



# Smart Grid Standards Information

Version 1.7

Tuesday, May 11, 2010

## Section I: Use and Application of the Standard

### A. Identification and Affiliation

1.	Number of the standard	ANSI/CEA-709.3-R2004
2.	Title of the standard	Free-Topology Twisted Pair Channel Specification
3.	Name of owner organization	ANSI/CEA
4.	Latest versions, stages, dates	September 2006
5.	URL(s) for the standard	<a href="http://www.ce.org/Standards/browseByCommittee_2544.asp">http://www.ce.org/Standards/browseByCommittee_2544.asp</a>
6.	Working group / committee	R7.1 HCS1 Subcommittee
7.	Original source of the content (if applicable)	Echelon Corporation
8.	Brief description of scope	<p>This document specifies the CEA-709.3 free-topology twisted-pair channel and serves as a companion document to CEA-709.1. The channel supports communication at 78.125 kbps between multiple nodes, each of which consists of a transceiver, a protocol processor, an application processor, a power supply, and application electronics.</p> <p>This document covers the complete physical layer (ISO OSI Layer 1), including the interface to the Media Access Control (MAC) layer and the interface to the medium. Parameters that are controlled by other layers but control the operation of the physical layer are also specified.</p> <p>Note: This standard represents the SDO standardization of the twisted-pair wire communications channel for the LONWORKS controls-networking protocol.</p>

### B. Level of Standardization

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1.	Names of standards development organizations that recognize this standard and/or accredit the owner organization	American National Standards Institute (ANSI); Association of American Railroads (AAR); British Standards Institute (BS); Consumer Electronics Association (CEA); Electronics Industries Alliance (EIA), formerly before CEA; European Committee for Standardization (CEN); European Committee of Domestic Equipment Manufacturers (CECED); Institute of Electrical and Electronics Engineers (IEEE); International Electrotechnical Commission (IEC); International Forecourt Standards Forum (IFSF); International Organization for Standardization (ISO); Semiconductor Equipment and Materials International (SEMI); Standardization Administration of China (SAC)
2.	Has this standard been adopted in regulation or legislation, or is it under consideration for adoption?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	Has it been endorsed or recommended by any level of government? If “Yes”, please describe	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No US Department of Defense: UFC 3-410-02 and UFGS-23 09 23 (Direct Digital Control for HVAC and Other Local Building Systems). UFC 3-401-01 and UFGS 25 10 10 (Utility Monitoring and Control System) for use on all United States Army Corps of Engineers & Air Force Civil Engineer Support Agency projects.
	Level of Standard (check all that apply)	<input checked="" type="checkbox"/> International <input checked="" type="checkbox"/> National <input checked="" type="checkbox"/> Industry <input checked="" type="checkbox"/> de Facto <input type="checkbox"/> Single Company
3.	Type of document	<input checked="" type="checkbox"/> Standard <input type="checkbox"/> Report <input type="checkbox"/> Guide <input type="checkbox"/> Technical Specification
4.	Level of Release	<input checked="" type="checkbox"/> Released <input type="checkbox"/> In Development <input type="checkbox"/> Proposed
<b>C. Areas of Use</b>		
5.	Currently used in which domains? (check all that apply)	<input type="checkbox"/> Markets <input checked="" type="checkbox"/> Operations <input checked="" type="checkbox"/> Service Providers <input checked="" type="checkbox"/> Generation <input checked="" type="checkbox"/> Transmission <input checked="" type="checkbox"/> Distribution <input checked="" type="checkbox"/> Customer
	Planned for use in which domains? (check all that apply)	<input checked="" type="checkbox"/> Markets <input checked="" type="checkbox"/> Operations <input checked="" type="checkbox"/> Service Providers <input checked="" type="checkbox"/> Generation <input checked="" type="checkbox"/> Transmission <input checked="" type="checkbox"/> Distribution <input checked="" type="checkbox"/> Customer

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	Please describe the Smart Grid systems and equipment to which this standard is applied	Is used in thermostats, appliances, controllers, lighting, and other small devices within the home or commercial facilities. Used in substation monitoring and automation, and electricity metering. Used in transportation (locomotive, light rail, subway, bus, automotive) for controls and monitoring. Used for commercial demand response, and building automation. Used in PV and Wind farms for monitoring and gen-set interfacing. Used in backup generator monitoring and control. Used for medium-voltage monitoring and distribution-transformer monitoring.
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### D. Relationship to Other Standards or Specifications

1.	Which standards or specifications are referenced by this standard?	CEA-709.1 Control Network Protocol Specification ANSI/TIA/EIA-568-A-1995, Commercial Building Telecommunications Cabling Standard, October 1995
	Which standards or specifications are related to this standard?	AAR S-200 ANSI/CEA 709.1, .3, and .4 CECED CHAIN EN 14908-1 through -6 GB/Z 20177.1 through .4 GB/T 20299.4 IEEE 1473-L ISO/IEC 14908-1 through -4 SEMI E54.16
2.	Which standards or specifications cover similar areas (may overlap)?	ASHRAE/ANSI 135 (BACnet)
3.	What activities are building on this work?	Specifications by the AAR, Chinese Ministry of Construction, IEEE, SEMI, and USACE. Smart Grid considerations include facility-interactions, DR Signaling, Generation, Metering, Lighting, and HVAC.

### 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 type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
2.	Accommodates all generation and storage options	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
3.	Enables new products, services and markets	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
4.	Provides the power quality for a range of needs	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
5.	Optimizes asset utilization and operating efficiency	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer

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6.	Operates resiliently to disturbances, attacks, and natural disasters	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
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## 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 type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
2.	Communicating and coordinating across inter-system interfaces	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
3.	Wide area situational awareness	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
4.	Smart grid-enabled response for energy demand	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
5.	Electric storage	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer
6.	Electric vehicle transportation	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Used in subways, light-rail, & buses. Also used in gasoline-station pumps and POS systems.
7.	Advanced metering infrastructure	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No Deployed in building-automation systems for OpenADR.
8.	Distribution grid management	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Specification concerns only the physical syntax layer

## G. Openness

1.	Amount of fee (if any) for the documentation	\$63.00 USD (normal purchase); \$47.25 USD (CEA Member)
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 URL: <a href="http://global.ihs.com/doc_detail.cfm?document_name=CEA-709.3">http://global.ihs.com/doc_detail.cfm?document_name=CEA-709.3</a> for fee.
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?	Under 10 organizations implement the standard; many of organizations build products based upon the implementations
9.	Approximately how many users are there?	Unknown, over 90 Million devices contain the underlying protocol (based upon MAC ID consumption)
10.	Where is the standard used outside of the USA?	Nearly everywhere but Iran and North Korea
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 type="checkbox"/> Yes <input checked="" type="checkbox"/> No
15.	How does one join the working group or committee that controls the standard?	Through participation in either CEA or CEN working groups
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 Voting members of working groups must maintain eligibility by attending meetings/calls.
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?	US and several EU countries

## 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)?	LonMark® International: <a href="http://www.lonmark.org">http://www.lonmark.org</a>
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 checked="" 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 type="checkbox"/> Internal to the lab <input type="checkbox"/> Published by standards organization <input checked="" 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 checked="" 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 checked="" type="checkbox"/> Interoperability Certificate <input checked="" 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 checked="" type="checkbox"/> Standard has no logo The standard has no logo but the user group has logos for devices that pass interoperability conformance testing and user-group membership.
8.	Is there a program to approve test labs?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
9.	Approximately how many test labs are approved (if any)?	Testing is in vendor labs while connected to the Internet-based testing tool.
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?	Approximately 5-to-10 vendors provide various test tools but only the user group's test tool qualifies a device to use the logo.
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 type="checkbox"/> Yes <input checked="" type="checkbox"/> No The testing is accomplished by the vendors in a self-certification method but the user group's tools determine passing/failing by inspection of the test results.
16.	Is there application testing for specific uses?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input 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 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 checked="" type="checkbox"/> Yes <input type="checkbox"/> No The user group has a small staff that participates in the SDOs and maintains the testing tools.

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)?	
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. The twisted-pair wiring can be simple CAT5 wiring, where only two wires are needed. The topology can be a bus (linear) or a free topology, where the cabling can be run in a star, t-configuration, or any combination thereof. The wire can be powered with low voltage/amperage (~42V DC and 3.2A) to allow for both communications and sourced power from the same pair of wires. Bus-powered devices can coexist and communicate with self-powered (other-sourced powered) devices on the same powered cabling. The communications are differential, Manchester encoding (not polarity sensitive) for easy wiring.

## 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](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	Communications Protocol
2.	<b>Layer 7: Business Objectives</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Communications Protocol
3.	<b>Layer 6: Business Procedures</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Communications Protocol
4.	<b>Layer 5: Business Context</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Communications Protocol
5.	<b>Layer 4: Semantic Understanding (object model)</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Communications Protocol
6.	<b>Layer 3: Syntactic Interoperability (OSI layers 5-7)</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Uses EN 14908-5, -6
7.	<b>Layer 2: Network Interoperability (OSI layers 3-4)</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No	Uses EN 14908-5, -6
8.	<b>Layer 1: Basic Connectivity (OSI layers 1-2)</b>	<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.

	<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: handled by ANSI/CEA-709.1 & EN 14908-5, -6.
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: handled by ANSI/CEA-709.1 & EN 14908-5, -6.
3.	Can implementers extend the information model?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable: handled by ANSI/CEA-709.1 & EN 14908-5, -6.
4.	Can implementers use a subset of the information model?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable: handled by ANSI/CEA-709.1 & EN 14908-5, -6.
	<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: handled by ANSI/CEA-709.1 & EN 14908-5, -6.
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: handled by ANSI/CEA-709.1 & EN 14908-5, -6.
	<b>Time Synchronization and Sequencing</b>	
7.	Can the standard remotely synchronize time?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable: handled by ANSI/CEA-709.1 & EN 14908-5, -6.
8.	Can the standard indicate the quality of timestamps?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable: handled by ANSI/CEA-709.1 & EN 14908-5, -6.
	<b>Security and Privacy</b>	

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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 type="checkbox"/> Yes <input checked="" type="checkbox"/> No: handled by ANSI/CEA-709.1.
11.	Does the standard permit role-based access control?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No: handled by ANSI/CEA-709.1.
12.	Does the standard provide encryption?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No: encryption for authentication handled by ANSI/CEA-709.1.
13.	Does the standard detect intrusions or attacks?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No: handled by ANSI/CEA-709.1.
14.	Does the standard facilitate logging and auditing of security events?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No: handled by ANSI/CEA-709.1.
15.	Can the security credentials be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> No Credentials: handled by ANSI/CEA-709.1.
16.	Can the security credentials be managed centrally?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> No Credentials: handled by ANSI/CEA-709.1.
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	PHY layer and interaction to MAC layer only. To be used with ANSI/CEA-709.1
<b>Logging and Auditing</b>		
20.	Does the standard facilitate logging and auditing of critical operations and events?	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
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 type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
<b>Transaction State Management</b>		
23.	Can the standard remotely enable or disable devices or functions?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
<b>System Preservation</b>		
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 type="checkbox"/> Not applicable <input checked="" 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>		
27.	Please describe any other system or network management capabilities the standard provides.	
<b>Quality of Service</b>		
28.	Is data transfer bi-directional?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
29.	Can data be prioritized?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable

## Section II: Functional Description of the Standard

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 checked="" type="checkbox"/> Provided in another layer
31.	Can information be broadcast to many locations with a single transmission?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not applicable
32.	Please describe any other methods the standard uses to manage quality of service.	Defines resistor values for proper termination. Differential, Manchester encoding allows for unshielded/ungrounded cabling and for carrying power on data lines.
<b>Discovery and Configuration</b>		
33.	Can the software or firmware be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
34.	Can configuration or settings be upgraded remotely?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
35.	Can implementations announce when they have joined the system?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Not applicable
36.	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>		
37.	What factors could limit the number of places the standard could be applied?	High-speed manufacturing with time-division precision is not supported. Messaging is asynchronous.
38.	What steps are required to increase the size of a system deploying this standard?	Logical division of hierarchy must be maintained to optimize the logical addressing; unless MAC ID addressing is used for messaging. The latter is limited to $2^{48}$ .
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 type="checkbox"/> No <input checked="" 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 checked="" type="checkbox"/> Yes <input 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	ANSI/CEA-709.1; EN 14908-5, -6. If used with ANSI/CEA-709.1 Also used with ASHRAE STD 135 (BACnet)
44.	Please describe any mechanism or plan to ensure the standard is as backward-compatible as possible with previous versions	Both CEA and CEN desire to keep the standard backward compatible. It is the goal of the participants to ensure such but there is no formal decree.
45.	Please describe how the design of this standard permits it to be used together with older or legacy technologies	

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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	Some buildings contain both ASHRAE STD 135 and ANSI/CEA-709.1 integrated. Some trains contain both IEC 61375-1 and ANSI/CEA-709.1 integrated.
47.	<b>Electromechanical</b>	

### M. Architectural Principles

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

1.	Symmetry – facilitates bi-directional flow of energy and information	CSMA
2.	Transparency – supports a transparent and auditable chain of transactions	N/A, handled by layers above.
3.	Composition – facilitates the building of complex interfaces from simpler ones	N/A, handled by layers above.
4.	Loose coupling – can support bilateral and multilateral transactions without elaborate pre-arrangement	N/A, handled by layers above.
5.	Shallow integration – does not require detailed mutual information to interact with other components	N/A, handled by layers above.
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	The standard is designed to the ISO OSI Reference Model to fit into a 7-layer, complete solution.