ICONICS – OPC UA Quality codes

APPLICATION NOTE

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Description: A quick introduction to the qualities and sub-qualities used by OPC UA.
OS Requirement: Windows Server 2003 x64/Vista x64/ Server 2008 x64/Windows 7 x64/ Server 2008 R2 x64
General Requirement: Installation of GENESIS64 v10.02 or above

Introduction

GENESIS64 has been developed to make full use of the OPC Unified Architecture, including the extensive quality and sub-quality options provided by the OPC-UA specifications. This document identifies the most common qualities and sub-qualities used.

Quality Values

The qualities can be divided into three main groups: Good, Uncertain, and Bad. The quality value is a 32 bit value, where the first byte represents the main quality. For Good quality the first byte has a value of zero (0), for uncertain quality the first byte has a value of 64, and for Bad quality the first byte has a value of 128.

Good Quality Values

Code Description	Code
Good	00000000
GoodSubscriptionTransferred	002D0000
GoodCompletesAsynchronously	002E0000
GoodOverload	002F0000
GoodClamped	00300000
GoodLocalOverride	00960000
GoodEntryInserted	00A20000
GoodEntryReplaced	00A30000
GoodNoData	00A50000
GoodMoreData	00A60000
GoodCommunicationEvent	00A70000
GoodShutdownEvent	00A80000
GoodCallAgain	00A90000
GoodNonCriticalTimeout	00AA0000
GoodResultsMayBeIncomplete	00BA0000

Uncertain Quality Values

Code Description	Code
Uncertain	40000000
UncertainReferenceOutOfServer	406C0000
UncertainNoCommunicationLastUsableValue	408F0000
UncertainLastUsableValue	40900000
UncertainSubstituteValue	40910000
UncertainInitialValue	40920000
UncertainSensorNotAccurate	40930000
UncertainEngineeringUnitsExceeded	40940000
UncertainSubNormal	40950000
UncertainDataSubNormal	40A40000
UncertainReferenceNotDeleted	40BC0000
UncertainNotAllNodesAvailable	40C00000

Bad Quality Values

Code Description	Code
Bad	80000000
BadUnexpectedError	80010000
BadInternalError	80020000
BadOutOfMemory	80030000
BadResourceUnavailable	80040000
BadCommunicationError	80050000
BadEncodingError	80060000
BadDecodingError	80070000
BadEncodingLimitsExceeded	80080000
BadUnknownResponse	80090000
BadTimeout	800A0000
BadServiceUnsupported	800B0000
BadShutdown	800C0000
BadServerNotConnected	800D0000
BadServerHalted	800E0000
BadNothingToDo	800F0000
BadTooManyOperations	80100000
BadDataTypeIdUnknown	80110000
BadCertificateInvalid	80120000

BadSecurityChecksFailed	80130000
BadCertificateTimeInvalid	80140000
BadCertificateIssuerTimeInvalid	80150000
BadCertificateHostNameInvalid	80160000
BadCertificateUriInvalid	80170000
BadCertificateUseNotAllowed	80180000
BadCertificateIssuerUseNotAllowed	80190000
BadCertificateUntrusted	801A0000
BadCertificateRevocationUnknown	801B0000
BadCertificateIssuerRevocationUnknown	801C0000
BadCertificateRevoked	801D0000
BadCertificateIssuerRevoked	801E0000
BadUserAccessDenied	801F0000
BadIdentityTokenInvalid	80200000
BadIdentityTokenRejected	80210000
BadSecureChannelIdInvalid	80220000
BadInvalidTimestamp	80230000
BadNonceInvalid	80240000
BadSessionIdInvalid	80250000
BadSessionClosed	80260000
BadSessionNotActivated	80270000
BadSubscriptionIdInvalid	80280000
BadRequestHeaderInvalid	802A0000
BadTimestampsToReturnInvalid	802B0000
BadRequestCancelledByClient	802C0000
BadNoCommunication	80310000
BadWaitingForInitialData	80320000
BadNodeIdInvalid	80330000
BadNodeIdUnknown	80340000
BadAttributeIdInvalid	80350000
BadIndexRangeInvalid	80360000
BadIndexRangeNoData	80370000
BadDataEncodingInvalid	80380000
BadDataEncodingUnsupported	80390000
BadNotReadable	803A0000
BadNotWritable	803B0000
BadOutOfRange	803C0000
BadNotSupported	803D0000
BadNotFound	803E0000
BadObjectDeleted	803F0000

BadNotImplemented	80400000
BadMonitoringModeInvalid	80410000
BadMonitoredItemIdInvalid	80420000
BadMonitoredItemFilterInvalid	80430000
BadMonitoredItemFilterUnsupported	80440000
BadFilterNotAllowed	80450000
BadStructureMissing	80460000
BadEventFilterInvalid	80470000
BadContentFilterInvalid	80480000
BadFilterOperandInvalid	80490000
BadContinuationPointInvalid	804A0000
BadNoContinuationPoints	804B0000
BadReferenceTypeIdInvalid	804C0000
BadBrowseDirectionInvalid	804D0000
BadNodeNotInView	804E0000
BadServerUriInvalid	804F0000
BadServerNameMissing	80500000
BadDiscoveryUrlMissing	80510000
BadSempahoreFileMissing	80520000
BadRequestTypeInvalid	80530000
BadSecurityModeRejected	80540000
BadSecurityPolicyRejected	80550000
BadTooManySessions	80560000
BadUserSignatureInvalid	80570000
BadApplicationSignatureInvalid	80580000
BadNoValidCertificates	80590000
BadRequestCancelledByRequest	805A0000
BadParentNodeIdInvalid	805B0000
BadReferenceNotAllowed	805C0000
BadNodeIdRejected	805D0000
BadNodeIdExists	805E0000
BadNodeClassInvalid	805F0000
BadBrowseNameInvalid	80600000
BadBrowseNameDuplicated	80610000
BadNodeAttributesInvalid	80620000
BadTypeDefinitionInvalid	80630000
BadSourceNodeIdInvalid	80640000
BadTargetNodeIdInvalid	80650000
BadDuplicateReferenceNotAllowed	80660000
BadInvalidSelfReference	80670000

BadReferenceLocalOnly	80680000
BadNoDeleteRights	80690000
BadServerIndexInvalid	806A0000
BadViewIdUnknown	806B0000
BadTooManyMatches	806D0000
BadQueryTooComplex	806E0000
BadNoMatch	806F0000
BadMaxAgeInvalid	80700000
BadHistoryOperationInvalid	80710000
BadHistoryOperationUnsupported	80720000
BadWriteNotSupported	80730000
BadTypeMismatch	80740000
BadMethodInvalid	80750000
BadArgumentsMissing	80760000
BadTooManySubscriptions	80770000
BadTooManyPublishRequests	80780000
BadNoSubscription	80790000
BadSequenceNumberUnknown	807A0000
BadMessageNotAvailable	807B0000
BadInsufficientClientProfile	807C0000
BadTcpServerTooBusy	807D0000
BadTcpMessageTypeInvalid	807E0000
BadTcpSecureChannelUnknown	807F0000
BadTcpMessageTooLarge	80800000
BadTcpNotEnoughResources	80810000
BadTcpInternalError	80820000
BadTcpEndpointUrlInvalid	80830000
BadRequestInterrupted	80840000
BadRequestTimeout	80850000
BadSecureChannelClosed	80860000
BadSecureChannelTokenUnknown	80870000
BadSequenceNumberInvalid	80880000
BadConfigurationError	80890000
BadNotConnected	808A0000
BadDeviceFailure	808B0000
BadSensorFailure	808C0000
BadOutOfService	808D0000
BadDeadbandFilterInvalid	808E0000
BadRefreshInProgress	80970000
BadConditionAlreadyDisabled	80980000

BadConditionDisabled	80990000
BadEventIdUnknown	809A0000
BadNoData	809B0000
BadNoBound	809C0000
BadDataLost	809D0000
BadDataUnavailable	809E0000
BadEntryExists	809F0000
BadNoEntryExists	80A00000
BadTimestampNotSupported	80A10000
BadInvalidArgument	80AB0000
BadConnectionRejected	80AC0000
BadDisconnect	80AD0000
BadConnectionClosed	80AE0000
BadInvalidState	80AF0000
BadEndOfStream	80B00000
BadNoDataAvailable	80B10000
BadWaitingForResponse	80B20000
BadOperationAbandoned	80B30000
BadExpectedStreamToBlock	80B40000
BadWouldBlock	80B50000
BadSyntaxError	80B60000
BadMaxConnectionsReached	80B70000
BadRequestTooLarge	80B80000
BadResponseTooLarge	80B90000
BadEventNotAcknowledgeable	80BB0000
BadInvalidTimestampArgument	80BD0000
BadProtocolVersionUnsupported	80BE0000
BadStateNotActive	80BF0000
BadFilterOperatorInvalid	80C10000
BadFilterOperatorUnsupported	80C20000
BadFilterOperandCountMismatch	80C30000
BadFilterElementInvalid	80C40000
BadFilterLiteralInvalid	80C50000
BadIdentityChangeNotSupported	80C60000
BadNotTypeDefinition	80C80000
BadViewTimestampInvalid	80C90000
BadViewParameterMismatch	80CA0000
BadViewVersionInvalid	80CB0000

Status Codes

These status codes are based on OPC UA status codes. The following excerpt from "OPC UA Part 4 specification" contains its definition. When you receive a status code you can break it down into individual bits to find what exactly it means. Based on the information stated in the tables below, if the bits 10:11 read 01; you can use the bits 0:4 to get the history status code.

Table 192 – StatusCode Bit Assignments

Field	Bit Range	Description
Severity	30:31	Indicates whether the *StatusCode* represents a good, bad or uncertain condition. These bits have the following meanings: Good Success – 00 – Indicates that the operation was successful and the associated results may be used. Uncertain Warning – 01 – Indicates that the operation was partially successful and that associated results might not be suitable for some purposes. Bad Failure – 10 – Indicates that the operation failed and any associated results cannot be used. Reserved – 11 – Reserved for future use. All *Clients* should treat a *StatusCode* with this severity as "Bad".
Reserved	29:28	Reserved for future use. Shall always be zero.
SubCode	16:27	The code is a numeric value assigned to represent different conditions. Each code has a symbolic name and a numeric value. All descriptions in the OPC UA specification refer to the symbolic name. Part 6 maps the symbolic names onto a numeric value.
Structure Changed	15:15	Indicates that the structure of the associated data value has changed since the last *Notification*. *Clients* should not process the data value unless they re-read the metadata. *Servers* shall set this bit if the *DataTypeEncoding* used for a *Variable* changes. Clause 7.23 describes how the *DataTypeEncoding* is specified for a *Variable*. The bit is also set if the data type *Attribute* of the *Variable* changes. A *Variable* with data type *BaseDataType* does not require the bit to be set when the data type changes. *Servers* shall also set this bit if the *ArrayDimensions* or the *ValueRank Attribute* or the *EnumStrings Property* of the *DataType* of the *Variable* changes. This bit is provided to warn *Clients* that parse complex data values that their parsing routines could fail because the serialized form of the data value has changed. This bit has meaning only for *StatusCodes* returned as part of a data change *Notification* or the *HistoryRead*. *StatusCodes* used in other contexts shall always set this bit to zero.
Semantics Changed	14:14	Indicates that the semantics of the associated data value have changed. *Clients* should not process the data value until they re-read the metadata associated with the *Variable*. *Servers* should set this bit if the metadata has changed in way that could cause application errors if the *Client* does not re-read the metadata. For example, a change to the engineering units could create problems if the *Client* uses the value to perform calculations. Part 8 defines the conditions where a *Server* shall set this bit for a DA *Variable*. Other specifications may define additional conditions. A *Server* may define other conditions that cause this bit to be set. This bit has meaning only for *StatusCodes* returned as part of a data change *Notification* or the *HistoryRead*. *StatusCodes* used in other contexts shall always set this bit to zero.
Reserved	12:13	Reserved for future use. Shall always be zero.

InfoType	10:11	The type of information contained in the info bits. These bits have the following meanings: NotUsed 00 The info bits are not used and shall be set to zero. DataValue 01 The *StatusCode* and its info bits are associated with a data value returned from the *Server*. Reserved 1X Reserved for future use. The info bits shall be ignored.
InfoBits	0:9	Additional information bits that qualify the *StatusCode*. The structure of these bits depends on the Info Type field.

Table 193. describes the structure of the *InfoBits* when the Info Type is set to *DataValue* (01).

Table 193 – DataValue InfoBits

Info Type	Bit Range	Description
LimitBits	8:9	The limit bits associated with the data value. The limits bits have the following meanings:: **Limit** **Bits** **Description** None 00 The value is free to change. Low 01 The value is at the lower limit for the data source. High 10 The value is at the higher limit for the data source. Constant 11 The value is constant and cannot change.
Overflow	7	If this bit is set, not every detected change has been returned since the *Server*'s queue buffer for the *MonitoredItem* reached its limit and had to purge out data.
Reserved	5:6	Reserved for future use. Shall always be zero.
HistorianBits	0:4	These bits are set only when reading historical data. They indicate where the data value came from and provide information that affects how the *Client* uses the data value. The historian bits have the following meaning: Raw XXX00 A raw data value. Calculated XXX01 A data value which was calculated. Interpolated XXX10 A data value which was interpolated. Reserved XXX11 Undefined. Partial XX1XX A data value which was calculated with an incomplete interval. Extra Data X1XXX A raw data value that hides other data at the same timestamp. Multi Value 1XXXX Multiple values match the aggregate criteria (i.e. multiple minimum values at different timestamps within the same interval) Part 11 describes how these bits are used in more detail.