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American National Standard

Protocol Specification for Interfacing to Data Communication Networks

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Foreword (This Foreword is not part of American National Standard C12.22-2012.)

This standard is intended to accommodate the network messaging requirements of an advanced metering infrastructure such as that identified by the Office of Electricity Delivery and Energy Reliability of the US Department of Energy; the Smart Metering Initiative of the Ontario Ministry of Energy (Canada) and the stated requirements of Measurement Canada for the approval of a metering device for use in Canada.

The standard describes four different but related communication modes of operation. One is the operation of an End Device (Node) over any network, a feature that all C12.22 compliant nodes need to implement. The second is an exposed point-to-point interface between a C12.22 Device, e.g., a meter, and, a C12.22 Communication Module, e.g., a network adaptor. The third is the capture, translation and transmission of one way messages (blurts). The fourth is communication with the End Device over a dedicated ANSI C12.18 ANSI Type 2 optical local port.

The standard assigns roles to all of the Utility AMI network assets to enable the automated deployment and configuration of network nodes in a distributed AMI enterprise system. The roles provide for Relays, Master Relays and Gateways; simple Hosts, Authentication Hosts, and Notification Hosts; and sensory End Devices. These devices work together to realize a Utility enterprise network in a manner that provides for a universal application framework that can operate any compliant appliance so that it can be deployed, accessed and communicated with seamlessly over any network infrastructure, hardware and available bandwidth. This is accomplished through the provision of well-defined network management services (e.g., trace, resolve, register, de-register), data access service (e.g., read, write), session management (e.g., logon, logoff, terminate, disconnect), message segmentation and assembly, message playback rejection, security and privacy.

All registration authorities that recognize registrars are governed by ANSI C12 and IEEE SCC31. To be recognized, any registration authority is expected to adhere to the requirements specified in this standard. See Annex D, “(normative) Universal Identifier.”

The protocol is well suited for two-way and one-way communication using an extremely wide network address space (using ApTitles). It implements subscription and Node discovery services so that any Utility enterprise (e.g., MDMS, DA, DR, or any other willing network appliance, such as a home energy monitoring system, or a thermostat) can register itself as a Notification Host so that it can receive advisory messages and alerts about network asset changes or changes in the state of the network. Network subscription services can be managed through distributed Authentication Hosts.

Altogether, this standard was designed to be simple and small. Therefore, it can meet the requirements of the smallest of AMI networks, while providing well-defined capacities that can grow and adapt to the largest of enterprise AMI networks and operations as needed. As such, this standard together with ANSI C12.19 addresses the end-to-end distributed AMI network needs from the smallest to the largest of enterprise AMI systems.

The second release of this standard is a minor release in that it establishes a new baseline document that includes all the corrections that were applied in Annex K, “Listing of Editorial Errors and Errors of Omission in ANSI C12.22-2008” of the first release of IEEE Std 1703-2012. Readers who are acquainted with ANSI C12.22-2008 should review the notable differences and corrections that exist in this release of the standard relative to its predecessor. These are listed below:

1. New clauses “1 Overview” and “1.1 Introduction” were introduced ahead of old clause “1 Scope.”
2. Old clause “1 Scope” was revised as clause “1.3 Purpose.”
3. New clause “1.3 Purpose” was introduced.
4. Moved clause “2.2 Other” to “Annex K, Bibliography” and adopted IEEE-style citations and references.
5. Added reference to the “IEEE-SA Standards Definitions Database” in clause “3.1 Definitions.”

6. Corrected Note 1 of clause “5.2.4 “Universal Identifiers Canonical Encoding,”
7. Added new response error code <nete> in clause “5.3.2.2 Response Codes.”
8. Added new response error code <nete> in clause “5.3.2.4.1 Identification Service.”
9. Corrected <octet-count> in clause “5.3.2.4.2 Read Service.”
10. Corrected <data> in clause 5.3.2.4.3, “Write Service.”
11. Corrected request description in clause “5.3.2.4.5 Security Service.”
12. Added new response error code <nete> in clause “5.3.2.4.5 “Security Service.”
13. Added new response error code <nete> in clause “5.3.2.4.8 “Disconnect Service.”
14. Added new response error code <nete> in clause “5.3.2.4.9 “Wait Service.”
15. Documented description of domain pattern in clause “5.3.2.4.10 “Registration Service.”
16. Corrected <reg-info> in clause “5.3.2.4.10 Registration Service.”
17. Corrected description of clause “5.3.2.4.12 “Resolve Service.”
18. Corrected description of <epsem-control> of clause “5.3.3 EPSEM Envelope Structure.”
19. Corrected Use of Assigned Subbranches in Relative ApTitle in clause “5.3.4.12 Use of Subbranches of a Registered ApTitle.”
20. Inserted “A.1 Description” into Annex A, and renumbered all subclauses in Annex A.
21. Corrected clause “A.6 C12.22 Master Relay ApTitle Auto-assignment.”
22. Inserted “C.1 Overview” into Annex C, and renumbered all subclauses in Annex C.
23. Added Element PATTERN_LEN_MULT to clause “C.3.1 Table 130 Relay Network Control Dimension Limits Table.”
24. Added Element PATTERN_LEN_MULT to clause “C.3.2 TABLE 131 Actual Network Relay Limiting Table.”
25. Corrected definition of END_DEVICE_FLAG of clause “C.3.3 Table 132 Registration List Table.”
26. Updated size of APTITLE_PATTERN of clause “C.3.4 Table 133 Static Routing Table.”
27. Updated size of NOTIFICATION_PATTERN of clause “C.3.5 Table 134 Host Notification Table.”
28. Updated size of SERIAL_NUMBER_PATTERN of clause “C.2.6 Table 135 Master Relay Assignment Table.”
29. Corrected description of CIPHER_MODE of clause “C.7 Table 47 Host Access Security Table.”
30. Corrected examples of clause “Annex G, Communication Examples.”
31. Added note on buffering to clause “I.1 EAX’ description.”

Suggestions for improvement to this standard are welcome. They should be sent to:

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This Standard was processed and approved for submittal to ANSI by Accredited Standards Committee for Electricity Metering C12. At the time the committee approved this standard, the C12 Committee had the following members:

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1 Overview

1.1 Introduction

This standard defines network Application Services for the exchange of Table data and control elements. These services must be implemented by all C12.22 Nodes, including "back-office" or "head-end" systems.

1.2 Scope

Initially, communications with electronic devices consisted of transporting memory data via proprietary protocols that were unique to each manufacturer. The desire for interoperability and support for multiple manufacturers by reading and programming systems created a need for standardization of data formats and transport protocols.

The first step was to standardize data formats. Internal data was abstracted as a set of Tables. A set of standard Table contents and formats were defined in ANSI C12.19/MC12.19/IEEE 1377, "Utility Industry End Device Data Tables."[1]

In the "Protocol Specification for ANSI Type 2 Optical Port" Standard (ANSI C12.18/MC12.18/IEEE 1701), a point-to-point protocol was developed to transport table data over an optical connection. The ANSI C12.18/ MC12.18/IEEE 1701 protocol include an application language called Protocol Specification for Electric Metering (PSEM) that allows applications to read and write Tables. The "Protocol Specification for Telephone Modem Communication" (ANSI C12.21/MC12.18/IEEE 1702) was then developed to allow devices to use PSEM to transport Tables over telephone modems.

This standard extends the concepts of ANSI C12.18/MC12.18/IEEE 1701, ANSI C12.21/MC12.18/IEEE 1702, and ANSI C12.19/MC12.19/ IEEE 1377 standards to allow transport of Table data over any reliable networking communications system. Note that in this use of the word, "reliable" means that for every message sent, the sender receives a response at its option: either a positive acknowledgment or an error message. That is, messages cannot fail silently in a reliable network (see discussion of Reliable Stream Transport Service in IPPA [B1]).[2]

In addition, this standard describes an optionally exposed point-to-point interface between a C12.22 Device and a C12.22 Communications Module designed to attach to "any" network. The terms "C12.22 XXXX" (e.g., C12.22 Device) were introduced by ANSI C12.22-2008. These terms can be interchangeably replaced with the terms "IEEE 1703 XXXX"; i.e., the IEEE 1703 Device is the same as the ANSI C12.22 Device and the IEEE 1703 Communication Module is the same as the C12.22 Communication Module. However, since this standard was originally developed under the auspice of ANSI C12 SC17 WG1, the document terminology is based on C12.22 terms.

Furthermore, this standard defines a methodology to capture, translate, and transmit one-way device messages (blurts).

This standard defines interfaces between IEEE 1377 Devices (ANSI C12.19 Devices) and network protocols.

Specific goals identified by the committee in the creation of this standard were:

a) Defining a Datagram that can convey ANSI C12.19 data Tables through any network

   This was accomplished by:

   — Assuming that the data source is ANSI C12.19 data Tables

   — Defining the Application Layer services (language)

[1] Information on references can be found in clause 2.

[2] Numbers in brackets correspond to those of the bibliography in Annex K.

b) Providing a full stack [ISO/IEC 7498-1] definition for interfacing a C12.22 Device to a C12.22 Communication Module

This was accomplished by:

- Defining the physical interface requirements between the C12.22 Device and the C12.22 Communication Module
- Defining the interface lower layers [ISO/IEC 7498-1]: 4 (transport), 3 (network), 2 (data link), and 1 (physical)

c) Providing a full stack definition for point-to-point communication to be used over local ports such as optical ports or modems

This was accomplished by defining a Layer 4 (transport) and Layer 2 (data link)

d) Providing support for efficient one-way messaging (blurts)

This was accomplished by:

- Defining a compact message format that can be easily transformed into a standard ANSI C12.22 Datagram
- Assuring that all needed layers defined in this standard can support one-way messaging

e) Providing network architecture compatible with this protocol (some architectural concepts were derived from HCCS 1 [B5], HCCS 2 [B6], HCCS 3 [B7], DND [B4], IPPA [B1], and TCPCE [B2])

This was accomplished by:

- Defining different types of nodes such as C12.22 Relay, C12.22 Master Relay, C12.22 Host, C12.22 Authentication Host, C12.22 Notification Host, and C12.22 Gateway
- Defining the roles and responsibilities of each of these C12.22 Nodes

f) Providing data structure definitions in support of this protocol

This was accomplished by:

- Defining an ANSI C12.19 Decade to be used by C12.22 Nodes
- Defining an ANSI C12.19 Decade to be used by C12.22 Relays
- Defining new procedures in support of this protocol
- Defining a new Table for enhanced security

