

INTERNATIONAL
STANDARD

**ISO/IEC/
IEEE
8802-3**

First edition
2014-04-01

Standard for Ethernet

Norme pour Ethernet

iTeh STANDARD PREVIEW
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[ISO/IEC/IEEE 8802-3:2014](https://standards.iteh.ai/catalog/standards/sist/cf88e1b5-8771-4eaf-9ef2-9728bbd4f17b/iso-iec-ieee-8802-3-2014)

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Reference number
ISO/IEC/IEEE 8802-3:2014(E)



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Published in Switzerland

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IEEE Std 802.3™-2012
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28 December 2012

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Abstract: Ethernet local area network operation is specified for selected speeds of operation from 1 Mb/s to 100 Gb/s using a common media access control (MAC) specification and management information base (MIB). The Carrier Sense Multiple Access with Collision Detection (CSMA/CD) MAC protocol specifies shared medium (half duplex) operation, as well as full duplex operation. Speed specific Media Independent Interfaces (MIIs) allow use of selected Physical Layer devices (PHY) for operation over coaxial, twisted-pair or fiber optic cables. System considerations for multisegment shared access networks describe the use of Repeaters that are defined for operational speeds up to 1000 Mb/s. Local Area Network (LAN) operation is supported at all speeds. Other specified capabilities include various PHY types for access networks, PHYs suitable for metropolitan area network applications, and the provision of power over selected twisted-pair PHY types.

Keywords: 10BASE; 100BASE; 1000BASE; 10GBASE; 40GBASE; 100GBASE; 10 Gigabit Ethernet; 40 Gigabit Ethernet; 100 Gigabit Ethernet; attachment unit interface; AUI; Auto Negotiation; Backplane Ethernet; data processing; DTE Power via the MDI; EPON; Ethernet; Ethernet in the First Mile; Ethernet passive optical network; Fast Ethernet; Gigabit Ethernet; GMII; information exchange; IEEE 802.3; local area network; management; medium dependent interface; media independent interface; MDI; MIB; MII; PHY; physical coding sublayer; Physical Layer; physical medium attachment; PMA; Power over Ethernet; repeater; type field; VLAN TAG; XGMII

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PDF: ISBN 973-07381-7312-2 **STD97287**
Print: ISBN 973-07381-7327-6 **STDPD97287**

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Wael William Diab, *Working Group Vice-Chair*
Adam Healey, *Working Group Secretary*
Steven B. Carlson, *Working Group Executive Secretary*
Valerie Maguire, *Working Group Treasurer*

Wael William Diab, *IEEE P802.3 (802.3bh) Task Force Chair and Chief Editor*
Valerie Maguire, *IEEE P802.3 (802.3bh) Task Force Recording Secretary and Clause Editor*
Peter Anslow, *IEEE P802.3 (802.3bh) Task Force Section Editor*
Marek Hajduczenia, *IEEE P802.3 (802.3bh) Task Force Section Editor*

Historical participants

The following individuals participated in the IEEE 802.3 working group during various stages of the standard's development. Since the initial publication, many IEEE standards have added functionality or provided updates to material included in this standard. Included is a historical list of participants who have dedicated their valuable time, energy, and knowledge to the creation of this material:

IEEE Std 802.3 document	Date approved by IEEE and ANSI	Officers at the time of working group ballot
IEEE Std 802.3-1985, Original 10 Mb/s standard, MAC, PLS, AUI, 10BASE5	23 June 1983 (IEEE) 31 December 1984 (ANSI)	Donald C. Loughry , <i>Working Group Chair</i>
IEEE Std 802.3a-1988 (Clause 10), 10 Mb/s MAU 10BASE2	15 November 1985 (IEEE) 28 December 1987 (ANSI)	Donald C. Loughry , <i>Working Group Chair</i> Alan Flatman , <i>Task Force Chair</i>
IEEE Std 802.3b-1985 (Clause 11), 10 Mb/s Broad-band MAU, 10BROAD36	19 September 1985 (IEEE) 28 February 1986 (ANSI)	Donald C. Loughry , <i>Working Group Chair</i> Menachem Abraham , <i>Task Force Chair</i>
IEEE Std 802.3c-1985 (9.1–9.8), 10 Mb/s Baseband Repeater	12 December 1985 (IEEE) 4 June 1986 (ANSI)	Donald C. Loughry , <i>Working Group Chair</i> Geoffrey O. Thompson , <i>Task Force Chair</i>
IEEE Std 802.3d-1987 (9.9), 10 Mb/s Fiber MAU, FOIRL	10 December 1987 (IEEE) 9 February 1989 (ANSI)	Donald C. Loughry , <i>Working Group Chair</i> Steven Moustakas , <i>Task Force Chair</i>
IEEE Std 802.3e-1987 (Clause 12), 1 Mb/s MAU and Hub 1BASE5	11 June 1987 (IEEE) 15 December 1987 (ANSI)	Donald C. Loughry , <i>Working Group Chair</i> Robert Galin , <i>Task Force Chair</i>
IEEE Std 802.3h-1990 (Clause 5), 10 Mb/s Layer Management, DTEs	28 September 1990 (IEEE) 11 March 1991 (ANSI)	Donald C. Loughry , <i>Working Group Chair</i> Andy J. Luque , <i>Task Force Chair</i>
IEEE Std 802.3i-1990 (Clauses 13 and 14), 10 Mb/s UTP MAU, 10 BASE-T	28 September 1990 (IEEE) 11 March 1991 (ANSI)	Donald C. Loughry , <i>Working Group Chair</i> Patricia Thaler , <i>Task Force Chair (initial)</i> Richard Anderson , <i>Task Force Chair (final)</i>

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IEEE Std 802.3j-1993 (Clauses 15–18), 10 Mb/s Fiber MAUs 10BASE-FP, 10BASE-FB, and 10BASE-FL	15 September 1993 (IEEE) 15 March 1994 (ANSI)	Patricia Thaler , <i>Working Group Chair</i> Keith Amundsen , <i>Task Force Chair (initial)</i> Frederick Scholl , <i>Task Force Chair (final)</i> Michael E. Lee , <i>Technical Editor</i>
IEEE Std 802.3k-1993 (Clause 19), 10 Mb/s Layer Management, Repeaters	17 September 1992 (IEEE) 8 March 1993 (ANSI)	Patricia Thaler , <i>Working Group Chair</i> Joseph S. Skorupa , <i>Task Force Chair</i> Geoffrey O. Thompson , <i>Vice Chair and Editor</i>
IEEE Std 802.3l-1992 (14.10), 10 Mb/s PICS Proforma 10BASE-T MAU	17 September 1992 (IEEE) 23 February 1993 (ANSI)	Patricia Thaler , <i>Working Group Chair</i> Mike Armstrong , <i>Task Force Chair and Editor</i> Paul Nikolich , <i>Vice Chair</i> William Randle , <i>Editorial Coordinator</i>
IEEE Std 802.3m-1995, Maintenance 2	21 September 1995 (IEEE) 16 July 1996 (ANSI)	Patricia Thaler , <i>Working Group Chair</i> Gary Robinson , <i>Maintenance Chair</i>
IEEE Std 802.3n-1995, Maintenance 3	21 September 1995 (IEEE) 4 April 1996 (ANSI)	Patricia Thaler , <i>Working Group Chair</i> Gary Robinson , <i>Maintenance Chair</i>
IEEE Std 802.3p-1993 (Clause 20), Management, 10 Mb/s Integrated MAUs	17 June 1993 (IEEE) 4 January 1994 (ANSI)	Patricia Thaler , <i>Working Group Chair</i> Joseph S. Skorupa , <i>Task Force Chair</i> Geoffrey O. Thompson , <i>Vice Chair and Editor</i>
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IEEE Std 802.3s-1995, Maintenance 4	21 September 1995 (IEEE) 8 April 1996 (ANSI)	Geoffrey O. Thompson , <i>Working Group Chair</i> Gary Robinson , <i>Maintenance Chair</i>
IEEE Std 802.3t-1995, 120 Ω informative annex to 10BASE-T	14 June 1995 (IEEE) 12 January 1996 (ANSI)	Geoffrey O. Thompson , <i>Working Group Chair</i> Jacques Christ , <i>Task Force Chair</i>
IEEE Std 802.3u-1995 (Clauses 21–30), Type 100BASE-T MAC param- eters, Physical Layer, MAUs, and Repeater for 100 Mb/s Operation	14 June 1995 (IEEE) 4 April 1996 (ANSI)	Geoffrey O. Thompson , <i>Working Group Chair</i> Peter Tarrant , <i>Task Force Chair (Phase 1)</i> Howard Frazier , <i>Task Force Chair (Phase 2)</i> Paul Sherer , <i>Task Force Editor-in-Chief (Phase 1)</i> Howard Johnson , <i>Task Force Editor-in-Chief (Phase 2)</i> Colin Mick , <i>Task Force Comment Editor</i>
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IEEE Std 802.3x-1997 and IEEE Std 802.3y-1997 (Revi- sions to IEEE Std 802.3, Clauses 31 and 32), Full- Duplex Operation and Type 100BASE-T2	20 March 1997 (IEEE) 5 September 1997 (ANSI)	Geoffrey O. Thompson , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Rich Seifert , <i>Task Force Chair and Editor (802.3x)</i> J. Scott Carter , <i>Task Force Chair (802.3y)</i> Colin Mick , <i>Task Force Editor (802.3y)</i>
IEEE Std 802.3z-1998 (Clauses 34–39, 41–42), Type 1000BASE-X MAC Param- eters, Physical Layer, Repeater, and Management Parameters for 1000 Mb/s Operation	25 June 1998 (IEEE)	Geoffrey O. Thompson , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Howard M. Frazier, Jr. , <i>Task Force Chair</i> Howard W. Johnson , <i>Task Force Editor</i>
IEEE Std 802.3aa-1998, Maintenance 5	25 June 1998 (IEEE)	Geoffrey O. Thompson , <i>Working Group Chair</i> Colin Mick , <i>Task Force Editor</i>

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IEEE Std 802.3ab-1999 (Clause 40), Physical Layer Parameters and Specifications for 1000 Mb/s Operation Over 4 Pair of Category 5 Balanced Copper Cabling, Type 1000BASE-T	26 June 1999 (IEEE)	Geoffrey O. Thompson , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Robert M. Grow , <i>Working Group Secretary</i> George Eisler , <i>Task Force Chair</i> Colin Mick , <i>Task Force Editor</i>
IEEE Std 802.3ac-1998, Frame Extensions for Virtual Bridged Local Area Network (VLAN) Tagging on IEEE 802.3 Networks	16 September 1998 (IEEE)	Geoffrey O. Thompson , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Andy J. Luque , <i>Working Group Secretary</i> Ian Crayford , <i>Task Force Chair</i> Rich Seifert , <i>Task Force Editor</i>
IEEE Std 802.3ad-2000 (Clause 43), Aggregation of Multiple Link Segments	30 March 2000 (IEEE)	Geoffrey O. Thompson , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Robert M. Grow , <i>Working Group Secretary</i> Steven Haddock , <i>Task Force Chair</i> Tony Jeffree , <i>Task Force Co-Editor</i> Rich Seifert , <i>Task Force Co-Editor</i>
IEEE Std 802.3-2002 (IEEE 802.3ag, Maintenance 6, Revision of the base), Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and Physical Layer specifications	14 January 2002 (IEEE)	Geoffrey O. Thompson , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Robert M. Grow , <i>Working Group Secretary</i>
IEEE Std 802.3ae-2002, (Clauses 44–53) Media Access Control (MAC) Parameters, Physical Layers, and Management Parameters for 10 Gb/s Operation	13 June 2002 (IEEE)	Geoffrey O. Thompson , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Robert M. Grow , <i>Working Group Secretary</i> R. Jonathan Thatcher , <i>Task Force Chair</i> Stephen Haddock , <i>Task Force Vice Chair</i> Bradley J. Booth , <i>Task Force Editor</i> Lacreshia Laningham , <i>Task Force Assistant Editor</i> Benjamin Brown , <i>Logic Track Chair</i> Walter Thirion , <i>Optical Track Chair</i>
IEEE Std 802.3af-2003, (Clause 33) Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)	12 June 2003 (IEEE)	Geoffrey O. Thompson , <i>Working Group Chair (Phase 1)</i> Robert M. Grow , <i>Working Group Chair (Phase 2)</i> David J. Law , <i>Working Group Vice Chair</i> Robert M. Grow , <i>Working Group Secretary (Phase 1)</i> Steven B. Carlson , <i>Working Group Secretary (Phase 2)</i> Steven B. Carlson , <i>Task Force Chair</i> Michael S. McCormack , <i>Task Force Editor (Phase 1)</i> John J. Jetzt , <i>Task Force Editor (Phase 2)</i> Chad M. Jones , <i>Task Force Comment Editor</i>
IEEE Std 802.3ah-2004, Media Access Control Parameters, Physical Layers, and Management Parameters for Subscriber Access Networks	6 April 2005 (IEEE)	Robert M. Grow , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Steven B. Carlson , <i>Working Group Secretary</i> Howard Frazier , <i>Task Force Chair</i> Wael W. Diab , <i>Task Force Editor-in-Chief</i> Hugh Barrass , <i>Task Force Vice-Chair</i> Scott Simon , <i>Task Force Recording Secretary</i> Behrooz Rezvani , <i>Task Force Executive Secretary</i>
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IEEE Std 802.3ak-2004, Physical Layer and Management Parameters for 10Gb/s Operation, Type 10GBASE-CX4	9 February 2004 (IEEE)	Robert M. Grow , <i>Working Group Chair</i> David J. Law , <i>Working Group Vice Chair</i> Steven B. Carlson , <i>Working Group Secretary</i> Daniel J. Dove , <i>Task Force Chair</i> Howard A. Baumer , <i>Task Force Editor</i>

IEEE Std 802.3 document	Date approved by IEEE and ANSI	Officers at the time of working group ballot
IEEE Std 802.3-2005 (IEEE 802.3REVam, Revision of the base). Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and Physical Layer specifications	9 June 2005 (IEEE)	Robert M. Grow , Working Group Chair David J. Law , Working Group Vice Chair Wael W. Diab , Secretary Steven B. Carlson , Working Group Executive Secretary Piers Dawe , Review Editor
IEEE Std 802.3an-2006, Physical Layer and Management Parameter for 10 Gb/s Operation, Type 10GBASE-T	8 June 2006 (IEEE)	Robert M. Grow , Working Group Chair David J. Law , Working Group Vice Chair Wael William Diab , Working Group Secretary Steven B. Carlson , Working Group Executive Secretary Bradley Booth , Task Force Chair Sanjay Kasturia , Task Force Editor-in-Chief George Eisler , Task Force Recording Secretary
IEEE Std 802.3ap-2007, Ethernet Operation over Electrical Backplanes	22 March 2007 (IEEE)	Robert M. Grow , Working Group Chair David J. Law , Working Group Vice-Chair Wael W. Diab , Working Group Secretary Steven B. Carlson , Working Group Executive Secretary Bradley Booth , Working Group Treasurer Adam Healey , Task Force Chair John D'Ambrosia , Task Force Secretary Schelto vanDoorn , Task Force Editor-in-Chief (Phase 1) Ilango S. Ganga , Task Force Editor-in-Chief (Phase 2)
IEEE Std 802.3aq-2006, Physical Layer and Management Parameters for 10 Gb/s Operation, Type 10GBASE-LRM	15 September 2006 (IEEE)	Robert M. Grow , Working Group Chair David J. Law , Working Group Vice Chair Wael William Diab , Working Group Secretary Steven B. Carlson , Working Group Executive Secretary David G. Cunningham , Task Force Chair Nick Weiner , Task Force Editor Piers Dawe , Task Force Contributing Editor
IEEE Std 802.3as-2006, Frame format extensions	15 September 2006 (IEEE)	Robert M. Grow , Working Group Chair David J. Law , Working Group Vice Chair Wael William Diab , Working Group Secretary Steven B. Carlson , Working Group Executive Secretary Kevin Q. Daines , Task Force Chair Glenn W. Parsons , Task Force Editor
IEEE Std 802.3-2005/Cor 1-2006 (IEEE 802.3au), DTE Power via MDI Isolation corrigendum	8 June 2006 (IEEE)	Robert M. Grow , Working Group Chair David J. Law , Working Group Vice Chair, Task Force Editor Wael W. Diab , Working Group Secretary Steven B. Carlson , Working Group Executive Secretary
IEEE Std 802.3-2005/Cor 2-2007 (IEEE 802.3aw), 10GBASE-T corrigendum	7 June 2007 (IEEE)	Robert M. Grow , Working Group Chair David J. Law , Working Group Vice Chair, Task Force Editor Wael W. Diab , Working Group Secretary Steven B. Carlson , Working Group Executive Secretary Bradley Booth , Working Group Treasurer
IEEE Std 802.3-2008 (IEEE 802.3ay), Maintenance #9 (Revision of the base), Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and Physical Layer specifications	26 September 2008 (IEEE)	Robert M. Grow , Working Group Chair David J. Law , Working Group Vice Chair, Task Force Editor Wael William Diab , Working Group Secretary Steven B. Carlson , Working Group Executive Secretary Bradley Booth , Working Group Treasurer
IEEE Std 802.3at-2009 Data Terminal Equipment (DTE) Power via the Media Dependent Interface (MDI) Enhancements	11 September 2009 (IEEE)	David J. Law , Working Group Chair Wael William Diab , Working Group Vice Chair Adam Healey , Working Group Secretary Steven B. Carlson , Working Group Executive Secretary Bradley Booth , Working Group Treasurer Mike McCormack , Task Force Chair D. Matthew Landry , Task Force Chief Editor Chad Jones , Task Force Comment Editor

IEEE Std 802.3 document	Date approved by IEEE and ANSI	Officers at the time of working group ballot
IEEE Std 802.3av-2009 Physical Layer Specifications and Management Parameters for 10 Gb/s Passive Optical Networks	11 September 2009 (IEEE)	David J. Law , <i>Working Group Chair</i> Wael William Diab , <i>Working Group Vice Chair</i> Adam Healey , <i>Working Group Secretary</i> Steven B. Carlson , <i>Working Group Executive Secretary</i> Bradley Booth , <i>Working Group Treasurer</i> Glen Kramer , <i>Task Force Chair</i> Duane Remein , <i>Task Force Chief Editor</i> Marek Hajduczenia , <i>Task Force Assistant Editor</i>
IEEE Std 802.3az-2010 Media Access Control Parameters, Physical Layers, and Management Parameters for Energy-Efficient Ethernet	30 September 2010 (IEEE)	David J. Law , <i>Working Group Chair</i> Wael William Diab , <i>Working Group Vice Chair</i> Steven B. Carlson , <i>Working Group Executive Secretary</i> Adam Healey , <i>Working Group Secretary</i> Bradley Booth , <i>Working Group Treasurer</i> Michael Bennett , <i>Task Force Chair</i> Sanjay Kasturia , <i>Task Force Editor-in-Chief</i>
IEEE Std 802.3ba Media Access Control Parameters, Physical Layers, and Management Parameters for 40 Gb/s and 100 Gb/s Operation	17 June 2010 (IEEE)	David J. Law , <i>Working Group Chair</i> Wael William Diab , <i>Working Group Vice-Chair</i> Steven B. Carlson , <i>Working Group Executive Secretary</i> Adam Healey , <i>Working Group Secretary</i> Bradley Booth , <i>Working Group Treasurer</i> John D'Ambrosia , <i>Task Force Chair</i> Ilango S. Ganga , <i>Task Force Editor-in-Chief</i>
IEEE Std 802.3-2008/Cor 1-2009 (IEEE 802.3bb) Pause Reaction Delay Corrigendum.	9 December 2009 (IEEE)	David J. Law , <i>Working Group Chair</i> Wael William Diab , <i>Working Group Vice-Chair</i> Steven B. Carlson , <i>Working Group Executive Secretary</i> Adam Healey , <i>Working Group Secretary</i> Bradley Booth , <i>Working Group Treasurer</i>
IEEE Std 802.3bc-2009 Ethernet Organizationally Specific Type, Length, Value (TLVs)	11 September 2009 (IEEE)	David J. Law , <i>Working Group Chair and Task Force Editor</i> Wael W. Diab , <i>Working Group Vice Chair, Task Force Chair</i> Steven B. Carlson , <i>Working Group Executive Secretary</i> Adam Healey , <i>Working Group Secretary</i> Bradley Booth , <i>Working Group Treasurer</i>
IEEE Std 802.3bd-2011 MAC Control Frame for Priority-based Flow Control	16 June 2011 (IEEE)	Tony Jeffree , <i>IEEE 802.1 Working Group Chair</i> Paul Congdon , <i>IEEE 802.1 Working Group Vice Chair</i> David J. Law , <i>IEEE 802.3 Working Group Chair</i> Wael W. Diab , <i>IEEE 802.3 Working Group Vice Chair</i> Pat Thaler , <i>Data Center Bridging Task Group Chair</i>
IEEE Std 802.3bf-2011 Media Access Control (MAC) Service Interface and Management Parameters to Support Time Synchronization Protocols	16 May 2011 (IEEE)	David J. Law , <i>Working Group Chair</i> Wael William Diab , <i>Working Group Vice-Chair</i> Adam Healey , <i>Working Group Secretary</i> Steven B. Carlson , <i>Working Group Executive Secretary</i> Valerie Maguire , <i>Working Group Treasurer</i> Steven B. Carlson , <i>Task Force Chair</i> Marek Hajduczenia , <i>Task Force Editor-in-Chief</i>
IEEE Std 802.3bg-2011 Physical Layer and Management Parameters for Serial 40 Gb/s Ethernet Operation Over Single-Mode Fiber	31 March 2011 (IEEE)	David J. Law , <i>Working Group Chair</i> Wael William Diab , <i>Working Group Vice-Chair</i> Adam Healey , <i>Working Group Secretary</i> Steven B. Carlson , <i>Working Group Executive Secretary</i> Valerie Maguire , <i>Working Group Treasurer</i> Mark Nowell , <i>Task Force Chair</i> Pete Anslow , <i>Task Force Editor-in-Chief</i>