



# Smart Grid Standards Information

Version 1.7

Wednesday, April 7, 2010

## Section I: Use and Application of the Standard

### Identification and Affiliation

	Number of the standard	1686-2007
	Title of the standard	IEEE Standard for Substation Intelligent Electronic Devices (IEDs) Cyber Security Capabilities
	Name of owner organization	Institute of Electrical and Electronic Engineers (IEEE)
	Latest versions, stages, dates	1686-2007
	URL(s) for the standard	<a href="http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=4453853">http://ieeexplore.ieee.org/xpl/freeabs_all.jsp?arnumber=4453853</a>
	Working group / committee	Parent subcommittee is IEEE PES Substations C0
	Original source of the content (if applicable)	
	Brief description of scope	The functions and features to be provided in substation intelligent electronic devices (IEDs) to accommodate critical infrastructure protection programs are defined in this standard. Security regarding the access, operation, configuration, firmware revision, and data retrieval from an IED is addressed in this standard. Communications for the purpose of power system protection (teleprotection) is not addressed. Encryption for the secure transmission of data both within and external to the substation, including supervisory control and data acquisition, is not part of this standard as this is addressed in other efforts.

### Level of Standardization

1.	Names of standards development organizations that recognize this standard and/or accredit the owner organization	
	Has this standard been adopted in regulation or legislation, or is it under consideration for adoption?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
	Has it been endorsed or recommended by any level of government? If "Yes", please describe	<input type="checkbox"/> Yes <input type="checkbox"/> No
	Level of Standard (check all that apply)	<input type="checkbox"/> International <input type="checkbox"/> National <input type="checkbox"/> Industry <input type="checkbox"/> de Facto <input type="checkbox"/> Single Company
	Type of document	<input type="checkbox"/> Standard <input type="checkbox"/> Report <input type="checkbox"/> Guide <input type="checkbox"/> Technical Specification
	Level of Release	<input checked="" type="checkbox"/> Released <input type="checkbox"/> In Development <input type="checkbox"/> Proposed

## Section I: Use and Application of the Standard

### Areas of Use

1.	Currently used in which domains? (check all that apply)	<input type="checkbox"/> Markets <input type="checkbox"/> Operations <input type="checkbox"/> Service Providers <input type="checkbox"/> Generation <input type="checkbox"/> Transmission <input type="checkbox"/> Distribution <input type="checkbox"/> Customer
	Planned for use in which domains? (check all that apply)	<input type="checkbox"/> Markets <input type="checkbox"/> Operations <input type="checkbox"/> Service Providers <input type="checkbox"/> Generation <input type="checkbox"/> Transmission <input type="checkbox"/> Distribution <input type="checkbox"/> Customer
	Please describe the Smart Grid systems and equipment to which this standard is applied	Substation (and possibly poletop) devices

### Relationship to Other Standards or Specifications

1.	Which standards or specifications are referenced by this standard?	C37.231
	Which standards or specifications are related to this standard?	
	Which standards or specifications cover similar areas (may overlap)?	DHS catalog (subset), CIP-011, except 1686 is more detailed in areas it covers, also a small subset of NIST SP800-63
	What activities are building on this work?	PC37.240, Draft Standard for Cyber Security Requirements for Substation Automation, Protection and Control Systems

### Dept of Energy Smart Grid Characteristics

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

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

## 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 Error: Reference source not found to discuss any other significant areas where the standard may be applied.

1.	Cybersecurity and physical security	<input type="checkbox"/> Yes <input type="checkbox"/> No
2.	Communicating and coordinating across inter-system interfaces	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
3.	Wide area situational awareness	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
4.	Smart grid-enabled response for energy demand	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
5.	Electric storage	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
6.	Electric vehicle transportation	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
7.	Advanced metering infrastructure	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
8.	Distribution grid management	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

## Openness

1.	Amount of fee (if any) for the documentation	
2.	Amount of fee (if any) for implementing the standard	
3.	Amount of fee (if any) to participate in updating the standard	Must be IEEE-SA member
4.	Is the standard documentation available online?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No URL:
5.	Are there open-source or reference implementations?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
6.	Are there open-source test tools?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
7.	Would open-source implementations be permitted?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
8.	Approximately how many implementers are there?	
9.	Approximately how many users are there?	
10.	Where is the standard used outside of the USA?	
11.	Is the standard free of references to patented technology?	<input type="checkbox"/> Yes <input type="checkbox"/> No
12.	If patented technology is used, does the holder provide a royalty-free license to users of the standard?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not Patented
13.	Can an implementer use the standard without signing a license agreement?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
14.	Are draft documents available to the public at no cost?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
15.	How does one join the working group or committee that controls the standard?	Join IEEE, PES, and the Substations C0 subcommittee.
16.	Is voting used to decide whether to modify the standard? If Yes, explain who is permitted to vote.	<input type="checkbox"/> Yes <input type="checkbox"/> No
17.	Is an ANSI-accredited process used to develop the standard?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
18.	What countries are represented in the working group or committee that controls the standard?	

## Support, Conformance, Certification and Testing

1.	Is there a users group or manufacturers group to support this standard?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2.	What is the name of the users group or manufacturers group (if any)?	
3.	What type of test procedures are used to test this standard? (please check all that apply)	<input type="checkbox"/> Internal to the lab <input type="checkbox"/> Published by standards organization <input type="checkbox"/> Published by users group <input checked="" type="checkbox"/> No procedures, informal testing
4.	Are there test vectors (pre-prepared data) used in testing? (please check all that apply)	<input type="checkbox"/> Internal to the lab <input type="checkbox"/> Published by standards organization <input type="checkbox"/> Published by users group <input checked="" type="checkbox"/> No procedures, informal testing
5.	What types of testing programs exist? (check all that apply)	<input type="checkbox"/> Interoperability Testing <input type="checkbox"/> Conformance Testing <input type="checkbox"/> Security Testing <input type="checkbox"/> No Testing
6.	What types of certificates are issued? (check all that apply)	<input type="checkbox"/> Interoperability Certificate <input type="checkbox"/> Conformance Certificate <input type="checkbox"/> Security Certificate (text document) <input type="checkbox"/> No Certificates
7.	Are there rules controlling how and when to use the logo?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Standard has no logo
8.	Is there a program to approve test labs?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
9.	Approximately how many test labs are approved (if any)?	
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?	<input type="checkbox"/> Yes <input type="checkbox"/> No
11.	Is there a published conformance checklist or table?	<input type="checkbox"/> Yes <input type="checkbox"/> No
12.	Are there defined conformance blocks or subsets?	<input type="checkbox"/> Yes <input type="checkbox"/> No
13.	Approximately how many vendors provide test tools?	
14.	Are there tools for pre-certification prior to testing?	<input type="checkbox"/> Yes <input type="checkbox"/> No
15.	Can vendors self-certify their implementations?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
16.	Is there application testing for specific uses?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
17.	Is there a "golden" or "reference" implementation to test against?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
18.	Who typically funds the testing? (check all that apply)	<input checked="" type="checkbox"/> User <input type="checkbox"/> Users Group <input checked="" type="checkbox"/> Vendor <input type="checkbox"/> Confidential
19.	Is there a method for users and implementers to ask questions about the standard and have them answered? (check all that apply)	<input type="checkbox"/> Yes, official interpretations <input checked="" type="checkbox"/> Yes, informal opinions <input checked="" type="checkbox"/> No
20.	Does the users' group (or some other group) fund specific tasks in the evolution of the standard?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
21.	Is the users' group working on integration, harmonization or unification with other similar standards?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

22.	What other standards is this standard being integrated, harmonized, or unified with (if any)?	
23.	Are there application notes, implementation agreements, or guidelines available describing specific uses of the standard?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable

**J. Notes**

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

1.	
----	--

## Section II: Functional Description of the Standard

### GridWise Architecture: Layers

Please identify which layers this standard specifies, as described in

[http://www.gridwiseac.org/pdfs/interopframework\\_v1\\_1.pdf](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.	<b>Layer 8: Policy</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
2.	<b>Layer 7: Business Objectives</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
3.	<b>Layer 6: Business Procedures</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
4.	<b>Layer 5: Business Context</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
5.	<b>Layer 4: Semantic Understanding (object model)</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
6.	<b>Layer 3: Syntactic Interoperability (OSI layers 5-7)</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
7.	<b>Layer 2: Network Interoperability (OSI layers 3-4)</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
8.	<b>Layer 1: Basic Connectivity (OSI layers 1-2)</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No

### 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.

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

## Section II: Functional Description of the Standard

12.	Does the standard provide encryption?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
13.	Does the standard detect intrusions or attacks?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
14.	Does the standard facilitate logging and auditing of security events?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
15.	Can the security credentials be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No Credentials
16.	Can the security credentials be managed centrally?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No Credentials
17.	Please list any security algorithms and standards used	
18.	Please provide additional information on how the standard addresses any "Yes" answers above	The standard specifies password construction and number of separate accounts. The standard specifies content of logs.
19.	Please provide additional information about why any of the questions listed above do not apply to this standard	The standard is a collection of cybersecurity language for inclusion in specifications for substation equipment. It addresses the topics of a small subset of the DHS catalog and possibly CIP-011, but in more detail.
<b>Logging and Auditing</b>		
20.	Does the standard facilitate logging and auditing of critical operations and events?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No It specifies log contents.
21.	Can the standard gather statistics on its operation?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
22.	Can the standard report alerts and warnings?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
<b>Transaction State Management</b>		
23.	Can the standard remotely enable or disable devices or functions?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
<b>System Preservation</b>		
24.	Can the standard automatically recover from failed devices or links?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable <input type="checkbox"/> Provided in another layer
25.	Can the standard automatically re-route messages?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable <input type="checkbox"/> Provided in another layer
26.	Can the standard remotely determine the health (as opposed to just connectivity) of devices or software?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
<b>Other Management Capabilities</b>		
	Please describe any other system or network management capabilities the standard provides.	
<b>Quality of Service</b>		
27.	Is data transfer bi-directional?	<input type="checkbox"/> Yes <input type="checkbox"/> No N/A
28.	Can data be prioritized?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
29.	What types of reliability are provided?	<input type="checkbox"/> Reliable <input type="checkbox"/> Non-guaranteed <b>N/A</b> <input type="checkbox"/> Both <input type="checkbox"/> Either <input type="checkbox"/> Provided in another layer
30.	Can information be broadcast to many locations with a single transmission?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable

## Section II: Functional Description of the Standard

	Please describe any other methods the standard uses to manage quality of service.	
	<b>Discovery and Configuration</b>	
31.	Can the software or firmware be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable <b>Defines security provisions for this.</b>
32.	Can configuration or settings be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable <b>Defines security provisions for this.</b>
33.	Can implementations announce when they have joined the system?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
34.	Can implementations electronically describe the data they provide?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
	<b>System Evolution and Scalability</b>	
35.	What factors could limit the number of places the standard could be applied?	Need for strong authentication. Otherwise, none.
36.	What steps are required to increase the size of a system deploying this standard?	
37.	Is the information model separate from the transport method?	<input type="checkbox"/> Yes <input type="checkbox"/> No N/A
38.	Does the standard support alternate choices in the layers(s) below it?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No layers below N/A
39.	List the most common technology choices for layers implemented below this standard	
40.	Does the standard support multiple technology choices in the layers above it?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No layers above N/A
41.	List the technologies or entities that would most commonly use this standard in the layer above	
42.	Please describe any mechanism or plan to ensure the standard is as backward-compatible as possible with previous versions	
43.	Please describe how the design of this standard permits it to be used together with older or legacy technologies	Not considered.
44.	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	N/A
45.	<b>Electromechanical</b>	
<b>Architectural Principles</b>		
Please describe how this standard may apply any of these principles:		
1.	Symmetry – facilitates bi-directional flow of energy and information	
2.	Transparency – supports a transparent and auditable chain of transactions	Defines audit log content.

## Section II: Functional Description of the Standard

3.	Composition – facilitates the building of complex interfaces from simpler ones	
4.	Loose coupling – can support bilateral and multilateral transactions without elaborate pre-arrangement	
5.	Shallow integration – does not require detailed mutual information to interact with other components	
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	