Smart Grid Standards Information

Version 1.6
Tuesday, May 11, 2010

Section I: Use and Application of the Standard

A. Identification and Affiliation

1.	Number of the standard	IEEE PC37.238 D4.0
2.	Title of the standard	Draft Standard Profile for Use of IEEE 1588 Precision Time Protocol in Power System Applications
3.	Name of owner organization	IEEE PES PSRC and IEEE PES SC
4.	Latest versions, stages, dates	Currently at Draft 4.0 Objective is IEEE Sponsor ballot in May 2010
5.	URL(s) for the standard	Draft IEEE standards are only available to IEEE Working Group and IEEE Standards Association members. Background on the IEEE 1588 standard can be found at: http://ieee1588.nist.gov/
6.	Working group / committee	IEEE Power Systems Relaying Committee - Working Group H7 and IEEE Substations Committee – Working Group C7
7.	Original source of the content (if applicable)	IEEE Std.1588 – 2008 IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.
8.	Brief description of scope	This standard specifies a common profile for use of IEEE 1588-2008 Precision Time Protocol (PTP) in power system protection, control, automation and data communication applications utilizing an Ethernet communications architecture. The profile specifies a well-defined subset of IEEE 1588-2008 mechanisms and settings aimed at enabling device interoperability, robust response to network failures, and deterministic control of delivered time quality. It specifies the preferred physical layer (Ethernet), higher level protocol used for PTP message exchange and the PTP protocol configuration parameters. Special attention is given to ensuring consistent and reliable time distribution within substations, between substations, and across wide geographic areas. (Source: IEEE PC37.238 D4.0 – Scope Statement)

B. Level of Standardization

1.	Names of standards development organizations (SDOs) that recognize this standard and/or accredit the owner organization	Standard is not released, however it is likely that other SDOs such as the IEC TC57 WG10 will recognize this standard.

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2.	Has this standard been adopted in regulation or legislation, or is it under consideration for adoption?	☐ Yes ☒ No
3.	Has it been endorsed or recommended by any level of government? If "Yes", please describe	☒ Yes ☐ No NIST has identified IEEE Std.1588-2008 and IEEE PC37.238 in its initial release of Smart Grid interoperability standards. Refer to the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0 (January 2010).
4.	Level of Standard (check all that apply)	☒International ☐National ☐Industry ☐de Facto ☐ Single Company (Upon release of the standard)
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	The primary applications for this standard are mission critical power system protection, control, automation, synchronized phasor measurement and data communication applications. Particular focus is given to providing consistent and reliable time distribution within substations, between substations, and across wide geographic areas.

D. Relationship to Other Standards or Specifications

1.	Which standards or specifications are referenced by this standard?	IEEE Std. 1588 – 2008 IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.
2.	Which standards or specifications are related to this standard?	It is expected the IEEE PC37.238 will be used for applications of the following standards: • IEC 61850 • IEEE C37.118

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3.	Which standards or specifications cover similar areas (may overlap)?	• IEEE Std.1588 - 2008 • IEC 61850-7-2 (Service model, time quality indication) • RFC 1305 Network Time Protocol (NTP) • RFC 2030 Simple Network Time Protocol (SNTP) • IEEE C37.118 (Time quality indication only) • IRIG-B • IEEE 802.1AS Draft D7.0
4.	What activities are building on this work?	• IEEE C37.118 updated standard is expected to reference this standard • IEC 61850 Edition 2 is expected to reference this standard • Applications: mission critical power system protection, control, automation, synchronized phasor measurement and data communication applications.

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 Enables precise time synchronization service to various applications
4.	Provides the power quality for a range of needs	☒ Yes ☐ No Enables phasor measurements for power quality analysis
5.	Optimizes asset utilization and operating efficiency	☐ Yes ☒ No #####
6.	Operates resiliently to disturbances, attacks, and natural disasters	☒ Yes ☐ No Continues and restores operation upon various failure conditions

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 Enables synchrionous actions across inter-system interfaces
3.	Wide area situational awareness	☒ Yes ☐ No Enables wide area phasor data accumulation and analysis of power quality
4.	Smart grid-enabled response for energy demand	☒ Yes ☐ No Enables synchronized co-ordination of enegry demand - response
5.	Electric storage	☐ Yes ☒ No #####
6.	Electric vehicle transportation	☒ Yes ☐ No Enables time synchronization inside electric vehicle transportation
7.	Advanced metering infrastructure	☒ Yes ☐ No Provides time synchronization to advanced metering infrastructure
8.	Distribution grid management	☒ Yes ☐ No Enables synchronized actions for distribution grid management

G. Openness

1.	Amount of fee (if any) for the documentation	Regular IEEE Standard cost
2.	Amount of fee (if any) for implementing the standard	None, expect potential patent fees
3.	Amount of fee (if any) to participate in updating the standard	#####
4.	Is the standard documentation available online?	☐ Yes ☒ No ##### URL
5.	Are there open-source or reference implementations?	☐ Yes ☒ No
6.	Are there open-source test tools?	☐ Yes ☒ No
7.	Would open-source implementations be permitted?	☒ Yes ☐ No
8.	Approximately how many implementers are there?	25-50
9.	Approximately how many users are there?	TBD once the standard gets approved
10.	Where is the standard used outside of the USA?	YES
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?	By stating in writing to Working Group Co-chairs that one would like to become a member.
16.	Is voting used to decide whether to modify the standard? If Yes, explain who is permitted to vote.	☒ Yes ☐ No Working Group members.
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?	USA, Canada, Germany, Switzerland, France, Japan, Korea, Taiwan, Australia, Austria, Brazil

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)?	N/A
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)?	N/A
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?	None
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)?	IEEE C37.118 and IEC 61850
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.	The IEEE PC37.238 Standard is still under development. Conformance testing activities and testing lab accreditation have not been initiated. There were 2 interoperability tests conducted. Testing is also in the scope of the NIST IEEE 1588 Testbed project.

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	This is the scope of this standard
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 Provision is provided to add authentication

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11.	Does the standard permit role-based access control?	☒ Yes ☐ No Should be provided by other standard(s)
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 Precise time enables precise timestamping for security (and other) events logging
15.	Can the security credentials be upgraded remotely?	☐ Yes ☐ No ☒ No Credentials Should be addressed by other standards
16.	Can the security credentials be managed centrally?	☐ Yes ☐ No ☒ No Credentials Should be addressed by other standards
17.	Please list any security algorithms and standards used	#####
18.	Please provide additional information on how the standard addresses any “Yes” answers above	#####
19.	Please provide additional information about why any of the questions listed above do not apply to this standard	The scope of this standard is to distribute time. Security shall be addressed by other standards. This standard provides a mechanism to add security features.
	Logging and Auditing	#####
20.	Does the standard facilitate logging and auditing of critical operations and events?	☒ Yes ☐ No Precise time enables precise timestaping for events logging
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.	The standard supports SNMP MIB for system-wide management
	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

Section II: Functional Description of the Standard		
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.	The standard uses IEEE 802.1Q tags for message prioritization.
	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?	Availability of Ethernet network architecture
38.	What steps are required to increase the size of a system deploying this standard?	Reducing residual time error
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	At physical layer, copper (electrical) and fiber cabling could be used, with potential extention to wireless.
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	IEEE C37.118 data mapped into UDP/IP or TCP/IP. IEC 61850-8-1 data over UDP/IP and IEC 61850-9-2 data over Layer 2 (same Layer with the standard)
44.	Please describe any mechanism or plan to ensure the standard is as backward-compatible as possible with previous versions	This is the first release of this standard. Backwards compatility will be addressed in the new releases. IEEE Std.1588-2008 provides backwards compatibility with its older version released in 2002.
45.	Please describe how the design of this standard permits it to be used together with older or legacy technologies	The protocol specified in this standard is transparent and can be used in parallel with SNMP protocol, and with IRIG-B time distribution
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	This standard specifies precise time distribution over Ethernet. It does not preclude time distribution over Ethernet using SNMP protocol, or using IRIG-B via dedicated cabling.
47.	**Electromechanical**	#####

Section II: Functional Description of the Standard

M. Architectural Principles

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

1.	Symmetry – facilitates bi-directional flow of energy and information	The standard distribute time information from master to slave devices. It also supports path delay measurements in slave to master direction, for more precise time synchronization.
2.	Transparency – supports a transparent and auditable chain of transactions	The protocol defines simple and auditable message exchange and port state machines.
3.	Composition – facilitates the building of complex interfaces from simpler ones	Precise time distrtibution is one system component that enables more complex functions and interfaces, e.g. synchrophasor measurements, analog measured sampled values, event recording, etc
4.	Loose coupling – can support bilateral and multilateral transactions without elaborate pre-arrangement	Loosly coupled, can support complex transistions (e.g. on topology or time master changes) without pre-arrangement
5.	Shallow integration – does not require detailed mutual information to interact with other components	The protocol provides simple mapping of time and time quality for other funtions and does not require detailed information exchange with more such functions.
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	IEC 61850 Communication Networks and Systems for Power Utility Automation (TC57 WG10). System management using SNMP MIB. OSI 7-layer protocol reference model.