SVENSK STANDARD SS-EN IEC 61158-6-10

Fastställd	Utgåva	Sida	Ansvarig kommitté
2019-10-23	4	1 (1+898)	SEK TK 65

Industriell processtyrning – Fältbuss – Del 6-10: Specifikation av protokoll i applikationsskiktet – Delar i fältbuss, Typ 10

Industrial communication networks – Fieldbus specifications – Part 6-10: Application layer protocol specification – Type 10 elements

Som svensk standard gäller europastandarden EN IEC 61158-6-10:2019. Den svenska standarden innehåller den officiella engelska språkversionen av EN IEC 61158-6-10:2019.

Nationellt förord

Europastandarden EN IEC 61158-6-10:2019

består av:

– **europastandardens ikraftsättningsdokument,** utarbetat inom CENELEC

– **IEC 61158-6-10, Fourth edition, 2019 - Industrial communication networks - Fieldbus specifications - Part 6-10: Application layer protocol specification - Type 10 elements**

utarbetad inom International Electrotechnical Commission, IEC.

Tidigare fastställd svensk standard SS-EN 61158-6-10, utgåva 3, 2015, gäller ej fr o m 2022-07-25.

ICS 35.110.00; 35.100.70; 25.040.40

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 61158-6-10

August 2019

ICS 25.040.40; 35.100.70; 35.110

Supersedes EN 61158-6-10:2014 and all of its amendments and corrigenda (if any)

English Version

Industrial communication networks - Fieldbus specifications - Part 6-10: Application layer protocol specification - Type 10 elements (IEC 61158-6-10:2019)

Réseaux de communication industriels - Spécifications des bus de terrain - Partie 6-10: Spécification du protocole de la couche application - Eléments de type 10 (IEC 61158-6-10:2019)

Industrielle Kommunikationsnetze - Feldbusse - Teil 6-10: Protokollspezifikation des Application Layer (Anwendungsschicht) - Typ 10-Elemente (IEC 61158-6-10:2019)

This European Standard was approved by CENELEC on 2019-07-25. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN IEC 61158-6-10:2019 E

European foreword

The text of document 65C/948/FDIS, future edition 4 of IEC 61158-6-10, prepared by SC 65C "Industrial networks" of IEC/TC 65 "Industrial-process measurement, control and automation" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61158-6-10:2019.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2020-04-25
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2022-07-25

This document supersedes EN 61158-6-10:2014 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61158-6-10:2019 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60793-2-30 NOTE Harmonized as EN 60793-2-30
IEC 60793-2-40 NOTE Harmonized as EN 60793-2-40
IEC 61784-3-3 NOTE Harmonized as EN 61784-3-3

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 61131-9	-	Programmable controllers - Part 9: Single-drop digital communication interface for small sensors and actuators (SDCI)	EN 61131-9	-
IEC 61158-1	2019	Industrial communication networks - Fieldbus specifications - Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series	EN IEC 61158-1	2019
IEC 61158-2	-	Industrial communication networks - Fieldbus specifications - Part 2: Physical layer specification and service definition	EN 61158-2	-
IEC 61158-5-10	2019	Industrial communication networks - Fieldbus specifications - Part 5-10: Application layer service definition - Type 10 elements	EN IEC 61158-5-10	2019
IEC 61158-6-3	2019	Industrial communication networks - Fieldbus specifications - Part 6-3: Application layer protocol specification - Type 3 elements	-	-
IEC 62439-2	-	Industrial communication networks – High availability automation networks – Part 2: Media Redundancy Protocol (MRP)	EN 62439-2	-
ISO 8601	-	Data elements and interchange formats - Information interchange - Representation of dates and times	-	-
ISO/IEC 646	1991	Information technology - ISO 7-bit coded-character set for information interchange	-	-
ISO/IEC 7498-1	-	Information technology - Open Systems-Interconnection - Basic Reference Model: The Basic Model	-	-
ISO/IEC 8822	-	Information technology - Open Systems-Interconnection - Presentation service definition	-	-
ISO/IEC 8824-1	-	Information technology - Abstract Syntax-Notation One (ASN.1): Specification of basic notation	-	-
ISO/IEC 9545	-	Information technology - Open Systems-Interconnection - Application Layer structure	-	-

ISO/IEC 9834-8	-	Information technology - Procedures for the operation of object identifier registration authorities - Part 8: Generation of universally unique identifiers (UUIDs) and their use in object identifiers	-
ISO/IEC 10646	-	Information technology - Universal Coded Character Set (UCS)	-
ISO/IEC 10731	-	Information technology - Open Systems Interconnection - Basic Reference Model - Conventions for the definition of OSI services	-
IEEE Std 802	-	IEEE Standard for Local and metropolitan area networks: Overview and Architecture	-
IEEE Std 802.15.1	-	IEEE Standard for Information technology -- Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements. - Part 15.1: Wireless medium access control (MAC) and physical layer (PHY) specifications for wireless personal area networks (WPANs)	-
IEEE Std 802.1AB	2016	IEEE Standard for Local and metropolitan area networks: Station and Media Access Control Connectivity Discovery	-
IEEE Std 802.1AC	-	IEEE Standard for Local and metropolitan area networks: Media Access Control (MAC) Service definition	
IEEE Std 802.1AS	-	IEEE Standard for Local and metropolitan area networks - Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks	-
IEEE Std 802.1Q	2018	IEEE Standard for Local and metropolitan area networks - Bridges and Bridged Networks	-
IEEE Std 802.3	-	IEEE Standard for Ethernet	-
IEEE Std 802.11	-	IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications	
IETF RFC 1034	-	Domain names - concepts and facilities	-
IETF RFC 1213	-	Management Information Base for Network Management of TCP/IP-based Internets: MIB-II	-
IETF RFC 2131	-	Dynamic Host Configuration Protocol	-
IETF RFC 2132	-	DHCP Options and BOOTP Vendor Extensions	-
IETF RFC 2236	-	Internet Group Management Protocol, Version 2	-
IETF RFC 2365	-	Administratively Scoped IP Multicast	-
IETF RFC 2474	-	Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers	-
IETF RFC 2674	-	Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering and Virtual LAN Extensions	-
IETF RFC 2863	-	The Interfaces Group MIB	-

IETF RFC 3418	-	Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)	-
IETF RFC 3621	-	Power Ethernet MIB	-
IETF RFC 4361	-	Node-specific Client Identifiers for Dynamic Host Configuration Protocol Version Four (DHCPv4)	-
IETF RFC 4363	-	Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering, and Virtual LAN Extensions	-
IETF RFC 4604	-	Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast	-
IETF RFC 4632	-	Classless Inter-domain Routing (CIDR): The Internet Address Assignment and Aggregation Plan	
IETF RFC 4836	-	Definitions of Managed Objects for IEEE 802.3 Medium Attachment Units (MAUs)	-
IETF RFC 5227	-	IPv4 Address Conflict Detection	-
IETF RFC 5890	-	Internationalized Domain Names for Applications (IDNA): Definitions and Document Framework	-
IETF RFC 5905	-	Network Time Protocol Version 4: Protocol and Algorithms Specification	
IETF RFC 6151	-	Updated Security Considerations for the MD5 Message-Digest and the HMAC-MD5 Algorithms	
IETF RFC 6890	-	Special-Purpose IP Address Registries	-
IETF RFC 768	-	User Datagram Protocol	-
IETF RFC 791	-	Internet protocol darpa internet program protocol specification	-
IETF RFC 792	-	Internet Control Message Protocol	-
IETF RFC 826	-	Ethernet Address Resolution Protocol: Or Converting Network Protocol Addresses to 48.bit Ethernet Address for Transmission on Ethernet Hardware	-
IETF RFC 950	-	Internet Standard Subnetting Procedure	-
ISO/IEC/IEEE 60559	2011	Information technology - Microprocessor Systems - Floating-Point arithmetic	-
The Open Group, Publication C706	-	Technical standard DCE1.1: Remote Procedure Call	

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-10: Application layer protocol specification – Type 10 elements

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
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8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

Attention is drawn to the fact that the use of the associated protocol type is restricted by its intellectual-property-right holders. In all cases, the commitment to limited release of intellectual-property-rights made by the holders of those rights permits a layer protocol type to be used with other layer protocols of the same type, or in other type combinations explicitly authorized by its intellectual-property-right holders.

NOTE Combinations of protocol types are specified in IEC 61784-1 and IEC 61784-2.

International Standard IEC 61158-6-10 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation.

This fourth edition cancels and replaces the third edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) integration of system redundancy basic functionality;
b) integration of dynamic reconfiguration basic functionality;
c) integration of reporting system basic functionality;
d) integration of asset management basic functionality;e) integration of media redundancy ring interconnection basic functionality.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
65C/948/FDIS	65C/956/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with ISO/IEC Directives, Part 2.

A list of all parts of the IEC 61158 series, published under the general title *Industrial communication networks – Fieldbus specifications,* can be found on the IEC web site.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be:

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'color inside' logo on the cover page of this publication indicates that it contains colors which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a color printer.

INTRODUCTION

This document is one of a series produced to facilitate the interconnection of automation system components. It is related to other standards in the set as defined by the “three-layer” fieldbus reference model described in IEC 61158-1.

The application protocol provides the application service by making use of the services available from the data-link or other immediately lower layer. The primary aim of this document is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer application entities (AEs) at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

– as a guide for implementers and designers;

– for use in the testing and procurement of equipment;

– as part of an agreement for the admittance of systems into the open systems environment;

– as a refinement to the understanding of time-critical communications within OSI.

This document is concerned, in particular, with the communication and interworking of sensors, effectors and other automation devices. By using this document together with other standards positioned within the OSI or fieldbus reference models, otherwise incompatible systems may work together in any combination.

NOTE Attention is drawn to the fact that use of the associated protocol type(s) is restricted by its (their) intellectual-property-right holder(s). In all cases, the commitment to limited release of intellectual-property-rights made by the holder(s) of those rights permits a particular data-link layer protocol type to be used with physical layer and application layer protocols in type combinations as specified explicitly in the IEC 61784 series. Use of the protocol type(s) in other combinations may require permission of their respective intellectual-property-right holder(s).

The International Electrotechnical Commission (IEC) draws attention to the fact that it is claimed that compliance with this document may involve the use of a patent concerning Type 10 elements and possibly other types given in this document as follows:

The following patent rights for Type 10 have been announced by [SI]:

Publication	Title
WO 02/043336	System and method for parallel transfer of real-time critical and non-real-time critical data via switchable data networks, particularly Ethernet
WO 02/076033	Synchronous clocked communication system with decentralized input/output modules and methods for integrating decentralized input/output modules in such a system
WO 03/028258	Method for synchronizing nodes of a communication system
WO 03/028259	Communications system and method for synchronizing a communications cycle
WO 04/030284	Method for permanent redundant transmission of data telegrams in communication systems
EP 1558002	Method for assigning an IP address to a device
EP 1318630	Matrices for controlling the device specific data transfer rates on a field bus

IEC takes no position concerning the evidence, validity and scope of these patent rights.

The holder of these patent rights has assured the IEC that he/she is willing to negotiate licences either free of charge or under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of these patent rights is registered with IEC. Information may be obtained from:

[SI]: Siemens AG
LC TE IP&IT

Otto-Hahn-Ring 6
D-81739 Munich
Germany

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights other than those identified above. IEC shall not be held responsible for identifying any or all such patent rights.

ISO (www.iso.org/patents) and IEC (http://www.iec.ch/tctools/patent_decl.htm) maintain on-line data bases of patents relevant to their standards. Users are encouraged to consult the data bases for the most up to date information concerning patents.

INDUSTRIAL COMMUNICATION NETWORKS – FIELDBUS SPECIFICATIONS –

Part 6-10: Application layer protocol specification – Type 10 elements

1 Scope

1.1 General

The Fieldbus Application Layer (FAL) provides user programs with a means to access the fieldbus communication environment. In this respect, the FAL can be viewed as a “window between corresponding application programs.”

This part of IEC 61158 provides common elements for basic time-critical and non-time-critical messaging communications between application programs in an automation environment and material specific to Type 10 fieldbus. The term “time-critical” is used to represent the presence of a time-window, within which one or more specified actions are required to be completed with some defined level of certainty. Failure to complete specified actions within the time window risks failure of the applications requesting the actions, with attendant risk to equipment, plant and possibly human life.

This International Standard defines in an abstract way the externally visible behavior provided by the Type 10 fieldbus application layer in terms of:

a) the abstract syntax defining the application layer protocol data units conveyed between communicating application entities,
b) the transfer syntax defining the application layer protocol data units conveyed between communicating application entities,
c) the application context state machine defining the application service behavior visible between communicating application entities, and
d) the application relationship state machines defining the communication behavior visible between communicating application entities.

The purpose of this document is to define the protocol provided to:

a) define the wire-representation of the service primitives defined in IEC 61158-5-10 and
b) define the externally visible behavior associated with their transfer.

This document specifies the protocol of the Type 10 fieldbus application layer, in conformance with the OSI Basic Reference Model (ISO/IEC 7498-1) and the OSI Application Layer Structure (ISO/IEC 9545).

1.2 Specifications

The principal objective of this document is to specify the syntax and behavior of the application layer protocol that conveys the application layer services defined in IEC 61158-5-10.

A secondary objective is to provide migration paths from previously-existing industrial communications protocols. It is this latter objective which gives rise to the diversity of protocols standardized in IEC 61158-6.

1.3 Conformance

This document does not specify individual implementations or products, nor does it constrain the implementations of application layer entities within industrial automation systems.

Conformance is achieved through implementation of this application layer protocol specification.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61131-9, *Programmable controllers – Part 9: Single-drop digital communication interface for small sensors and actuators (SDCI)*

IEC 61158-1:2019, *Industrial communication networks – Fieldbus specifications – Part 1: Overview and guidance for the IEC 61158 and IEC 61784 series*

IEC 61158-2, *Industrial communication networks – Fieldbus specifications – Part 2: Physical layer specification and service definition*

IEC 61158-5-10:2019, *Industrial communication networks – Fieldbus specifications – Application layer service definition – Type 10 elements*

IEC 61158-6-3:2019, *Industrial communication networks – Fieldbus specifications – Part 6-3: Application layer protocol specification – Type 3 elements*

IEC 62439-2, *Industrial communication networks – High availability automation networks – Part 2: Media Redundancy Protocol (MRP)*

ISO/IEC 646:1991, *Information technology – ISO 7-bit coded character set for information interchange*

ISO/IEC 7498-1, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*

ISO/IEC 8822, *Information technology – Open Systems Interconnection – Presentation service definition*

ISO/IEC 8824-1, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*

ISO/IEC 9545, *Information technology – Open Systems Interconnection – Application Layer structure*

ISO/IEC 9834-8, *Information technology – Procedures for the operation of object identifier registration authorities – Part 8: Generation of universally unique identifiers (UUIDs) and their use in object identifiers*

ISO/IEC 10646, *Information technology – Universal Coded Character Set (UCS)*

ISO/IEC 10731, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

ISO/IEC/IEEE 60559:2011, *Information technology – Microprocessor Systems – Floating-Point arithmetic*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

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IEEE Std 802.1AB:2016, *IEEE Standard for Local and metropolitan area networks: Station and Media Access Control Connectivity Discovery*, available at http://www.ieee.org [viewed 2018-09-27]

IEEE Std 802.1AC, *IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Service definition*, available at http://www.ieee.org [viewed 2018-09-27]

IEEE Std 802.1AS, *IEEE standard for Local and metropolitan area networks – Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks*, available at http://www.ieee.org [viewed 2018-09-27]

IEEE Std 802.1Q-2018, *IEEE Standard for Local and metropolitan area networks – Bridges and Bridged Networks*, available at http://www.ieee.org [viewed 2018-09-27]

IEEE Std 802.3, *IEEE Standard for Ethernet*, available at http://www.ieee.org [viewed 2018-09-27]

IEEE Std 802.11, *IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications,* available at http://www.ieee.org [viewed 2018-09-27]

IEEE Std 802.15.1, *IEEE Standard for Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 15.1: Wireless medium access control (MAC) and physical layer (PHY) specifications for wireless personal area networks (WPANs),* available at http://www.ieee.org [viewed 2018-09-27]

IETF RFC 768, *User Datagram Protocol*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 791, *Internet Protocol*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 792*, Internet Control Message Protocol*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 826, *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48.bit Ethernet Address for Transmission on Ethernet Hardware*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 950, *Internet Standard Subnetting Procedure*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 1034, *Domain names – Concepts and Facilities*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 1213, *Management Information Base for Network Management of TCP/IP-based internets: MIB-II;* available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 2131, *Dynamic Host Configuration Protocol*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 2132, *DHCP Options and BOOTP Vendor Extensions*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 2236, *Internet Group Management Protocol, Version 2*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 2365, *Administratively Scoped IP Multicast*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 2474, *Definition of the Differentiated Services Field (DS Field) in the IPv4 and IPv6 Headers;* available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 2674, *Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering and Virtual LAN Extensions*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 2863, *The Interfaces Group MIB*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 3418, *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 3621, *Power Ethernet MIB*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 4361, *Node-specific Client Identifiers for Dynamic Host Configuration Protocol Version Four (DHCPv4)*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 4363, *Definitions of Managed Objects for Bridges with Traffic Classes, Multicast Filtering, and Virtual LAN Extensions*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 4604, *Using Internet Group Management Protocol Version 3 (IGMPv3) and Multicast Listener Discovery Protocol Version 2 (MLDv2) for Source-Specific Multicast,* available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 4632, *Classless Inter-domain Routing (CIDR): The Internet Address Assignment and Aggregation Plan*, available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 4836, *Definitions of Managed Objects for IEEE Std 802.3 Medium Attachment Units (MAUs)*, available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 5227*, IPv4 Address Conflict Detection*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 5890, *Internationalized Domain Names for Applications (IDNA): Definitions and Document Framework*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 5905, *Network Time Protocol Version 4: Protocol and Algorithms Specification*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 6151, *Updated Security Considerations for the MD5 Message-Digest and the HMAC-MD5 Algorithms*; available at http://www.ietf.org [viewed 2018-09-27]

IETF RFC 6890, *Special-Purpose IP Address Registries*; available at http://www.ietf.org [viewed 2018-09-27]

The Open Group, *Publication C706, Technical standard DCE1.1: Remote Procedure Call,* available at <http://www.opengroup.org/onlinepubs/9629399/toc.htm> [viewed 2018-09-27]