Smart Grid Standards Information

Version 1.6
Monday, May 10, 2010

Section I: Use and Application of the Standard

A. Identification and Affiliation

1.	Number of the standard	C12.19 (ANSI) 1377 (IEEE) MC1219 (Measurement Canada)
2.	Title of the standard	Utility Industry End Device Data Tables (ANSI C12.19) Utility Industry Metering Communication Protocol Application Layer (End Device Data Tables) (IEEE 1377, MC1219)
3.	Name of owner organization	ANSI, IEEE, Measurement Canada
4.	Latest versions, stages, dates	2008 (ANSI) 1998 (IEEE), Next publication 2010 2005 Utility Industry Standard Tables User's Guide (Measurement Canada, Revised Version 3.2, 2005)
5.	URL(s) for the standard	http://webstore.ansi.org/FindStandards.aspx?SearchString=ANSI+C12.19-2008&SearchOption=0&PageNum=0&SearchTermsArray=null%7cANSI+C12.19-2008%7cnull
6.	Working group / committee	ANSI C12 SC17 WG2 / ANSI C12.19 IEEE SCC31 End Device/TIU Subcommittee, IEEE P1377 Working Group Measurement Canada Task Force on Data Communications Protocol for Electronic Metering Devices
7.	Original source of the content (if applicable)	(Richard) Tucker Tables + IEEE SCC31 End Device/TIU Subcommittee IEEE P1377 Working Group
8.	Brief description of scope	This standard provides common structures for encoding data in communication between End Devices (meters, home appliances, C12.22 Nodes) and Utility enterprise collection and control systems using binary codes and XML content. The standard addresses the AMI and SmartGrid requirements as identified by the Office of Electricity Delivery and Energy Reliability of the U.S. Department of Energy; the Smart Metering Initiative of the Ontario Ministry of Energy (Canada) and of Measurement Canada. The standard exposes sets of tables that are grouped together into sections that pertain to a particular feature-set and related function such as Time-of-use, Load Profile, Security, Power Quality and more. Each standard Table Set (Data Model) can be expanded or restricted by the Manufacturer of the ANSI C12.19/IEEE 1377/MC1219 Device or home appliance using XML/TDL descriptive registered syntax (XML-based Table Definition Language) and enterprise data-value management using EDL (Exchange Data Language) in a manner that is machine readable. Published jointly by IEEE, ANSI and Measurement Canada, this standard provides Tables in support of Gas, Water and Electric sensors and related appliances. It also provides Tables for network configuration and management by referencing its companion standard IEEE 1703 / ANSI C12.22/MC1222. ANSI C12.19-2008 is co-published as IEEE P1377-2010 and MC1219-2010.

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B. Level of Standardization

1.	Names of standards development organizations that recognize this standard and/or accredit the owner organization	ANSI, NEMA, IEEE, Measurement Canada
2.	Has this standard been adopted in regulation or legislation, or is it under consideration for adoption?	☒ Yes ☐ No Measurement Canada, Texas Public Utility Comission
3.	Has it been endorsed or recommended by any level of government? If "Yes", please describe	☒ Yes ☐ No Measurement Canada (endorsed)
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	End Devices (e.g., electricity, water and gas meters), Control Devices, AMI network equipment, metering systems, meter data management systems, home appliances, head-end systems, communication modules.

D. Relationship to Other Standards or Specifications

	Which standards or specifications are referenced by this standard?	ANSI C12.18-2006, Protocol Specification For Telephone Modem Communication ANSI C12.21-2006, Protocol Specification for ANSI Type 2 Optical Port ANSI C12.22-2008, Protocol Specification For Interfacing to Data Communication Networks ANSI C12.10-2004 American National Standard for Physical Aspects of Watthour Meters—Safety Standard, (or latest version). ANSI X9.31-1998 Public Key Cryptography Using Reversible Algorithms for the Financial Services Industry (rDSA), 1998. ANSI/IEEE 100-2000 The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition (New York, New York, IEEE Press, 2000, ISBN 0-7381-2601-2). AS 4140-1995 Australian Standard, Metering and Utility Information Exchange—Glossary of Terms. CAN/CSA ISO/IEC-10118-1: 2000 Information Technology—Security Techniques—Hash-functions—Part 1: General CAN/CSA ISO/IEC-10118-2: 2000 Information Technology—Security Techniques—Hash-functions—Part 2: Hash-Functions Using an n-bit Block Cipher ECMA 94 (1996) 8-Bit Single-Byte Coded Graphic Character Sets—Latin Alphabets No. 1

		to No. 4-2nd Edition. IEEE Std 519-1992 IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems. IEEE Std 754-1985 IEEE Standard for Binary Floating-Point Arithmetic. IEEE Std 1159-1995 (R2001) IEEE Recommended Practice for Monitoring Electric Power Quality. IEEE Std C57.123-2002 IEEE Guide for Transformer Loss Measurement. IEC 62053-23 (2003-01) Electricity Metering Equipment (a.c.)—Particular Requirements—Part 23: Static Meters for Reactive Energy (classes 2 and 3). IEC/TR 61000-2-1 (1990-05) Electromagnetic Compatibility (EMC)—Part 2: Environment—Section 1: Description of the Environment—Electromagnetic Environment for Low frequency Conducted Disturbances and Signalling in Public Power Supply Systems. ISO 8859-1: 1998 Information Technology—8-bit Single-byte Coded Graphic Character Sets—Part 1: Latin Alphabet No 1. ISO/IEC 646: 1991 Information Technology—ISO 7-bit Coded Character Set for Information Interchange. ISO/IEC 7498-1: 1996 Information Technology—Open Systems Interconnection—Basic Reference Model: The Basic Model ISO/IEC 10646: 2003 Information Technology—Universal Multiple-Octet Coded Character Set (UCS). ACPTLC : 1998 Algorithm for Computing and Programming Transformer Loss Constants in Solid-State Meters, A. Hannah, “in Proc. 1998 Rural Electric Power Conference, pp. B3-1-17. EEI HEM : 2002 Handbook for Electricity Metering, 10th Edition (Washington, District of Columbia, Edison Electric Institute, 2002, ISBN 0-931032-52-0). IEEE EPEH : 2000 The Electric Power Engineering Handbook, CRC Press and IEEE Press, 2000, L. L. Grigsby, Ed., Section 3, “Transformers”, J.H. Harlow, Ed. IEEE IAM : 11/12 2003 S. Y. Merritt and S. D. Chaitkin, “No-load Versus Load Loss,” IEEE Industry Applications Magazine, pp. 21-28, Nov./Dec. 2003. ISBN 0-201-30998-X The Unified Modeling Language Reference Manual (The Addison-Wesley Object Technology Series, 1999, ISBN 0-201-30998-X) ISBN 0-321-18578-1 The Unicode Consortium. The Unicode Standard, Version 4.0.0, defined by: The Unicode Standard, Version 4.0 (Boston, Massachusetts, Addison-Wesley, 2003. ISBN 0-321-18578-1). http://www.unicode.org/versions/Unicode4.0.0/ ISBN 0-321-24562-8 The Unified Modeling Language Reference Manual, Second Edition (Upper Saddle River, New Jersey, Addison-Wesley, 2005, ISBN 0-321-24562-8). ISBN 0-8493-0628-0 CRC Standard Mathematical Tables, 28th Edition (CRC Press, Inc.,1987, Boca Raton, Florida, ISBN 0-8493-0628-0). IS-E-01-E Specifications Relating to Event Loggers for Electricity Metering Devices and Systems (Measurement Canada, IS-E-01-E, 2003) MCPSMTD : 1999 Principles for Sealing Meters and Trade Devices (Measurement Canada, 1999-07-26) UG : 2005 Utility Industry Standard Tables User’s Guide (Measurement Canada, Revised Version 3.2, 2005).

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4.	Which standards or specifications are related to this standard?	ANSI C12.18-2006, Protocol Specification For Telephone Modem Communication ANSI C12.21-2006, Protocol Specification for ANSI Type 2 Optical Port ANSI C12.22-2008, Protocol Specification For Interfacing to Data Communication Networks Draft ANSI C12.23-200x, Compliance Testing For Standard Protocol C12.18, C12.21, C12.22 and C12.19 IEEE 1701-2009, Optical Port Communication Protocol to complement the Utility Industry End Device Data Tables IEEE 1702-2009, Telephone Modem Communication Protocol to complement the Utility Industry End Device Data Tables IEEE P1703-2010, Local Area Network/Wide Area Network (LAN/WAN) Node Communication Protocol to complement the Utility Industry End Device Data Tables IEEE P1704 (draft) Utility Industry End Device Communications Module IEEE P1705 (draft) Compliance Testing Standard for Utility Industry metering communications protocol standards SmartGrid/AEIC AMI Interoperability Standard Guidelines for ANSI C12.19 End Device Communications and Supporting Enterprise Devices, Networks and Related Accessories Draft, 2010, Version 2.0.
5.	Which standards or specifications cover similar areas (may overlap)?	DLMS/COSEM IEC62056 suite
6.	What activities are building on this work?	PAP 5, PAP 6, CIM, NAEDRA

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 (when implemented with ANSI C12.22 / IEEE 1703)	☒ 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	$246 / $0.00 (MC)
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?	☒ Yes ☐ No http://webstore.ansi.org/FindStandards.aspx?SearchString=ANSI+C12.19-2008&SearchOption=0&PageNum=0&SearchTermsArray=null%7cANSI+C12.19-2008%7cnull
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?	10's
9.	Approximately how many users are there?	100's
10.	Where is the standard used outside of the USA?	ANSI meter market in the Americas
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?	Attend a meeting, send a request to chair person or secretary
16.	Is voting used to decide whether to modify the standard? If Yes, explain who is permitted to vote.	☒ Yes ☐ No Working Group members vote during meetings then vote the entire document to the SC. Subcommittee members vote to send to the Main Committee for balloting. The Main Committee ballots to make a standard.
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, UK

H. Support, Conformance, Certification and Testing

1.	Is there a users group or manufacturers group to support this standard?	☒ Yes ☐ No Now being formed, NAEDRA, AEIC, AIMTUG
2.	What is the name of the users group or manufacturers group (if any)?	##### NAEDRA, AEIC, AIMTUG
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 (internal to lab) ☒ 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)?	10's
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 (but does exist)
12.	Are there defined conformance blocks or subsets?	☒ Yes ☐ No (yes see AEIC guidelines)
13.	Approximately how many vendors provide test tools?	##### 2
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 (now being developed)
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)?	ANSI C12.18, ANSI C12.21, ANSI C12.22 Multispeak, DLMS/COSEM
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 standard semantic model, device clases and related network node space is managed by registrars under the control of NAEDRA.

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	#####Device Classes / TDL / EDL
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	#####Provides procedures
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	#####Role based, then relies on underlying communications
9.	Where is security provided for this standard?	☒ Within this standard ☒ By other standards
10.	Does the standard provide authentication?	☐ Yes ☒ No (TDL/EDL yes)
11.	Does the standard permit role-based access control?	☒ Yes ☐ No
12.	Does the standard provide encryption?	☐ Yes ☒ No
13.	Does the standard detect intrusions or attacks?	☒ Yes ☐ No

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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	#####MD5, SHA-2 (digital signatures for TDL)
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	#####Security, encryption, authentication are covered by ANSI C12.22, the service and communication element of the companion required standard.
	Logging and Auditing	#####Very strong audit history and event logger is available as an option.
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 (requires C12.22 Tables)
	Transaction State Management	#####The standard allows sessions, and rollback of operations.
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.	#####When integrated with a C12.22 Master Relay and a C12.19 Registry it is plug-and-play capable.
	Quality of Service	#####
28.	Is data transfer bi-directional?	☒ Yes ☐ No
29.	Can data be prioritized?	☒ Yes ☐ No ☐ Not applicable (via C12.22)
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 (via C12.22)
32.	Please describe any other methods the standard uses to manage quality of service.	#####Provides quality of service tables, audit logs, device state monitors, and exception notification (this service assumes ANSI C12.22)
	Discovery and Configuration	#####

Section II: Functional Description of the Standard		
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 (via C12.22 Registration Service and Notification)
36.	Can implementations electronically describe the data they provide?	☒ Yes ☐ No ☐ Not applicable (via TDL and EDL and registered device classes, also Table 00)
	System Evolution and Scalability	#####
37.	What factors could limit the number of places the standard could be applied?	#####Your imagination
38.	What steps are required to increase the size of a system deploying this standard?	#####MDMSs need to become C12 aware. Head-end systems need to use Table Processors based on registered device classes.
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	#####TCP/IP, UDP/IP, Wireless Radio, ARDIS, SMS, GPRS
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	#####MultiSpeak, Zigbee SmartEnetrgy Profile, DLMS/COSEM
44.	Please describe any mechanism or plan to ensure the standard is as backward-compatible as possible with previous versions	#####A requirement and process defined in the standard document.
45.	Please describe how the design of this standard permits it to be used together with older or legacy technologies	#####Provides mapping tables (user defined and extended user defined tables) that can map any data to/from C12.19.
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	#####Does not define the network transport. When operating in an IP Network, there are reserved port numbers broadcast and multicast addresses and IETF RFCs describing the interoperable use (assumes C12.22 or C12.18)
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	#####Yes. Four quadrants and green energy indicators.
2.	Transparency – supports a transparent and auditable chain of transactions	#####Yes using the event logger and secure register reading (traceable to measurement source)
3.	Composition – facilitates the building of complex interfaces from simpler ones	#####Supports multi-device instances and aggregations. With C12.22 it also supports separation of metrology from communication.

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4.	Loose coupling – can support bilateral and multilateral transactions without elaborate pre-arrangement	#####multi-user role based multi-session concurrent transactions are possible.
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	#####W3C/XML and schema, OSI layers 5,6,7, IEC TC13 WG14