



Smart Grid Standards Information

Version 1.6

Tuesday, April 20, 2010

Section I: Use and Application of the Standard

A. Identification and Affiliation

1.	Number of the standard	C12.21-2006
2.	Title of the standard	Protocol Specification for Telephone Modem Communication
3.	Name of owner organization	ANSI
4.	Latest versions, stages, dates	2006
5.	URL(s) for the standard	http://webstore.ansi.org/RecordDetail.aspx?sku=NEMA+ANSI+C12.21%3a2006
6.	Working group / committee	ANSI SC12.17 WG4
7.	Original source of the content (if applicable)	
8.	Brief description of scope	<p>This Standard details the criteria required for communications between a C12.21 Device and a C12.21 Client via a modem connected to the switched telephone network. The C12.21 Client could be a laptop or portable computer, a master station system or some other electronic communications device.</p> <p>This Standard does not specify the implementation requirements of the telephone switched network to the modem, nor does it include definitions for the establishment of the communication channel.</p> <p>This document provides details for an implementation of the OSI 7-layer model.</p> <p>The protocol specified in this Standard was designed to transport data in Table format. The Table definitions are in ANSI C12.19, and Annex D of this document.</p> <p>This Standard specifies the differences between ANSI C12.18-2005, Protocol Specification for ANSI Type 2 Optical Port and ANSI C12.19-1997, Utility Industry End Device Data Tables, and those features and services required to describe a protocol specification for Telephone Modem Communications.</p>

B. Level of Standardization

1.	Names of standards development organizations that recognize this standard and/or accredit the owner organization	ANSI, IEEE, Measurement Canada, NEMA
2.	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

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3.	Has it been endorsed or recommended by any level of government? If "Yes", please describe	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
4.	Level of Standard (check all that apply)	<input checked="" type="checkbox"/> International <input checked="" type="checkbox"/> National <input type="checkbox"/> Industry <input type="checkbox"/> de Facto <input type="checkbox"/> Single Company
5.	Type of document	<input checked="" type="checkbox"/> Standard <input type="checkbox"/> Report <input type="checkbox"/> Guide <input type="checkbox"/> Technical Specification
6.	Level of Release	<input checked="" type="checkbox"/> Released <input type="checkbox"/> In Development <input type="checkbox"/> Proposed

C. 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 checked="" type="checkbox"/> Distribution <input checked="" type="checkbox"/> Customer
2.	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 checked="" type="checkbox"/> Distribution <input checked="" type="checkbox"/> Customer
3.	Please describe the Smart Grid systems and equipment to which this standard is applied	Metering equipment and software systems that handle commodity metering data

D. Relationship to Other Standards or Specifications

1.	Which standards or specifications are referenced by this standard?	ANSI C12.18, Protocol Specification for ANSI Type 2 Optical Port ANSI C12.19, Utility Industry End Device Data Tables ANSI INCITS 92-1981 (R2003), Data Encryption Algorithm ISO/IEC 7498-1 (1994), Information Technology - Open Systems Interconnection - Basic Reference Model: The Basic Model ISO/IEC 8825-1 (2002), Information Technology - ASN.1 Encoding Rules: Specification Of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) And Distinguished Encoding Rules (DER) ISO/IEC 13239 (2002), Information Technology - Telecommunications And Information Exchange Between Systems - High-Level Data Link Control (HDLC) Procedures
2.	Which standards or specifications are related to this standard?	ANSI C12.18/IEEE P1701/MC1218, ANSI C12.19/IEEE1377/MC1219, ANSI C12.22/IEEE P1703/MC1222
3.	Which standards or specifications cover similar areas (may overlap)?	IEC/TS 62056-41
4.	What activities are building on this work?	ANSI C12.22/IEEE P1703/MC1222

E. Dept of Energy Smart Grid Characteristics

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

1.	Enables informed participation by customers	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Standardized commands for data handling. Data is also prescribed by a standard.
2.	Accommodates all generation and storage options	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Data transported by standard is not limited.

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3.	Enables new products, services and markets	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Data transported by standard is not limited.
4.	Provides the power quality for a range of needs	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Data transported by standard is not limited.
5.	Optimizes asset utilization and operating efficiency	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Allows for the minimization of data needs / maximizing bandwidth; data model can be streamlined as well.
6.	Operates resiliently to disturbances, attacks, and natural disasters	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Caveat that technology employing this standard must also do the same.

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	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Can be used to recover devices compromised by another communications means.
2.	Communicating and coordinating across inter-system interfaces	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Uses public switched telephone network
3.	Wide area situational awareness	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Participates in gathering the data needed to develop this, provided the devices have the relevant data.
4.	Smart grid-enabled response for energy demand	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No The standardized data model contains load control and pricing elements that may be used for demand response.
5.	Electric storage	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Can be used to interrogate/data gather from those devices. Data model flexible enough to account for this.
6.	Electric vehicle transportation	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Can be used to interrogate/data gather from those devices. Data model flexible enough to account for this.
7.	Advanced metering infrastructure	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No An extension of the primary protocol used in all electricity, water and gas meters for communications over telephone networks.
8.	Distribution grid management	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Can be used to interrogate/data gather from those devices. Data model flexible enough to account for this.

G. Openness

1.	Amount of fee (if any) for the documentation	\$104
2.	Amount of fee (if any) for implementing the standard	None
3.	Amount of fee (if any) to participate in updating the standard	None
4.	Is the standard documentation available online?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No http://webstore.ansi.org/RecordDetail.aspx?sku=NEMA+ANSI+C12.21%3a2006
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?	10's
9.	Approximately how many users are there?	1000's
10.	Where is the standard used outside of the USA?	Canada, Caribbean, Central America
11.	Is the standard free of references to patented technology?	<input checked="" 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 checked="" 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 checked="" type="checkbox"/> Yes <input type="checkbox"/> No
15.	How does one join the working group or committee that controls the standard?	Attend a meeting.
16.	Is voting used to decide whether to modify the standard? If Yes, explain who is permitted to vote.	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No For the Working Group, any attendee. For the Subcommittee, attendees must attend two of three meetings to obtain voting privileges. For the balloting Committee, there is a formal application process to maintain balance per ANSI requirements.
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?	USA, Canada

H. Support, Conformance, Certification and Testing

1.	Is there a users group or manufacturers group to support this standard?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
2.	What is the name of the users group or manufacturers group (if any)?	NEMA
3.	What type of test procedures are used to test this standard? (please check all that apply)	<input checked="" type="checkbox"/> Internal to the lab <input type="checkbox"/> Published by standards organization <input type="checkbox"/> Published by users group <input type="checkbox"/> No procedures, informal testing

4.	Are there test vectors (pre-prepared data) used in testing? (please check all that apply)	<input checked="" type="checkbox"/> Internal to the lab <input type="checkbox"/> Published by standards organization <input type="checkbox"/> Published by users group <input type="checkbox"/> No procedures, informal testing
5.	What types of testing programs exist? (check all that apply)	<input type="checkbox"/> Interoperability Testing <input checked="" 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 checked="" type="checkbox"/> No Certificates
7.	Are there rules controlling how and when to use the logo?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" 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)?	Unknown
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 checked="" type="checkbox"/> Yes <input type="checkbox"/> No
11.	Is there a published conformance checklist or table?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
12.	Are there defined conformance blocks or subsets?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
13.	Approximately how many vendors provide test tools?	10's
14.	Are there tools for pre-certification prior to testing?	<input checked="" 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 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 checked="" type="checkbox"/> Yes, official interpretations <input checked="" type="checkbox"/> Yes, informal opinions <input 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 type="checkbox"/> No
21.	Is the users' group working on integration, harmonization or unification with other similar standards?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
22.	What other standards is this standard being integrated, harmonized, or unified with (if any)?	ANSI C12.22
23.	Are there application notes, implementation agreements, or guidelines available describing specific uses of the standard?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable

J. Notes

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

- | | |
|----|--|
| 1. | Readers of this standard are required to obtain, read and understand ANSI C12.18 and ANSI C12.19 to complete an implementation.
AEIC is publishing a guideline for the use of the ANSI “protocol suite” (ANSI C12.18, C12.21, C12.19 and C12.22). |
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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	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No #####
2.	Layer 7: Business Objectives	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No #####
3.	Layer 6: Business Procedures	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No #####
4.	Layer 5: Business Context	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No #####
5.	Layer 4: Semantic Understanding (object model)	<input type="checkbox"/> Yes <input type="checkbox"/> No #####
6.	Layer 3: Syntactic Interoperability (OSI layers 5-7)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No #####
7.	Layer 2: Network Interoperability (OSI layers 3-4)	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No #####
8.	Layer 1: Basic Connectivity (OSI layers 1-2)	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> 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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
2.	Can data be arranged and accessed in groups or structures?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
3.	Can implementers extend the information model?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
4.	Can implementers use a subset of the information model?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
	Resource Identification	#####
5.	Can data be located using human-readable names?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
6.	Can names and addresses be centrally managed without human intervention?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
	Time Synchronization and Sequencing	#####
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 checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Provided in another layer
	Security and Privacy	#####
9.	Where is security provided for this standard?	<input type="checkbox"/> Within this standard <input checked="" type="checkbox"/> By other standards
10.	Does the standard provide authentication?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Authentication service to reject playback attacks.
11.	Does the standard permit role-based access control?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No passwords

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12.	Does the standard provide encryption?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Employs DES.
13.	Does the standard detect intrusions or attacks?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No one would record the errors during the login or authentication attempts
14.	Does the standard facilitate logging and auditing of security events?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No via the data model
15.	Can the security credentials be upgraded remotely?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No Credentials Client/Server protocol over telephone networks.
16.	Can the security credentials be managed centrally?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> No Credentials Client/Server model.
17.	Please list any security algorithms and standards used	Data Encryption Standard, X3.92-1981
18.	Please provide additional information on how the standard addresses any "Yes" answers above	Security service is optionally supported by the device. Authenticate service is optionally supported by the device.
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?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No via the companion data model standard and specific implementation.
21.	Can the standard gather statistics on its operation?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable via the companion data model standard and specific implementation.
22.	Can the standard report alerts and warnings?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable via the companion data model standard and specific implementation.
	Transaction State Management	#####
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
	System Preservation	#####
24.	Can the standard automatically recover from failed devices or links?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input 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 checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable via the companion data model standard and specific implementation.
	Other Management Capabilities	
27.	Please describe any other system or network management capabilities the standard provides.	None.
	Quality of Service	#####
28.	Is data transfer bi-directional?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

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29.	Can data be prioritized?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable By the user.
30.	What types of reliability are provided?	<input type="checkbox"/> Reliable <input checked="" type="checkbox"/> Non-guaranteed <input type="checkbox"/> Both <input type="checkbox"/> Either <input type="checkbox"/> Provided in another layer
31.	Can information be broadcast to many locations with a single transmission?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Not applicable
32.	Please describe any other methods the standard uses to manage quality of service.	Via the companion data model standard and specific implementation.
	Discovery and Configuration	#####
33.	Can the software or firmware be upgraded remotely?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
34.	Can configuration or settings be upgraded remotely?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
35.	Can implementations announce when they have joined the system?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> Not applicable
36.	Can implementations electronically describe the data they provide?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
	System Evolution and Scalability	#####
37.	What factors could limit the number of places the standard could be applied?	No telephone connection = no need.
38.	What steps are required to increase the size of a system deploying this standard?	Telephone connections to each endpoint.
39.	Is the information model separate from the transport method?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
40.	Does the standard support alternate choices in the layers(s) below it?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> No layers below
41.	List the most common technology choices for layers implemented below this standard	#####
42.	Does the standard support multiple technology choices in the layers above it?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No <input type="checkbox"/> No layers above
43.	List the technologies or entities that would most commonly use this standard in the layer above	#####
44.	Please describe any mechanism or plan to ensure the standard is as backward-compatible as possible with previous versions	Explicit statement of backward and forward compatibility in the standard.
45.	Please describe how the design of this standard permits it to be used together with older or legacy technologies	Not applicable.
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	Different protocol/command set from others sharing the same physical media.
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	Information only.
2.	Transparency – supports a transparent and auditable chain of transactions	Via the companion data model standard and specific implementation.
3.	Composition – facilitates the building of complex interfaces from simpler ones	Yes.
4.	Loose coupling – can support bilateral and multilateral transactions without elaborate pre-arrangement	No.
5.	Shallow integration – does not require detailed mutual information to interact with other components	No.
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	Part of the ANSI C12 “protocol suite”: C12.18, C12.19 C12.21, C12.22, C12.23 and co-published IEEE and Measurement Canada standards.