MC12.22

User's Guide

For

Local Area Network/Wide Area Network (LAN/WAN)
Node Communication Protocol
to Complement the Utility Industry End Device Data Tables

October 29, 2013

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Abstract: The technical content of this User's Guide is nearly identical to IEEE Std 1703™-2012 and ANSI C12.22-2012, using IEEE Std 1703-2012 as the baseline for the MC12.22 User's Guide. The protocol provides a set of application layer messaging services that are applicable for the enterprise and End Device ends of an Advanced Metering Infrastructure (AMI). The application services include those useful for managing the AMI network assets defined by this standard. These messages may be transported over a wide range of underlying network transports such as TCP/IP, UDP, IEEE 802.11, IEEE 802.15.4 IEEE 802.16, PLC and SMS over GSM, over a wide range of physical media. Additionally, interfaces are defined for a Communication Module and a Local Port (e.g. ANSI C12.18/IEEE Std 1701™/MC12.18 optical port). The described protocol is tailored for, but not limited to, the transport of ANSI C12.19/IEEE 1377™/MC12.19 Table data. It also provides a means by which information can be sent in a secure manner using AES-128 and the EAX' mode. This work was developed jointly with ANSI (published as ANSI C12.22) and IEEE (published as IEEE Std 1703™).

Keywords: IEEE Std 1703, ANSI C12.22, MC12.22, ACSE, Communication Module, End Device

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Introduction

This introduction is not part of the MC12.22 User's Guide. For consistency with IEEE Std 1703 and ANSI C12.22 the word "standard" was retained throughout this User's Guide in reference to this document. Also in reference to MC12.18, MC12.19, MC12.21 and MC12.22, the term "standard" means "User's Guide".

The ANSI C12.22 and IEEE Std 1703 standard and the MC12.22 User's Guide provide an open-platform and requirements for communications over networks. The protocol defines 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.

Described within are four different but related communication modes of operation. One is the operation of an End Device (node) over any network, a feature that all ANSI C12.22/IEEE Std 1703/MC12.22 conforming nodes must implement. The second is an exposed point-to-point interface between an MC12.22 Device (e.g., a meter) and an MC12.22 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 Type 2 optical local port that is backward compatible with that described by MC12.18.

The guide 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 may 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 themselves as Notification Hosts so that they can receive advisory messages and alerts about network asset changes or changes in the state of the network. Network subscription services may be managed through distributed Authentication Hosts.

This protocol was designed to 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 protocol together with MC12.19 addresses the end-to-end distributed AMI network needs from the smallest to the largest of enterprise AMI systems.

This User's Guide establishes a new baseline document that includes all of 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 and additional corrections that were published in ANSI C12.22-2012. Readers that are acquainted with ANSI C12.22-2008, IEEE Std 1703-2012 and ANSI C12.22-2012 should review the notable differences and corrections that exist in this release of the Standard relative to IEEE Std 1703-2012. The differences between ANSI C12.22-2008 and IEEE Std 1703-2012 are documented in IEEE Std 1703-2012 and are not reproduced in the MC12.22 User's Guide.

The 2012 update to the ANSI publication of ANSI C12.22-2012, the publication of IEEE Std 1703-2012 and the release of this MC12.22 User's Guide should be considered in the context of the so-called "protocol suite" of standards:

a. ANSI C12.18 / MC12.18 / IEEE Std 1701™,

b. ANSI C12.19 / MC12.19 / IEEE Std 1377™,

c. ANSI C12.21 / MC12.21 / IEEE Std 1702™,

d. ANSI C12.22 / MC12.22 / IEEE Std 1703™, and

e. Draft ANSI C12.23 / Draft MC12.23 / IEEE P1705™.

Note that, in this User's Guide, the terms "C12.22 XXXX" (e.g., C12.22 Device) may be interchangeably replaced with the terms "IEEE 1703 XXXX" or "MC12.22 XXXX"; i.e., the IEEE 1703 Device is the same as the C12.22 Device and MC12.22 Device. However, since this document jointly developed under the auspice of ANSI C12 SC17 WG1, the document terminology is based on C12.22 terms. Therefore references to ANSI or IEEE devices or standards are equivalent to references to the corresponding MC12.xx devices or User's Guides.

Otherwise, this document is equivalent to the published ANSI C12.22-2012 / IEEE Std 1703-2012 Standards.

Notice to users

The body of this User's Guide was developed jointly with ANSI C12.22 and IEEE Std 1703. The joint agreement calls for the standards and regulatory organizations IEEE, ANSI and MC to maintain the body of this standard in step as they publish versions and revisions of the standard. A number of editorial corrections were made in the preparation of the MC12.22 User's Guide after the publication of IEEE Std 1703-2012. These corrections were incorporated into this User's Guide and highlighted in the body of the document to indicate that the text was corrected. The detailed list of corrections is also shown in Annex L, "Listing of Editorial Corrections to IEEE Std 1703-2012".

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Participants

At the time this User's Guide was completed, the Measurement Canada Task Force on Data Communications Protocol for Electronic Metering Devices had the following membership:

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Table of Contents

Page

Table of Figures

User's Guide for Local Area Network/Wide Area Network (LAN/WAN) Node Communication Protocol to Complement the Utility Industry End Device Data Tables

Protocol Specification for Interfacing to Data Communication Networks

1 Overview

1.1 Introduction

This User's Guide details the network Application Services for the exchange of Table data and control elements. These services need to 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 Std 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 Std 1701), a point-to-point protocol was developed to transport table data over an optical connection. The ANSI C12.18 / MC12.18/IEEE Std 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 Std 1702) was then developed to allow devices to use PSEM to transport Tables over telephone modems.

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

This guide extends the concepts of ANSI C12.18/MC12.18/IEEE Std 1701, ANSI C12.21/MC12.18/IEEE 1702, and ANSI C12.19/MC12.19/ IEEE Std 1377 protocols 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 the document 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. The same applies to "MC12.22 XXXX" terms.

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

It defines interfaces between MC12.22 Devices (C12.19 Devices/IEEE 1377 Devices) and network protocols.

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

a) Defining a Datagram that may convey ANSI C12.19/MC12.19/IEEE Std 1377 data Tables through any network

   This was accomplished by:

   — Assuming that the data source is ANSI C12.19/MC12.19/IEEE Std 1377 data Tables
   — Defining the Application Layer services (language)

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])

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

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

1.3 Purpose

The Utility Industry has a need for a standard that provides an operable "plug-and-play" environment for field devices (e.g., meters, communication modules, and Utility systems). The purpose of this standard is to define the network framework and means to transport the Utility End Device Data Tables via any Local-area / Wide-area network for use by enterprise systems in a multi-source environment.

This standard is intended to accommodate the concept of an advanced metering infrastructure such as that 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 the stated requirements of Measurement Canada for the approval of a metering device for use in Canada.

This protocol is to provide a uniform, managed, adaptive, and secured network data and message delivery system for Utility End Devices and ancillary devices (e.g., home appliances and communication technology) that can operate in a "plug-and-play" and "end-to-end" multi-source enterprise AMI environment, in a manner that allows independence from the underlying network implementation (i.e., an End Device can implement this standard by utilizing a transceiver that is independent of the meter's metrology logic and for the meter not to depend on the design of the network that is serviced by that transceiver). The independence from the underlying native network protects the End Device from premature obsolescence that may occur as networks may come and go.

This document extends the definitions provided by ANSI C12.19/IEEE Std 1377/MC12.19 to include provisions for enterprise-level asset management, data management, and uniform data exchange interfaces, through the use of network and relay tables and services. In addition, it is to provide all the necessary support services needed to deploy, commission, notify, manage, and access End Devices in a manner that preserves the privacy, security, and integrity of the network.