT                        hrStatus,
[in] DWORD                          dwNumItems,
[in, size_is(dwNumItems)] OPCHDA_ANNOTATION
      *pAnnotationValues,
[in, size_is(dwNumItems)] HRESULT                     *phrErrors
);

HRESULT OnInsertAnnotations (
[in] DWORD        dwTransactionID,
[in] HRESULT            hrStatus,
[in] DWORD        dwCount,
[in, size_is(dwCount)] OPCHANDLE    *phClients,
[in, size_is(dwCount)] HRESULT      *phrErrors
);

HRESULT OnPlayback (
[in] DWORD              dwTransactionID,
[in] HRESULT                  hrStatus,
[in] DWORD              dwNumItems,
[in, size_is(dwNumItems)] OPCHDA_ITEM ** ppItemValues,
[in, size_is(dwNumItems)] HRESULT         *phrErrors
);

HRESULT OnUpdateComplete (
[in] DWORD        dwTransactionID,
[in] HRESULT            hrStatus,
[in] DWORD        dwCount,
[in, size_is(dwCount)] OPCHANDLE    *phClients,
[in, size_is(dwCount)] HRESULT      *phrErrors
);

HRESULT OnCancelComplete(
[in] DWORD        dwCancelID
);
}



// This TYPELIB is generated as a convenience to users of high level
tools
// which are capable of using or browsing TYPELIBs.
// 'Smart Pointers' in VC5 is one example.
// {1F1217BA-DEE0-11d2-A5E5-000086339399}
//DEFINE_GUID(<<name>>,
//0x1f1217ba, 0xdee0, 0x11d2, 0xa5, 0xe5, 0x0, 0x0, 0x86, 0x33, 0x93,
0x99);
[
    uuid(1F1217BA-DEE0-11d2-A5E5-000086339399),
    version(1.0),
    helpstring("OPCHDA 1.0 Type Library")
```

```
]
library OPCHDA
{
    importlib("stdole32.tlb");
    importlib("stdole2.tlb");

    interface IOPCHDA_Server ;
    interface IOPCHDA_Browser ;
    interface IOPCHDA_SyncRead;
    interface IOPCHDA_SyncUpdate ;
    interface IOPCHDA_SyncAnnotations ;
    interface IOPCHDA_AsyncRead ;
    interface IOPCHDA_AsyncUpdate ;
    interface IOPCHDA_AsyncAnnotations;
    interface IOPCHDA_Playback ;
    interface IOPCHDA_DataCallback ;

};
```

8. Appendix B – Historical Data Access Error Codes

```
/*++
Module Name:
 OpcHDA_Error.h
Author:
Ayana Craven, OSI Software, Inc.

Revision History:

--*/

/*
Code Assignments:
  0000 to 0200 are reserved for Microsoft use
  (although some were inadverdantly used for OPC 1.0 errors).
  0200 to 8000 are reserved for future OPC use.
  8000 to FFFF can be vendor specific.

  HDA error codes are 1000 throu 10FF

*/

#ifndef __OPCHDAERROR_H
#define __OPCHDAERROR_H

//
//  Values are 32 bit values laid out as follows:
//
//   3 3 2 2 2 2 2 2 2 2 2 2 1 1 1 1 1 1 1 1 1 1
//   1 0 9 8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3 2 1 0 9 8 7 6 5 4 3
     2 1 0
//  +---+-+-+-----------------------+-------------------------
     ------+
//  |Sev|C|R|     Facility          |               Code
     |
//  +---+-+-+-----------------------+-------------------------
     ------+
//
//  where
//
//      Sev - is the severity code
//
//          00 - Success
//          01 - Informational
//          10 - Warning
//          11 - Error
//
//      C - is the Customer code flag
//
//      R - is a reserved bit
//
```

```
//      Facility - is the facility code
//
//      Code - is the facility's status code
//
//

//
// MessageId: OPC_S_NODATA
//
// MessageText:
//
//  There is no data within the specified parameters
//

#define OPC_S_NODATA                 ((HRESULT)0x40041002L)


//
// MessageId: OPC_S_MOREDATA
//
// MessageText:
//
// There is more data satisfying the query than was returned
//

#define OPC_S_MOREDATA               ((HRESULT)0x40041003L)


//
// MessageId: OPC_S_CURRENTVALUE
//
// MessageText:
//
//  The server only returns current values for the requested
     item attributes.
//

#define OPC_S_CURRENTVALUE
        ((HRESULT)0x40041005L)


//
// MessageId: OPC_S_EXTRADATA
//
// MessageText:
//
//  Additional data satisfying the query was found.
//

#define OPC_S_EXTRADATA
        ((HRESULT)0x40041006L)
```

```
//
// MessageId: OPC_S_INSERTED
//
// MessageText:
//
//  The requested insert occurred.
//

#define OPC_S_INSERTED
        ((HRESULT)0x4004100EL)


//
// MessageId: OPC_S_REPLACED
//
// MessageText:
//
//  The requested replace occurred.
//

#define OPC_S_REPLACED
        ((HRESULT)0x4004100FL)


//
// MessageId: OPC_W_NOFILTER
//
// MessageText:
//
//  The server does not support this filter.
//


#define OPC_W_NOFILTER
        ((HRESULT)0x80041007L)


//
// MessageId: OPC_E_MAXEXCEEDED
//
// MessageText:
//
//  The maximum number of values requested exceeds the
     server's limit.
//

#define OPC_E_MAXEXCEEDED           ((HRESULT)0xC0041001L)


//
// MessageId: OPC_E_UNKNOWNATTRID
//
// MessageText:
```

```
//
//  The server does not support this attribute.
//

#define OPC_E_UNKNOWNATTRID         ((HRESULT)0xC0041008L)


//
// MessageId: OPC_E_NOT_AVAIL
//
// MessageText:
//
//  The requested aggregate is not available for the specified
     item.
//

#define OPC_E_NOT_AVAIL
        ((HRESULT)0xC0041009L)


//
// MessageId: OPC_E_INVALIDDATATYPE
//
// MessageText:
//
//  The supplied value for the attribute is not a correct data
     type.
//

#define OPC_E_INVALIDDATATYPE       ((HRESULT)0xC004100AL)


//
// MessageId: OPC_E_DATAEXISTS
//
// MessageText:
//
//  Unable to insert - data already present.
//
#define OPC_E_DATAEXISTS           ((HRESULT)0xC004100BL)


//
// MessageId: OPC_E_INVALIDATTRID
//
// MessageText:
//
//  The supplied attribute ID is not valid.
//
#define OPC_E_INVALIDATTRID        ((HRESULT)0xC004100CL)


//
```

```
// MessageId: OPC_E_INVALIDAGGREGATE
//
// MessageText:
//
//  The aggregate requested is not valid.
//

#define OPC_E_INVALIDAGGREGATE
        ((HRESULT)0xC0041004L)


#endif // OpcHDA_Error
```