Smart Grid Standards Information

Version 1.7
Friday, May 14, 2010

Section I: Use and Application of the Standard		

A. Identification and Affiliation

1.	Number of the standard	IEC 62541
2.	Title of the standard	OPC Unified Architecture Specification
3.	Name of owner organization	OPC Foundation and IEC TC 65
4.	Latest versions, stages, dates	Release 1.01 February 9, 2009
5.	URL(s) for the standard	http://www.opcfoundation.org/UA/
6.	Working group / committee	TC65/SC65E
7.	Original source of the content (if applicable)	OPC Foundation
8.	Brief description of scope	OPC UA is a platform-independent Web Service Definition Language standard through which various kinds of systems and devices can communicate by sending Messages between Clients and Servers over various types of networks. It can support information models such as the IEC TC 57 Common Information Model as well as others such as IEC 61850. It supports robust, secure communication that assures the identity of Clients and Servers and resists attacks. OPC UA defines sets of Services that Servers may provide, and individual Servers specify to Clients what Service sets they support. Information is conveyed using OPC UA-defined and vendor-defined data types, and Servers define object models that Clients can dynamically discover. Servers can provide access to both current and historical measurement data, as well as Alarms and Events to notify Clients of important changes. OPC UA can be mapped onto a variety of communication protocols and data can be encoded in various ways to trade off portability and efficiency.

B. Level of Standardization

1.	Names of standards development organizations that recognize this standard and/or accredit the owner organization	▶EDDL in cooperation with Fieldbus Foundation, Hart and Profibus. ▶FDI ▶ISA S95 and S88 ▶MIMOSA ▶PLCOpen / IEC 61131-3
2.	Has this standard been adopted in regulation or legislation, or is it under consideration for adoption?	☐ Yes ☒ No

Section I: Use and Application of the Standard

3.	Has it been endorsed or recommended by any level of government? If "Yes", please describe	☒ Yes ☐ No Included in NIST Smart Grid Roadmap.
4.	Level of Standard (check all that apply)	☒International ☐National ☐Industry ☐de Facto ☐ Single Company
5.	Type of document	☒Standard ☐ Report ☐ Guide ☐ Technical Specification
6.	Level of Release	☐ Released ☒ In Development ☐ Proposed

C. Areas of Use

1.	Currently used in which domains? (check all that apply)	☐ Markets ☐ Operations ☐ Service Providers ☒ Generation ☐ Transmission ☐ Distribution ☒ Customer
2.	Planned for use in which domains? (check all that apply)	☐ Markets ☒ Operations ☐Service Providers ☒ Generation ☒ Transmission ☒ Distribution ☒ Customer
3.	Please describe the Smart Grid systems and equipment to which this standard is applied	General purpose reliable messaging passing services that can be used to exchange common information model data.

Section I: Use and Application of the Standard

D. Relationship to Other Standards or Specifications

1.	Which standards or specifications are referenced by this standard?	Part 2: OPC UA Specification: Part 2 – Security Model, Version 1.01 or later http://www.opcfoundation.org/UA/Part2/ Part 3: OPC UA Specification: Part 3 – Address Space Model, Version 1.01 or later http://www.opcfoundation.org/UA/Part3/ Part 4: OPC UA Specification: Part 4 – Services, Version 1.01 or later http://www.opcfoundation.org/UA/Part4/ Part 5: OPC UA Specification: Part 5 – Information Model, Version 1.01 or later http://www.opcfoundation.org/UA/Part5/ Part 6: OPC UA Specification: Part 6 – Mappings, Version 1.0 or later http://www.opcfoundation.org/UA/Part6/ Part 7: OPC UA Specification: Part 7 – Profiles, Version 1.0 or later http://www.opcfoundation.org/UA/Part7/ Part 8: OPC UA Specification: Part 8 – Data Access, Version 1.01 or later http://www.opcfoundation.org/UA/Part8/ Part 9: OPC UA Specification: Part 9 – Alarms and Conditions, Version 1.0 or later http://www.opcfoundation.org/UA/Part9/ Part 10: OPC UA Specification: Part 10 – Programs, Version 1.01 or later http://www.opcfoundation.org/UA/Part10/ Part 11: OPC UA Specification: Part 11 – Historical Access, Version 1.01 or later http://www.opcfoundation.org/UA/Part11/ Part 12: OPC UA Specification: Part 12 – Discovery, Version 1.0 or later http://www.opcfoundation.org/UA/Part12/ Part 13: OPC UA Specification: Part 13 – Aggregates, Version 1.0 or later http://www.opcfoundation.org/UA/Part13/
2.	Which standards or specifications are related to this standard?	Precursors to this standard: Microsoft Component Object Model (COM): http://www.microsoft.com/com/default.mspx, Microsoft Distributed Component Object Model (DCOM): http://msdn.microsoft.com/en-us/library/ms809340.aspx

Section I: Use and Application of the Standard

3.	Which standards or specifications cover similar areas (may overlap)?	
4.	What activities are building on this work?	▶EDDL in cooperation with Fieldbus Foundation, Hart and Profibus. ▶FDI ▶ISA S95 and S88 ▶MIMOSA ▶PLCOpen / IEC 61131-3

E. Dept of Energy Smart Grid Characteristics

Please describe how this standard may encourage each of the following:

1.	Enables informed participation by customers	☒ Yes ☐ No
2.	Accommodates all generation and storage options	☒ Yes ☐ No
3.	Enables new products, services and markets	☒ Yes ☐ No
4.	Provides the power quality for a range of needs	☐ Yes ☐ No
5.	Optimizes asset utilization and operating efficiency	☒ Yes ☐ No
6.	Operates resiliently to disturbances, attacks, and natural disasters	☒ Yes ☐ No

F. Priority Areas Previously Mentioned by FERC and NIST

Please describe if and how this standard may be applied in each of the following areas. Note that there is space in section J to discuss any other significant areas where the standard may be applied.

1.	Cybersecurity and physical security	☒ Yes ☐ No
2.	Communicating and coordinating across inter-system interfaces	☒ Yes ☐ No
3.	Wide area situational awareness	☒ Yes ☐ No
4.	Smart grid-enabled response for energy demand	☒ Yes ☐ No
5.	Electric storage	☒ Yes ☐ No
6.	Electric vehicle transportation	☐ Yes ☒ No
7.	Advanced metering infrastructure	☒ Yes ☐ No
8.	Distribution grid management	☒ Yes ☐ No

G. Openness

1.	Amount of fee (if any) for the documentation	Free to OPC members. Also available from the IEC.
2.	Amount of fee (if any) for implementing the standard	Free. Source code is available to OPC members from the OPC Foundation.
3.	Amount of fee (if any) to participate in updating the standard	OPC Foundation or IEC SC 65 membership required.
4.	Is the standard documentation available online?	☒ Yes ☐ No URL: http://www.opcfoundation.org/UA/ or http://www.iec.ch/dyn/www/f?p=102:7:0::::FSP_ORG_ID:1452
5.	Are there open-source or reference implementations?	☒ Yes ☐ No For OPC Members
6.	Are there open-source test tools?	☒ Yes ☐ No For OPC Members
7.	Would open-source implementations be permitted?	☒ Yes ☐ No
8.	Approximately how many implementers are there?	15
9.	Approximately how many users are there?	100 (estimated)
10.	Where is the standard used outside of the USA?	Worldwide
11.	Is the standard free of references to patented technology?	☒ Yes ☐ No
12.	If patented technology is used, does the holder provide a royalty-free license to users of the standard?	☐ Yes ☐ No ☒ Not Patented
13.	Can an implementer use the standard without signing a license agreement?	☐ Yes ☒ No
14.	Are draft documents available to the public at no cost?	☐ Yes ☒ No
15.	How does one join the working group or committee that controls the standard?	
16.	Is voting used to decide whether to modify the standard? If Yes, explain who is permitted to vote.	☒ Yes ☐ No Members of the OPC Foundation and IEC SC 65.
17.	Is an ANSI-accredited process used to develop the standard?	☒ Yes ☐ No
18.	What countries are represented in the working group or committee that controls the standard?	Worldwide

H. Support, Conformance, Certification and Testing

1.	Is there a users group or manufacturers group to support this standard?	☒ Yes ☐ No
2.	What is the name of the users group or manufacturers group (if any)?	OPC Founation
3.	What type of test procedures are used to test this standard? (please check all that apply)	☐ Internal to the lab ☐ Published by standards organization ☒ Published by users group ☐ No procedures, informal testing

4.	Are there test vectors (pre-prepared data) used in testing? (please check all that apply)	☐ Internal to the lab ☐ Published by standards organization ☒ Published by users group ☐ No procedures, informal testing
5.	What types of testing programs exist? (check all that apply)	☒ Interoperability Testing ☒ Conformance Testing ☒ Security Testing ☐ No Testing
6.	What types of certificates are issued? (check all that apply)	☐ Interoperability Certificate ☒ Conformance Certificate ☐ Security Certificate (text document) ☐ No Certificates
7.	Are there rules controlling how and when to use the logo?	☒ Yes ☐ No ☐ Standard has no logo
8.	Is there a program to approve test labs?	☒ Yes ☐ No
9.	Approximately how many test labs are approved (if any)?	At this time, conformance test tools are only available from the OPC Foundation.
10.	Is there a defined process for users to make technical comments on the standard or propose changes to the standard and have these issues resolved?	☒ Yes ☐ No
11.	Is there a published conformance checklist or table?	☒ Yes ☐ No
12.	Are there defined conformance blocks or subsets?	☒ Yes ☐ No
13.	Approximately how many vendors provide test tools?	
14.	Are there tools for pre-certification prior to testing?	☒ Yes ☐ No
15.	Can vendors self-certify their implementations?	☒ Yes ☐ No
16.	Is there application testing for specific uses?	☒ Yes ☐ No ☐ Not applicable
17.	Is there a "golden" or "reference" implementation to test against?	☒ Yes ☐ No
18.	Who typically funds the testing? (check all that apply)	☒ User ☐ Users Group ☒ Vendor ☐ Confidential
19.	Is there a method for users and implementers to ask questions about the standard and have them answered? (check all that apply)	☐ Yes, official interpretations ☒ Yes, informal opinions ☐ No
20.	Does the users' group (or some other group) fund specific tasks in the evolution of the standard?	☒ Yes ☐ No
21.	Is the users' group working on integration, harmonization or unification with other similar standards?	☒ Yes ☐ No
22.	What other standards is this standard being integrated, harmonized, or unified with (if any)?	▶EDDL in cooperation with Fieldbus Foundation, Hart and Profibus. ▶FDI ▶ISA S95 and S88 ▶MIMOSA ▶PLCOpen / IEC 61131-3
23.	Are there application notes, implementation agreements, or guidelines available describing specific uses of the standard?	☒ Yes ☐ No ☐ Not applicable

J. Notes

Please present here any additional information about the standard that might be useful:

1.	OPC UA is being considered for use in IEC TC 57.

Section II: Functional Description of the Standard

K. GridWise Architecture: Layers

Please identify which layers this standard specifies, as described in http://www.gridwiseac.org/pdfs/interopframework_v1_1.pdf, and the applicable section of the standard. Note the mapping to the Open Systems Interconnect (OSI) model is approximate.

1.	**Layer 8: Policy**	☐ Yes ☐ No
2.	**Layer 7: Business Objectives**	☐ Yes ☐ No
3.	**Layer 6: Business Procedures**	☐ Yes ☐ No
4.	**Layer 5: Business Context**	☐ Yes ☐ No
5.	**Layer 4: Semantic Understanding (object model)**	☒ Yes ☐ No
6.	**Layer 3: Syntactic Interoperability (OSI layers 5-7)**	☒ Yes ☐ No
7.	**Layer 2: Network Interoperability (OSI layers 3-4)**	☒ Yes ☐ No
8.	**Layer 1: Basic Connectivity (OSI layers 1-2)**	☐ Yes ☐ No

L. GridWise Architecture: Cross-Cutting Issues

Please provide an explanation in the box beside the heading for any questions answered "Not applicable". If the question is not applicable because the function is provided in another layer or standard, please suggest any likely candidates. Note that "the standard" refers to the technology specified by the standard, not the documents themselves.

	Shared Meaning of Content	
1.	Do all implementations share a common information model?	☒ Yes ☐ No ☐ Not applicable
2.	Can data be arranged and accessed in groups or structures?	☒ Yes ☐ No ☐ Not applicable
3.	Can implementers extend the information model?	☒ Yes ☐ No ☐ Not applicable
4.	Can implementers use a subset of the information model?	☒ Yes ☐ No ☐ Not applicable
	Resource Identification	
5.	Can data be located using human-readable names?	☒ Yes ☐ No ☐ Not applicable
6.	Can names and addresses be centrally managed without human intervention?	☒ Yes ☐ No ☐ Not applicable
	Time Synchronization and Sequencing	
7.	Can the standard remotely synchronize time?	☐ Yes ☐ No ☒ Provided in another layer
8.	Can the standard indicate the quality of timestamps?	☒ Yes ☐ No ☐ Provided in another layer
	Security and Privacy	
9.	Where is security provided for this standard?	☐ Within this standard ☒ By other standards
10.	Does the standard provide authentication?	☒ Yes ☐ No
11.	Does the standard permit role-based access control?	☒ Yes ☐ No

Section II: Functional Description of the Standard

12.	Does the standard provide encryption?	☒ Yes ☐ No
13.	Does the standard detect intrusions or attacks?	☒ Yes ☐ No
14.	Does the standard facilitate logging and auditing of security events?	☒ Yes ☐ No
15.	Can the security credentials be upgraded remotely?	☒ Yes ☐ No ☐ No Credentials
16.	Can the security credentials be managed centrally?	☒ Yes ☐ No ☐ No Credentials
17.	Please list any security algorithms and standards used	WS Security for Web Service Profile.
18.	Please provide additional information on how the standard addresses any "Yes" answers above	Leverages Web Services Interoperability Technology http://en.wikipedia.org/wiki/Web_Services_Interoperability_Technology
19.	Please provide additional information about why any of the questions listed above do not apply to this standard	
	Logging and Auditing	
20.	Does the standard facilitate logging and auditing of critical operations and events?	☒ Yes ☐ No
21.	Can the standard gather statistics on its operation?	☒ Yes ☐ No ☐ Not applicable
22.	Can the standard report alerts and warnings?	☒ Yes ☐ No ☐ Not applicable
	Transaction State Management	
23.	Can the standard remotely enable or disable devices or functions?	☒ Yes ☐ No ☐ Not applicable
	System Preservation	
24.	Can the standard automatically recover from failed devices or links?	☒ Yes ☐ No ☐ Not applicable ☐ Provided in another layer
25.	Can the standard automatically re-route messages?	☐ Yes ☐ No ☐ Not applicable ☒ Provided in another layer
26.	Can the standard remotely determine the health (as opposed to just connectivity) of devices or software?	☒ Yes ☐ No ☐ Not applicable
	Other Management Capabilities	
27.	Please describe any other system or network management capabilities the standard provides.	SNMP to OPC bridging tools are available commercially.
	Quality of Service	
28.	Is data transfer bi-directional?	☒ Yes ☐ No
29.	Can data be prioritized?	☒ Yes ☐ No ☐ Not applicable
30.	What types of reliability are provided?	☒ Reliable ☐ Non-guaranteed ☐ Both ☐ Either ☐ Provided in another layer
31.	Can information be broadcast to many locations with a single transmission?	☒ Yes ☐ No ☐ Not applicable
32.	Please describe any other methods the standard uses to manage quality of service.	

Section II: Functional Description of the Standard

	Discovery and Configuration	
33.	Can the software or firmware be upgraded remotely?	☒ Yes ☐ No ☐ Not applicable
34.	Can configuration or settings be upgraded remotely?	☒ Yes ☐ No ☐ Not applicable
35.	Can implementations announce when they have joined the system?	☒ Yes ☐ No ☐ Not applicable
36.	Can implementations electronically describe the data they provide?	☒ Yes ☐ No ☐ Not applicable
	System Evolution and Scalability	
37.	What factors could limit the number of places the standard could be applied?	OPC UA provides reliable messaging which may not always be required.
38.	What steps are required to increase the size of a system deploying this standard?	
39.	Is the information model separate from the transport method?	☒ Yes ☐ No
40.	Does the standard support alternate choices in the layers(s) below it?	☒ Yes ☐ No ☐ No layers below
41.	List the most common technology choices for layers implemented below this standard	Web Services, Binary, and Web Services with attachements
42.	Does the standard support multiple technology choices in the layers above it?	☒ Yes ☐ No ☐ No layers above
43.	List the technologies or entities that would most commonly use this standard in the layer above	Web Services, TCP/IP
44.	Please describe any mechanism or plan to ensure the standard is as backward-compatible as possible with previous versions	OPC COM to OPC UA wrappers available from the OPC Foundation.
45.	Please describe how the design of this standard permits it to be used together with older or legacy technologies	OPC Clients and Servers are commercially available for many legacy applications and technologies.
46.	Please describe how the design of this standard permits it to co-exist on the same network or in the same geographic area with similar technologies, and give examples	Web Service technology is used including Web Service Security
47.	**Electromechanical**	

M. Architectural Principles

Please describe how this standard may apply any of these principles:

1.	Symmetry – facilitates bi-directional flow of energy and information	Although OPC UA is client/server in nature, data consumers and providers can be built.
2.	Transparency – supports a transparent and auditable chain of transactions	OPC UA supports persistent connections, auditing, as well as a process control model.

Section II: Functional Description of the Standard

3.	Composition – facilitates the building of complex interfaces from simpler ones	OPC UA supports a server chaining architecture where more simple data (such as IEC 61850) exposed by lower level servers can be combined with more complex data (such as IEC 61970) exposed by higher level servers.
4.	Loose coupling – can support bilateral and multilateral transactions without elaborate pre-arrangement	Clients and servers can communicate with only a shared understanding of a common model and shared services.
5.	Shallow integration – does not require detailed mutual information to interact with other components	The internals of applications, databases, and devices may be wrapped using OPC UA.
6.	Please list any other architectural models, reference architectures or frameworks this standard was designed to be compliant with, e.g. W3C, IEC TC57, OSI and how it fits those models	W3C Web Services and IEC TC 57. OPC UA can be used to convey data defined by the TC 57 working groups.