

IEEE Standard for Automatic Meter Reading Via Telephone—Network to Telemetry Interface Unit

Sponsor

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on
Automatic Meter Reading and Energy Management**

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Abstract: The telephone network interface to a telemetry interface unit operating under the utility telemetry service architecture is described. The interface is described in terms of a utility meter reading application, but any enhanced service provider communication can be transported. Telemetry calls may be initiated by either the utility/enhanced service provider (outbound) or the telemetry Interface unit/customer premise equipment (inbound) on the end user's premise.

Keywords: automatic meter reading, energy management, enhanced service provider, meter reading, telemetry interface unit, telephone network, utility communication

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Introduction

(This introduction is not part of IEEE Std 1390.2-1999, IEEE Standard for Automatic Meter Reading Via Telephone—Network to Telemetry Interface Unit.)

This standard was prepared by the TIU-Communications Interface Subcommittee, which is a technical subcommittee of the IEEE Standards Coordinating Committee 31 on Automatic Meter Reading and Energy Management. The members of the subcommittee that prepared this standard consisted of the following people:

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IEEE Standard for Automatic Meter Reading Via Telephone—Network to Telemetry Interface Unit

1. Overview

1.1 Scope

This standard describes the telephone network interface to a telemetry interface unit (TIU) operating under the utility telemetry service (UTS) architecture. The UTS basic transport architecture is capable of supporting many different applications. Telemetry calls may be initiated from either the utility/enhanced service provider (ESP) or the TIU on the end user's premise. There are two access methods defined for this service [central office service unit (COSU) access method and direct dial access method]. There are two TIU transmission methods defined for this service (off-hook transmission method and on-hook transmission method). The interface covered in this standard is described in terms of a basic utility meter reading/controling service. However, any number of other applications can be delivered using the telemetry transport service.

1.2 Purpose

The purpose of this standard is to provide a generic interface to a TIU that will be supported by the architecture of the UTS. The architecture will provide utilities a facility that is readily available, has short set up times, and allows for automatic meter reading using the capabilities of the switched telephone network. The architecture and interface will support a multitude of different transport applications for other industries.

2. References

This standard shall be used in conjunction with the following publications. When the following standards are superseded by an approved revision, the revision shall apply.

ANSI T1401-1993, American National Standard for Telecommunications—Interface Between Carriers and Customer Installations—Analog Voicegrade Switched Access Lines Using Loop-Start and Ground-Start Signaling.¹

Canadian Department of Communications CS-03: 1998, Terminal Equipment, Terminal Systems, Network Protection Devices, Connection Arrangements, and Hearing Aids Compatibility.²

Federal Communications Commission Rules and Regulations, Title 47, Part 68, Connection of Terminal Equipment to the Telephone Network.³

IEEE Std 820-1984 (Reaff 1992), IEEE Standard Telephone Loop Performance Characteristics.⁴

IEEE Std 1390-1995, IEEE Standard for Utility Telemetry Service Architecture for Switched Telephone Network.

IEEE Std 1390.3-1998, IEEE Standard for Automatic Meter Reading Via Telephone Network—Network to Utility Controller.

3. Definitions, abbreviations, and acronyms

3.1 Definitions

Terms used in this document are defined with respect to the architecture and interfaces of a basic utility telemetry service. IEEE Std 100-1996, The IEEE Standard Dictionary for Electrical and Electronics Terms, Sixth Edition, should be referenced for terms not defined in this clause.

3.1.1 abbreviated ringing: A short, variable burst of power ringing that is required to establish a temporary communications path in certain types of network pair-gain equipment. The switch is instructed, via trunk signals, to output this abbreviated ringing on the end users line.

3.1.2 alert tone: A non-power ringing tone, or combination of tones, used to request the telemetry interface unit (TIU) or customer premise equipment (CPE) to become active.

3.1.3 alert tone code: A data byte, from the utility controller, that identifies which alert tone is to be used by the central office service unit (COSU).

3.1.4 automatic call distribution (ACD): A service that evenly distributes calls among incoming end user lines.

3.1.5 automatic number identification (ANI): The local access and transport area (LATA) or interLATA billing number of the calling party.

3.1.6 call-type information (CTI) digits: Sent to the switch from the central office service unit (COSU) via signaling on the utility telemetry trunk, per call, which specify the customer premise equipment (CPE) transmission interface (i.e., on-hook or off-hook operation). These information digits are assigned, on a trunk group basis, through the switch administration procedures.

¹ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA (<http://www.ansi.org/>).

²This document is available from Global Engineering Documents, 15 Inverness Way East, Englewood, Colorado 80112-5704, USA (<http://www.global.ihs.com/>).

³FCC documents are available from the Federal Communications Commission, 445 12th Street S.W., Washington, D. C., 20554, USA. Title 47 is freely available via the web at <http://www.fcc.gov/wtb/rules.html>.

⁴IEEE publications are available from the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA (<http://www.standards.ieee.org/>).

3.1.7 central office service unit (COSU): A telephone company controller resident in a central office that connects to the utility controller and, via the utility telemetry trunk, to the switch. The COSU provides the function of originating and terminating calls to and from telemetry interface units (TIUs). For the COSU access method, the COSU performs a security check with the utility controller and places a call to the end user in response to the information sent to it by the utility controller. The COSU performs a security check and initiates a connection to the utility controller when called by the TIU. The COSU also provides a multiplexing interface between the utility controller and COSU and the COSU and TIU(s). The COSU may also provide traffic measurements.

3.1.8 central office service unit (COSU) access method: Utilizes the switched telephone network, comprised of a COSU, switch, and other network elements. This combination provides for automatically invoking/ignoring certain switch based telemetry communications capabilities and establishes a communications path between a utility/enhanced service provider (ESP) and a telemetry interface unit (TIU).

3.1.9 customer premise equipment (CPE): Equipment located on the customer's premises that is connected to the telephone line [e.g., telemetry interface units (TIUs), telephones, answering machines, and modems].

3.1.10 customer premise equipment (CPE) active state: The CPE has been alerted and performing a communication function.

3.1.11 customer premise equipment (CPE) inactive state: The CPE has completed its communication function.

3.1.12 cut-through: A transmission path through the switched telephone network to an end user.

3.1.13 digital loop carrier (DLC): Equipment that increases the number of end users served by existing loopside pairs through the use of digital multiplexing. These concentration systems are often called pair-gain devices. Both universal and integrated DLCs may be used.

3.1.14 direct dial access method: Utilizes the switched telephone network, comprised of a switch and other network elements that establish a communication path between a utility/enhanced service provider (ESP) and a telemetry interface unit (TIU).

3.1.15 enhanced service provider (ESP): A service provider offering services through the telephone network using the telemetry transport capabilities to deliver their services.

3.1.16 in-band tones: Typically, a signal on the communication path in the range of 400–3300 Hz.

3.1.17 inbound telemetry: Communication initiated by a telemetry interface unit (TIU) toward a utility or enhanced service provider (ESP).

3.1.18 independent telephone company: A company not associated with a regional Bell operating company (non-Bell operating company).

3.1.19 local access and transport area (LATA): An area typically served by a regional Bell operating company (RBOC).

3.1.20 local loop: The communication path between the telephone company's switching office and the end user.

3.1.21 loop current feed open (LCFO): A Bellcore-defined, switch generated, fixed open (no voltage) on the line within the range of 150–350 ms as sent by the switch. Its purpose is to signal certain digital loop carrier (DLC) devices to assign a time slot (transmission path) for a 15 s interval.

3.1.22 modified calling line disconnect: A telephone network feature that, if the end user is off-hook, requires the end user's line to go on-hook before receiving dial tone from the telephone network.

3.1.23 multi-line hunt group (MLHG): A group of lines that have a fixed alternate routing should one or more of the lines in the group be busy.

3.1.24 network interface (demarcation point): The point of connection between the local loop and the end user's (customer's) wiring.

3.1.25 no-test trunk: A specialized switch facility used for operator and service personnel metallic testing of a subscriber's telephone lines (also known as a test trunk facility).

3.1.26 on-hook/off-hook: Signaling conditions on a line in the form of dc impedance presented to the local loop by the telemetry interface unit (TIU). Off-hook implies that the TIU is in a low resistance state and is allowing significant current to flow. On-hook implies that the TIU is in a high resistance state and is not allowing significant current to flow. See ANSI T1401-1993 and the local access and switching area (LATA) Switching Systems Generic Requirements (LSSGR), Section 6.2.2, Bell Communications Research (Bellcore) for more detail.

3.1.27 outbound telemetry: Communication initiated by a utility or enhanced service provider (ESP) toward a telemetry interface unit (TIU).

3.1.28 polarity guard: A device that guarantees proper tip and ring polarity.

3.1.29 post disconnect timing: A timing interval (normally about 12 s in length), initiated when the called party goes on-hook, in which the established connection remains in place as long as the calling party continues to remain off-hook.

3.1.30 regional Bell operating company (RBOC): A regional telephone company that may or may not be made up of individual operating companies.

3.1.31 technical advisory (TA): A telephone company publication intended to disclose information and request comments regarding network services.

3.1.32 technical requirements (TR): A telephone company publication intended to disclose information and operation regarding network services.

3.1.33 telemetry interface unit (TIU): A customer premise equipment (CPE) device that provides a network gateway function and an interface to one or more meters (water, gas, and electric) or other telemetry/control devices or to a local area network. The TIU may be placed in series with or bridged onto the local loop assigned to the end user. Because the TIUs are not network elements, but CPE, they are connected to the end user's line (tip/ring) of the local loop at the network interface. In existing systems, these units are also known as meter interface units (MIUs).

3.1.34 utility controller (UC): A controller resident on a utility/enhanced service provider (ESP) premises, that connects, via the telephone network, to the telemetry interface unit (TIU) (using the direct dial network access method), to the central office service unit (COSU) (using the COSU network access method or the no-test trunk network access method).

3.1.35 utility telemetry trunk (UTT): A two-way telephone company facility connecting the central office service unit (COSU) to the switch. This facility allows a utility or enhanced service provider (ESP), via the telephone network (COSU), to automatically invoke/ignore certain telephone network capabilities as well as provide suppressed or abbreviated ringing access to a telemetry interface unit(s) [TIU(s)] on an end user's line. The TIU may also originate calls, through the telephone network (COSU and switch), which will

automatically invoke/ignore certain telephone network capabilities and provide a connection to the utility or ESP.

3.1.36 wink: A momentary off-hook condition in telephone trunk signaling. A wink may have different meanings depending on where it is used in the signaling stream (i.e., start or connect).

3.2 Abbreviations and acronyms

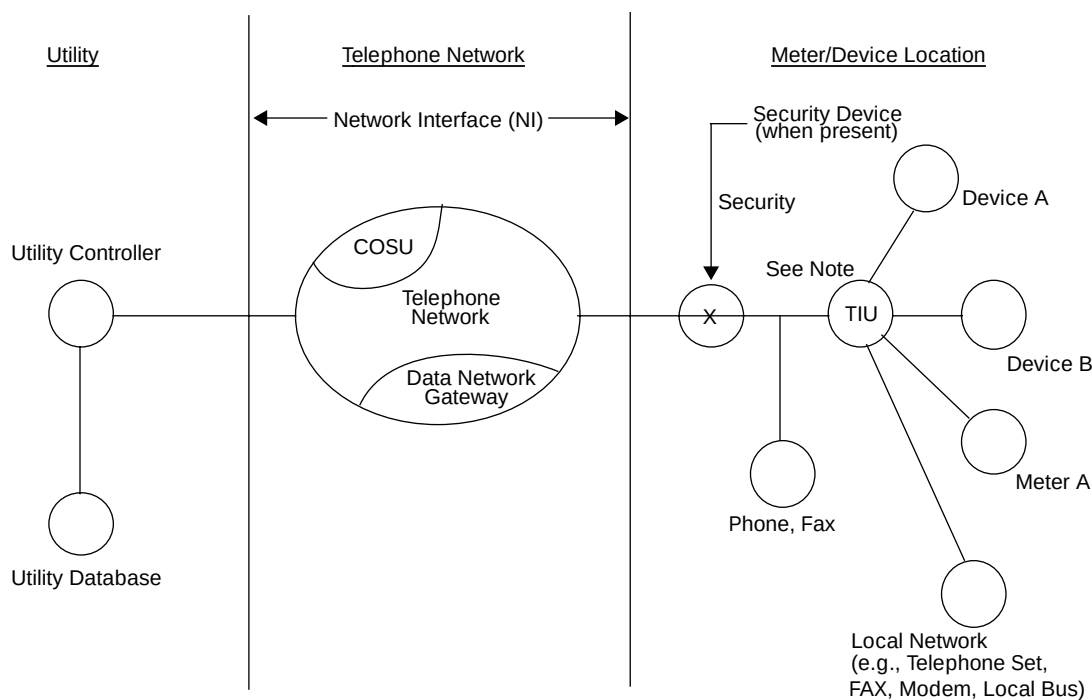
AMR	automatic meter reading
ACD	automatic call distribution
COSU	central office service unit
CPE	customer premise equipment
DLC	digital loop carrier
DTMF	dual-tone multiple frequency
ESP	enhanced service provider
LATA	local access and transport area
LSSGR	LATA Switching Systems Generic Requirements
MIU	meter interface units
MLHG	multiline hunt group
RBOC	regional Bell operating company
TIU	telemetry interface unit
UTS	utility telemetry service
UTT	utility telemetry trunk

4. UTS description

4.1 Feature description

This analog feature allows for the transport of data between a utility or an ESP and an end user's TIU or other CPE device attached to the telephone line. Communication may be established by the utility/ESP or TIU. Communication connections from the utility/ESP to the telephone network shall utilize the switched network, private networks, packet networks, or telephone company gateways with combinations of networks set up for efficient communication. Figure 1 illustrates the functional elements of the UTS.

Automatic meter reading (AMR) is used to describe this utility telemetry service (UTS). AMR is the most popular use for the UTS feature today. There are, however, other applications which will take advantage of a suppressed ringing end user access or a CPE device that initiates calls from the end user's premise. An example of utility-initiated (outbound) applications could include control of remote devices (i.e., resource shut-off), ESP-initiated messaging (i.e., voice-mail message waiting notification), or ESP-initiated appliance diagnosis. Examples of TIU-initiated (inbound) calling devices are end user security systems, end user medical alert systems, utility load control systems, and smart appliances. Smart appliances may initiate calls to service bureaus based on internal maintenance routines or to provide usage-sensitive billing. Calls to the utility/ESP may also be connected to telephone-company-provided multiline hunt groups (MHGs) or automatic call distribution (ACD) services for more efficient communication capability.



NOTE—In some cases the TIU may reside on the network side of the network interface,

Figure 1—UTS architecture for telephone network communications

The telephone end user whose line is being used for UTS is typically not alerted (i.e., by an audible signal) that a utility telemetry call is in process. Also, calling priority is always given to the end user (except for security devices, as described in other sections). When the utility or ESP calls the TIU using the COSU access method, the end user's line is alerted by a signal that does not operate the end user's CPE ringer. The direct dial access method will cause the end user's ringer to be operated. Additionally, the TIU must go on-hook (off-hook transmission method) or go to the idle state (on-hook transmission method) if the end user goes off-hook (except for security devices, as described in other sections). The end user will only become aware of the utility/ESP call if dialing or data transmission is heard or a delayed dial tone is detected.

Various components and protocols of the UTS are the subject of IEEE Std 1390-1995,⁵ IEEE P1390.1/AMR.5/99-001, 3 February 1999 [B4], and IEEE Std 1390.3-1998.

Multiple TIUs, as well as other end-user CPE devices, may be present on a single end user's line. Each TIU may access one or more ports that are connected to the devices requiring communication capability.

To completely describe the progress of the telemetry call and the differences between the identified network access methods, it is important to describe certain internal telephone network operations. These internal telephone network operations are controlled by the local telephone company and are fully defined in the local telephone company technical documents.

⁵Information on references can be found in Clause 2.

4.2 Telephone network access methods

The COSU access method and direct dial access method shall coexist with each other, and one TIU may implement both access methods.

4.2.1 COSU access method

When the COSU access method is utilized, the call shall be handled by the COSU-switch combination, which allows for automatic invoking/ignoring of certain switch based communication capabilities. For example, this access method will provide a connection to a line that has a valid directory number but connection has been denied because of vacation service or financial reasons. These communication capabilities are covered by the technical documents issued by a regional Bell operating company (RBOC) or an independent telephone company.

4.2.2 Direct dial access method

When the direct dial access method is utilized, the call shall proceed through the existing switched network, activating those communication capabilities that can be activated by the end user. Network features assigned to the line may affect the call. For example, the TIU may activate/deactivate selected telephone network (switch) features assigned to the end user's line, as an end user would, with a sequence of dialed digits for each feature. These communication capabilities are covered by the technical documents issued by an RBOC or an independent telephone company.

4.3 Call initiation by utility or ESP

4.3.1 Using the COSU access method

A suppressed ringing connection shall be established, allowing cut-through to the end user's line and allowing communication with the TIU. The TIU shall be alerted by an alert tone(s) and subaddresses, if present. Data is exchanged in either direction. When the data exchange is completed, the telephone network (COSU) causes the telephone network (switch) to disconnect from the end user's line.

4.3.2 Using the direct dial access method

Several defacto techniques have been implemented to cause the TIU to become active and either answer the call or dial back to the utility/ESP.

4.4 Call initiated by the TIU

The TIU initiates a call by going off-hook and dialing a preprogrammed series of digits. With either the COSU access method or the direct dial access method, the call shall be connected, via the telephone network, to the utility or ESP. Data is exchanged in either direction and the call is disconnected.

4.5 TIU transmission methods

4.5.1 Off-hook transmission method

When the off-hook transmission method is utilized and the TIU is alerted or wakes up and becomes active, the TIU goes off-hook, causing a bidirectional communication path to be established through loopside elements and the switch. While the TIU is communicating, the TIU is off-hook. During the communication, the switch cannot detect multiple off-hook signals from the end user's line (the TIU is already off-hook).