IEC TR 62357-200

Edition 1.0 2015-07

TECHNICAL REPORT

colour inside

Power systems management and associated information exchange – Part 200: Guidelines for migration from Internet Protocol version 4 (IPv4) to Internet Protocol version 6 (IPv6)

IEC TR 62357-200:2015-07(en)

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

About the IEC
The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications
The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

IEC Catalogue - webstore.iec.ch/catalogue
The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

IEC publications search - www.iec.ch/searchpub
The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

Electropedia - www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in 15 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IEC Glossary - std.iec.ch/glossary
More than 60 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

IEC Customer Service Centre - webstore.iec.ch/csc
If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: csc@iec.ch.

IEC TR 62357-200

Edition 1.0 2015-07

TECHNICAL REPORT

colour inside

Power systems management and associated information exchange – Part 200: Guidelines for migration from Internet Protocol version 4 (IPv4) to Internet Protocol version 6 (IPv6)

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ICS 33.200

ISBN 978-2-8322-2795-4

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE –

Part 200: Guidelines for migration from Internet Protocol version 4 (IPv4) to Internet Protocol version 6 (IPv6)

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.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
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.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 62357-200, which is a technical report, has been prepared by IEC technical committee 57: Power systems management and associated information exchange.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
57/1563/DTR	57/1580/RVC

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

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

A list of all parts in the IEC 62357 series, published under the general title *Power systems management and associated information exchange*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This Technical Report provides definitions, guidelines, and recommendations for migration of data communication protocols which are today using the Internet Protocol version 4 (IPv4) to the Internet Protocol version 6 (IPv6).

This Technical Report addresses data communication for power systems at all voltage levels, from transmission level down to the low voltage. It is in addition useful for any other application domain which specifies the use of IP transport.

This Technical Report starts with a tutorial on the aspects of IPv4 and IPv6 technologies that are relevant for the migration.

This Technical Report addresses issues such as motivation for migration, migration strategies in general and specific application in power systems communications.

This Technical Report contains recommendations for the device manufacturers, network engineers and for standardization bodies.

This Technical Report defines a time table for the standard bodies defining data communication in power systems, as follows:

- All new or revised IEC documents support IPv6 as an option for projects that mandate it, starting in 2015.
- All IEC documents request both IPv6 and IPv4 support, while use is not mandatory, until 2030.
- All IEC documents consider IPv4 as deprecated after 2050.

POWER SYSTEMS MANAGEMENT AND ASSOCIATED INFORMATION EXCHANGE –

Part 200: Guidelines for migration from Internet Protocol version 4 (IPv4) to Internet Protocol version 6 (IPv6)

1 Scope

This part of IEC 62357, which is a Technical Report, applies to information exchange in power systems including, but not restricted to, substations, control centre, maintenance centre, energy management systems, synchrophasor-based grid stability systems, bulk energy generation (including fossil fuel plants), distributed energy generation (renewables, wind and solar), energy storage, load management (demand side management and demand response for distribution level consumers or producers).

This Technical Report addresses the issues encountered when migrating from Internet Protocol version 4 (IPv4) to the Internet Protocol version 6 (IPv6). It describes migration strategies, covering impact on applications, communication stack, network nodes, configuration, address allocation, cyber security and the related management.

This Technical Report considers backward compatibility and show concepts as well as necessary migration paths to IPv6 from IPv4 where necessary, for a number of protocols in the IEC 61850 framework.

Following a review of IEC standards and technical reports according to the reference architecture for power system information exchange (IEC 62357-1), this Technical Report supports modifications caused by the introduction of IPv6 for revision of these documents, considering the impact of permitting or requiring IPv6.

This Technical Report does not impose the use of the IPv6 technology in utility communications.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International electrotechnical vocabulary (available at: <http://www.electropedia.org/>)*

IEC 60870-5-104, *Telecontrol equipment and systems – Part 5-104: Transmission protocols – Network access for IEC 60870-5-101 using standard transport profiles*

IEC 61588:2009, *Precision clock synchronization protocol for networked measurement and control systems*

IEC 61850-6:2009, *Communication networks and systems for power utility automation – Part 6: Configuration description language for communication in electrical substations related to IEDs*

IEC 61850-8-1:2011, *Communication networks and systems for power utility automation – Part 8-1: Specific communication service mapping (SCSM) – Mappings to MMS (ISO 9506-1 and ISO 9506-2) and to ISO/IEC 8802-3*

IEC 61850-9-2:2011, *Communication networks and systems for power utility automation – Part 9-2: Specific communication service mapping (SCSM) – Sampled values over ISO/IEC 8802-3*

IEC TR 61850-90-1:2010, *Communication networks and systems for power utility automation – Part 90-1: Use of IEC 61850 for the communication between substations*

IEC TR 61850-90-2, *Communication networks and systems for power utility automation – Part 90-2: Using IEC 61850 for the communication between substations and control centres*[1]

IEC TR 61850-90-4, *Communication networks and systems for power utility automation – Part 90-4: Network engineering guidelines*

IEC TR 61850-90-5, *Communication networks and systems for power utility automation – Part 90-5: Use of IEC 61850 to transmit synchrophasor information according to IEEE C37.118*

IEC TR 61850-90-12, *Communication networks and systems for power utility automation – Part 90-12: Wide area network engineering guidelines*

IEC 62351 (all parts), *Power systems management and associated information exchange – Data and communications security*

ISO 9506-1, *Industrial automation systems – Manufacturing message specification – Part 1: Service definition*

ISO 9506-2, *Industrial automation systems – Manufacturing message specification – Part 2: Protocol Specification*

IEEE 802.1Q, *IEEE standards for local and metropolitan area network; Virtual bridged local area networks (VLANs and priorities)*

IEEE 1815, *IEEE Standard for Electric Power – Systems Communications – Distributed Network Protocol (DNP3)*

RFC 0768, *User Datagram Protocol*

RFC 0791, *Internet Protocol (IPv4)*

RFC 0792, *Internet Control Message Protocol (ICMP)*

RFC 0793, *Transmission Control Protocol, Protocol Specification*

RFC 0826, *An Ethernet Address Resolution Protocol*

RFC 0894, *A Standard for the Transmission of IP Datagrams over Ethernet Networks*

RFC 0959, *File Transfer Protocol (FTP)*

---

[1] To be published.

RFC 1142, *OSI IS-IS Intra-domain Routing Protocol",* February 1990

RFC 1191, *Path MTU Discovery*

RFC 1240, *OSI Connectionless Transport Services on top of UDP Version 1*

RFC 1305, *Network Time Protocol (Version 3)*

RFC 1918, *Address Allocation for Private Internet*

RFC 1981, *Path MTU Discovery for IP version 6*

RFC 2131, *Dynamic Host Configuration Protocol (DHCPv4)*

RFC 2147, *TCP and UDP over IPv6 Jumbograms*

RFC 2401, *IPsec*

RFC 2328, *OSPF Version 2*

RFC 2460, *Internet Protocol, Version 6 (IPv6) Specification*

RFC 2464, *Transmission of IPv6 Packets over Ethernet Networks*

RFC 2473, *Generic Packet Tunneling in IPv6 Specification*

RFC 2529, *Transmission of IPv6 over IPv4 Domains without Explicit Tunnels*

RFC 2663, *IP Network Address Translator (NAT) Terminology and Considerations*

RFC 2766, *Network Address Translation – Protocol Translation (NAT-PT)*

RFC 3022, *Traditional IP Network Address Translator (Traditional NAT)*

RFC 3056, *Connection of IPv6 Domains via IPv4 Clouds (6to4)*

RFC 3315, *DHCP for IPv6 (DHCPv6)*

RFC 3416, *Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)*

RFC 3931, *IETF Network Working Group, Layer Two Tunneling Protocol – Version 3 (L2TPv3)*

RFC 4038, *Application Aspects of IPv6 Transition*

RFC 4193, *Unique Local IPv6 Unicast Addresses*

RFC 4213, *Basic Transition Mechanisms for IPv6 Hosts and Routers*

RFC 4291, *IP Version 6 Addressing Architecture*

RFC 4302, *IP Authentication Header*

RFC 4303, *IP Encapsulating Security Payload (ESP)*

RFC 4380, Teredo: *Tunneling IPv6 over UDP through Network Address Translators (NATs)*

RFC 4443, *Internet Control Message Protocol (ICMPv6) for the Internet Protocol Version 6 (IPv6) Specification*

RFC 4459, *MTU and Fragmentation Issues with In-the-Network Tunneling*

RFC 4554, *Use of VLANs for IPv4-IPv6 Coexistence in Enterprise Networks*

RFC 4632, *Classless Inter-domain Routing (CIDR): The Internet Address Assignment and Aggregation Plan*

RFC 4861, *Neighbor Discovery for IP version 6 (IPv6)*

RFC 4919, *IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs)*

RFC 4944, *Transmission of IPv6 Packets over IEEE 802.15.4 Networks*

RFC 4966, *Reasons to Move the Network Address Translator – Protocol Translator (NAT-PT) to Historic Status*

RFC 5214, *Intra-Site Automatic Tunnel Addressing Protocol (ISATAP)*

RFC 5569, *IPv6 Rapid Deployment on IPv4 Infrastructures (6rd)*

RFC 5641, *Layer Two Tunneling Protocol – Version 3 (L2TPv3) Extended Circuit Status Values*

RFC 5771, *IANA Guidelines for IPv4 Multicast Address Assignments*

RFC 5905, *Network Time Protocol Version 4: Protocol and Algorithms Specification*

RFC 5942, *IPv6 Subnet Model: The Relationship between Links and Subnet Prefixes*

RFC 5952, *A Recommendation for IPv6 Address Text Representation*

RFC 5991, *Teredo Security Updates (Updates RFC 4380)*

RFC 6052, *IPv6 Addressing of IPv4/IPv6 Translators*

RFC 6081, *Teredo Extensions*

RFC 6144, *Framework for IPv4/IPv6 Translation (NATs after RFC 4966)*

RFC 6145, *IP/ICMP Translation Algorithm*

RFC 6146, *Stateful NAT64: Network Address and Protocol Translation from IPv6 Clients to IPv4 Servers*

RFC 6282, *Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks*

RFC 6333, *Dual-Stack Lite Broadband Deployments Following IPv4 Exhaustion*

RFC 6535, *Dual-Stack Hosts using the "Bump-in-the-Host" Technique (BIH)*

RFC 6550, *IPv6 Routing Protocol for Low-Power and Lossy Networks*

RFC 6775, *Neighbor Discovery Optimization for IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs)*

RFC 6864, *Updated Specification of the IPv4 ID Field*

RFC 7059, *A comparison of IPv6-over-IPv4 Tunnel Mechanisms.*

RFC 7230, *Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing*

3 Terms, definitions, abbreviated terms, acronyms and conventions

3.1 Terms and definitions

For the purposes of this document the terms and definitions given in IEC 60050-191, as well as the following, apply.

3.1.1
application-level gateway
network device that converts the application payload received over a first protocol into an application payload over a second protocol, using application knowledge of the transmitted information

3.1.2
bridge
network device that connects network segments at the data link layer (Layer 2) of the OSI model

[SOURCE: ISO/IEC 10038, ANSI/IEEE 802.1D – 2004]

3.1.3
decapsulation
extraction of the data elements belonging to a first network protocol from a second network protocol used to transport the first protocol

3.1.4
DHCP server
network server that assigns an IP address to a host for a given period of time (lease)

3.1.5
domain name server
DNS
network server that resolves the IP address given the unique resource location (URL) of a communication partner

3.1.6
encapsulation
embedding of the data elements belonging to a first network protocol into a second network protocol that is used to transport it

3.1.7
host
network node aware of the IP protocol