American National Standard

ANSI INCITS 263-1995 (S2010)
(formerly INCITS 263-1995 (R2005))

American National Standard for Information Technology — Fibre Distributed Data Interface (FDDI) — Token Ring Twisted Pair Physical Layer Medium Dependent (TP-PMD)

Developed by



Where IT all begins



PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

Adopted by INCITS (InterNational Committee for Information Technology Standards) as an American National Standard.

Date of ANSI Approval: 7/7/2010

Published by American National Standards Institute,
25 West 43rd Street, New York, New York 10036

Copyright 2010 by Information Technology Industry Council
(ITI). All rights reserved.

These materials are subject to copyright claims of International Standardization Organization (ISO), International Electrotechnical Commission (IEC), American National Standards Institute (ANSI), and Information Technology Industry Council (ITI). Not for resale. No part of this publication may be reproduced in any form, including an electronic retrieval system, without the prior written permission of ITI. All requests pertaining to this standard should be submitted to ITI, 1250 Eye Street NW, Washington, DC 20005.
Printed in the United States of America

© ITIC 2010 – All rights reserved

Contents

Page

Foreword iii

1 Scope 1

2 Normative references 2

3 Definitions 3

4 Conventions and abbreviations 5

4.1 Conventions 5
4.2 Abbreviations 6

5 General description 7

5.1 Ring overview 7
5.2 Environment 9

6 Services 11

6.1 TP-PMD-to-PHY services 11
6.2 TP-PMD-to-SMT services 14

7 Media independent operations 16

7.1 Transmit function 17
7.2 Receive function 20

8 Media interface connector specifications 23

8.1 Media interface connectors 24
8.2 Testing recommendations 27
8.3 Station labeling 27
8.4 Isolation requirements 27

9 Media signal interface 28

9.1 Active Output Interface 28
9.2 Active Input Interface specifications 31

10 Interface signals 33

10.1 Receiver 33
10.2 Transmitter 36

11 Cable plant interface specification 36

11.1 Cable plant specification 36
11.2 Crossover function 38
11.3 Connectors, cords, and cross-connect equipment 38

Tables

1 UTP-MIC contact assignments 24

2 STP-MIC contact assignments 26

3 Twisted Pair Active Output Interface characteristics 31

4 Signal_Detect summary 35

Figures

1 FDDI links and connections 7

Page

2 FDDI topology example 8

3 FDDI representative distribution environment example 10

4 Dual attachment TP-PMD services....12

5 TP-PMD functions 16

6 Encoder state diagram....19

7 Decoder state diagram....21

8 Example of a UTP-MIC receptacle 24

9 Example of a UTP-MIC plug....25

10 Example of a STP-MIC receptacle 26

11 Example of a STP-MIC plug....26

12 Active output interface overshoot....29

13 Inductance measurement technique....30

14 Active output interface duty cycle distortion....31

15 Differential input signals 32

16 Common mode rejection....33

17 Signal_Detect assertion threshold....34

18 Signal_Detect threshold and timing....35

19 Mask of permitted cable plant reference insertion loss and reference crosstalk attenuation 37

Annexes

A Test procedures 39

B Electrical interface considerations....48

C Example of system jitter allocation....50

D Labeling considerations....52

E Alternative cable plant usage....54

F Impedance and insertion loss deviation....55

G Stream cipher scrambling function 56

H Equipment cabling in a structured cabling context 64

I Common mode cable termination....65

J Twisted Pair Active Output Interface template 67

K Bibliography 68

Foreword (This foreword is not part of American National Standard X3.263-1995.)

The Fibre Distributed Data Interface (FDDI) is intended for use in a high-performance general purpose multi-station network and is designed for efficient operation with a peak data rate of 100 Mbit/s. It uses a Token Ring architecture with optical fibre as the primary transmission medium. FDDI provides for hundreds of stations operating over an extent of tens of kilometers.

The FDDI Token ring twisted pair physical layer medium dependent (TP-PMD) standard specifies the lower sublayer of the Physical Layer for FDDI for operation on twisted pair cables. As such it specifies the power levels and characteristics of the transmitter and receiver, and the interface signal requirements including jitter. TP-PMD also specifies the connector details, the requirements of conforming FDDI cable plants, and the permissible bit error rates. TP-PMD is designed to operate with one twisted pair in each direction.

TP-PMD is one of a set of American National Standard alternative PMDs being developed, or already developed, for FDDI. This set includes the original PMD for multimode fibre, the Single Mode Fibre PMD (SMF-PMD), and the Low Cost Fibre PMD (LCF-PMD).

The set of FDDI standards, when completed, will include the following standards:

a) A FDDI PART: Token ring physical layer protocol (PHY), which specifies the upper sublayer of the physical layer for the FDDI, including the data encode/decode, framing and clocking, as well as the elasticity buffer, smoothing, and repeat filter functions;

b) A FDDI PART: Token ring media access control (MAC),which specifies the lower sublayer of the data link layer for FDDI, including the access to the medium, addressing, data checking, and data framing;

c) A FDDI PART: Token ring station management (SMT), which specifies the local portion of the system management application process for FDDI, including the control required for proper operation of a station in an FDDI ring.

American National Standards for FDDI MAC (ANSI X3.139-1987), FDDI PHY (ANSI X3.148-1988), and FDDI PMD (ANSI X3.166-1990) have been approved and published. In addition, FDDI standards are being processed as International Standards by standards committee ISO/IEC JTC 1/SC 25. International standards for FDDI PHY, FDDI MAC, and FDDI PMD (ISO 9314-1:1989, 9314-2:1989 and ISO/IEC 9314-3:1990, respectively) have also been published.

An extension to the basic FDDI is now in the X3 approval process. The standard FDDI HRC, commonly known as FDDI-II, will extend the capability of FDDI to handle isochronous data streams at a multiplicity of data rates.

A standard for an enhancement to MAC is in process. This standard will be referred to as FDDI MAC-2 when it is necessary to distinguish it from the approved FDDI MAC standard ANSI X3.139-1988. Changes to be considered for this update of the FDDI MAC standard include those identified in footnotes in the published standard on MAC as areas that the standards

committee intended to change as well as changes that may be required for any proposed extensions to FDDI, such as FDDI-II or MAC Bridging. A similar enhancement project is in process for the FDDI PHY standard. This standard will be referred to as FDDI PHY-2.

The text and format of this FDDI TP-PMD standard is based upon the International FDDI PMD standard ISO/IEC 9314-3. As a consequence, certain conventions, references, spelling, and units commonly used in International Standards have been used in this standard. These are different from those normally used in American National Standards, but are not expected to cause difficulty in understanding or use.

This standard contains 11 annexes. Annex A is normative and is considered part of this standard. Annexes B–K are for information only.

Requests for interpretation, suggestions for improvement or addenda, or defect reports are welcome. They should be sent to the ITI, 1250 Eye Street, NW, Washington, DC 20005.

This standard was processed and approved for submittal to ANSI by the Accredited Standards Committee on Information Technology, X3. Committee approval of this standard does not necessarily imply that all committee members voted for its approval. At the time it approved this standard, the X3 Committee had the following members:

James D. Converse, Chair
Donald C. Loughry, Vice-Chair
Joanne Flanagan, Secretary

Organization Represented	*Name of Representative*
American Nuclear Society	Geraldine C. Main
	Sally Hartzell (Alt.)
AMP, Inc.	Edward Kelly
	Charles Brill (Alt.)
Apple Computer, Inc.	David K. Michael
AT&T Global Information Systems	Robert K. Kramer
	Thomas F. Frost (Alt.)
Bull HN Information Systems, Inc.	William M. George, Jr.
Compaq Computers	Mitesh Patel
Digital Equipment Corporation	Scott K. Jameson
	Richard Hovey (Alt.)
Eastman Kodak Company	James D. Converse
	Michael Nier (Alt.)
Hewlett-Packard	Donald C. Loughry
	Karen Higgenbottom (Alt.)
Hitachi America, Ltd.	John Neumann
	Kei Yamashita (Alt.)
Hughes Aircraft Company	Harold Zebrack
IBM Corporation	Joel Urman
	Mary Anne Lawler (Alt.)
Institute for Certification of Computer Professionals (ICCP)	Kenneth Zemrowski
National Communications Systems	Dennis Bodson
	Granger Kelley (Alt.)
National Institute of Standards and Technology	Michael D. Hogan
	James H. Burrows (Alt.)
Neville & Associates	Carlton Neville
Northern Telecom, Inc.	Mel Woinsky
	John Pugh (Alt.)
Recognition Technology Users Association	Herbert P. Schantz
	Gerald Farmer (Alt.)
Share, Inc.	Gary Ainsworth
	David Thewlis (Alt.)

Organization Represented	*Name of Representative*
Sony Corporation	Michael Deese
Storage Technology Corporation	Joseph S. Zajaczkowski
	Samuel D. Cheatham (Alt.)
Sun Microsystems, Inc.	Gary S. Robinson
Sybase, Inc.	Donald R. Deutsch
Texas Instruments, Inc.	Clyde Camp
	Fritz Whittington (Alt.)
3M Company	Eddie T. Morioka
	Paul D. Jahnke (Alt.)
Unisys Corporation	John L. Hill
	Stephen P. Oksala (Alt.)
U.S. Department of Defense	Jerry L. Smith
	C. J. Pasquariello (Alt.)
U.S. Department of Energy	Carol S. Blackston
	Bruce R. White (Alt.)
Xerox Corporation	Roy Pierce
	William Ted Smith (Alt.)

Subcommittee X3T9 on Computer Input/Output Interfaces, which reviewed and approved this standard, had the following members:

Delbert L. Shoemaker, Chair
Robert L. Fink, Vice-Chair

Charles Brill
William Burr
Jefferson Connell
Stephen Cooper
Roger Cummings
James Hamstra
David Husak
Reinhard Knerr
Lawrence Lamers
Robert Masterson
George Michael
Arthur Miller
Gene Milligan
Doug Morrissey
Steven Myers
Kevin Pokorney
Everett Rigsbee
Floyd Ross
Amit Shah
Tad Szostak
Pat Thaler
Don Tolmie
Schelto van Doorn
Jim Vogt
Carl Zeitler

Task Group X3T9.5, which developed this standard, and Subcommittee X3T12, that assumed this standard, had the following members:

Gene Milligan, Chair
Floyd Ross, Vice-Chair

Rajeev Agarwal
Bernhard Albert
Paul Anderson
Richard M. Bailly
Charles Brill
Jack Brown
William Burr
Luca Cafiero
William Calvert
Ramiro Calvo
Brian Cashman
Steve Chen
Steve Cooper
William J. Cronin, Jr.
Al Feaster
Bob Fink
Sian Gates
Martin Gibson
Simon Ginzburg
Joe Golio
Michael Griffin
Robert Grow
R.C. Halgren
Jim Hamstra
Virginia Haydu
Carl Hayssen
James Jones
Bryan Kim
Reinhard Knerr
Michael Jay Leib
Robert Masterson
Gene Milligan
Scott Mindemann
James Miura
James Morris
Kirk Moulton
Liam Quinn
James Reeves
Everett O. Rigsbee III
Floyd Ross
Thomas Ruf
Herb Schneider
Michael Shoemake
Ramesh Sivakolunda
Carl Staab
Don Staddon
Pat Thaler
Geoff Thompson
David Thorne
James Torgerson
Koichi Tsuno
Ryan Tze
Schelto van Doorn
Jeffrey Warren
Keith Willete
Mark Wood

The TP-PMD Ad hoc Working Group of X3T9.5, which developed this standard, had the following members:

Luc Adriaenssens
Bejan Afsharpour
Rajeev Agarwal
Sal Ahmad
Claude Allard
Gordon Allen
Paul Aloisi
Basil Alwan
Paul Anderson
K. Annamalai
Jacques Anthonioz
David Archibald
Ashby Armistead
Ray Assayesh
Cecil Aswell
Dan Ater
Reynette Au
Chris Baldwin
Tom Banwell
Stephen Barilovits
Trudy Barker
Dan Beavers
Bob Bellino
William Benson
John Berlin
Jeffrey Berk
Larry Birenbaum
Robert Blake
Mitch Bloom
David Boniella
Paul Booth
Terry Boston
Jeff Bottman
Sam Bourche
Sidney Bouzagle
John Boyle
Doug Brenneke
David Brief
Charles Brill
Kirk Brinkworth
Jack Brown
Jeff Brown
Phillip Brownlee
Dutt V. Bulusu
Bill Burr
Steve Buska
Robert A. Busse
Luca Cafiero
Paul Callahan
William L. Calvert
Ramiro Calvo
Robert R. Campbell
Andrew Campling
Sean Cardosa
Rob Carl
Jim Carlo
Richard Carlson
Rick Carrell
Ilan Carmi
Brian S. Cashman
Rami Caspi
Keith Caves
Nick Celenza
V. Chalam
Philip Chan
Prem G. Chandran
Paul Chang
Giovanni Cherubini
Ray Chock
Kevin Clark
Bill Clark
Chris A. Clufo
Steve Cohen
Patrick Conlon
Michael Connaughton
D.A. "Bo" Conrad
Keith Conroy
Robert Conte
John Cook
Steve Cooper
Dave Copeland
John Costello
Paul Cowell
Billy Cox
Simon A. Cox
Vick Cox
Earl Crandall
John Crandell
Ron Crane
Guy Crauwels
Edward C. Cronin
William J. Cronin, Jr.
Felix Cross
Ed Cuellar
Alan Cunningham
David Cunningham
Nabil G. Damouny
Charles Daniels
Tony Daquino
John J. DeAndrea
Tom Debiec
Bruce De Bree
Joe Dellagala
Jeff Dena
Tazio M. DeNicolo
W. Keith Denning
Dave Depuy
Sanjay Dhawan
Thomas Dineen
Rhonda Dirvin
Alex Djenguerian
Hugh Doherty
Gary Dorsey
Daniel Dove
Steve Dreyer
Eric Drucker
Diana Dunbar
Patricia Dwyer
George Economou
Tom Edsal
George Eisler
Demetri Elias
Steve Ellsworth
Jim Everitt
Marc Facchini
Suzanne C.M. Falksen
Dennis C. Farley
Al Feaster
Severn Ferdun
Tony Fernandes
Juan E. Figueroa
Robert L. Fink
Ed Fiore
Avraham Fischer
David Fischer
Laura Fleming
Hank Foglia
Kevin Fong
Harry Forbes
Howard M. Frazier, Jr.
Staffan Fredricsson
Atsuhisa Fukuoka
Tak Fukuoka
Jim Fugere
Masami Furukori
Richard A. Gajewski
Bob Galazka
Tom Gandy
Alan D. Gant
Buck Gee
Danny George
Eugen Gershon
Charlie Ghahremani
Mark Gibbons
Martin Gibson
Brian Gillings
Simon Ginzburg
Duncan Glendinning
Joe Golio
Paramesh Gopi
Martin Graham
Tom Grasmehr
Patrick Green
Michael Griffin
Brian Griggs
Fred Grover
Robert Grow
Jack Guedj
Mark Guinther
Rade Gvozdanovic
Ronald S. Gyurcsik
Lee C. Haas
Randy Haberman
Stephen Haddock
Bruce K. Haddon
Will Hahn
Ron Ham
Larry Haley
Ross Halgren
Yuji Hamasaki
Jim Hamstra
Del Hanson
Lloyd Hasley
A.T. Hassani-Azad
David Hatch
Virginia Haydu
Dan Hayes
Trent Hayes
Carl G. Hayssen
Mike Helles
Hendrik Helnes
Bruce Hewitt

Robert C. Herron
David Hess
Gary Hildebrand
Henry Hinrichs
Koichi Hiramatsu
Steve Hodapp
Charles R Hoffman
Simon Honey
Gi-Hong
Mark Hoover
Toshihiko Horima
Andy J. Howard
Jacob Hsu
Gang Huang
John C. Huber
Steve Hunt
Walter Hurwitz
David Husak
Carol Hutchinson
Naoya Ikeda
Tony Imburgia
Carol Jens
Ernie Jensen
Gungho Jeong
Yantao Jia
James R. Johns
Howard W. Johnson
Ray Johnson
Scott Johnson
Jim Jones
Mark Jones
Joop Joosten
Jay Kadambi
Hyun Kook Kahng
Michael Kaplit
Allen Kasey
Steve Kaufman
John Kelly
Dan Kennefick
Azita Kia
Michael Kieli
Gray Kinnie
Moti Kintzlinger
Paul Kish
Jason Knickerbocker
Kenneth Koch
Ning Kong
Thomas Korn
Mitsuhiro Kotani
Piyush Kothary
Richard Krebs
Steven R. Kubes
Jim Kubinec
Beugt Kuist
Alex Kukielka
John Kwan
Lawrence J. Lang
Kenneth Lau
Eric Lawrence
Victor B. Lawrence
Michael Kip Lebar
Howard Lee
Jack Lee
Joseph Lee
Michael J. Leib
Richard Lewis
Sung-Min Lim
Brad Lincoln
Henry Line
Wen-Pai Lu
Anna Lutz
Bruce MacAloney
Stuart Maceachern
Ron Mackey
Bob Maddex
Terry Maezawa
Olle Magnusson
Frank Mara
Joe Margevicius
Thomas Marks
David Mathieson
Jeff Martin
Ian A. Masson
Michael L. Masucci
Bo Matthys
Mario Mazzola
Kelly McClellan
Bruce McClure
Andy McDonald
David McFadden
Mukesh Mehta
David Mendenhall
Dave Michael
John Middleton
Scott Miles
Art Miller
Scott Mindemann
George Mityko
Akira J. Miura
Fanny Mlinarsky
Rudolph A. Montgeias
Steve Monti
Patricia Moore
Paul B. Moore
Shimon Muller
Carrie Munson
Michael C. Muma
Satoru Nagata
Arthur Nehr
Rod Nelson
Carolyn Nguyen
Phu (Frederick) Nguyen
Tim Nicholson
Paul Nikolich
Thinh Niguyenpho
Hiroaki Nishimoto
Lars Norman
Robert E. Norton
Masahiro Nomura
Kevin O'Brien
Sedat Olcer
Bob O'Hara
Keith Onodera
Deane Osborne
Tetsuo Oura
Craig Owens
Charles Palanzo
Roger Pandanda
Dave Parker
Karen Parker
Masood Parvaresh
Ron Pashby
Jerry Pate
Arun B. Patel
Bhavesh Patel
Anthony Peck
David Pearce
Eric Peterson
Greg Pfeiffer
Roger Pfister
Doug Piper
Gary Polhemus
Gideon Prat
Jon Price
George Prodan
Graeme Proudler
John Pryma
Jim Quilici
Terri Quinn
G. Ramakrishnan
Brian Ramsey
Bill Randle
Dave Rasmussen
David Rawlings
Karen Rayburn
Pat Reardon
Steve Reed
James Reeves
Dennis Rehm
Mark Riehm
E.O. Rigsbee
J.R. Rivers
Sam Rizk
Jean Marc Roberge
Dave Roberts
Chuck Roedel
Mats Roman
Floyd Ross
Thomas Ruf
Juan Salas
F. Williams Sarles
Gershon Schatzberg
Darrell Scherbarth
Herb Schneider
Frederick Scholl
Baker Scott
Craig Scott
Paul Scott
Tony Seaman
Stephen Sedio
Amit Shah
Shahab Shahbae
Shahab Shahbaz
George Shilling
Dror Shindelmar
Rachiv Shlomo
Rami Shmueli
Michael Shoemake
Del Shoemaker
Ned Sigmon
Ramesh Sivakolundu
Tom Slykhouse
Bob Smith
Douglas C. Smith
Gary Smith
Andy Smonk
Jerry Somer
Walter Sotelo
Bob Southard
Ben Speiser
Michael Spratt
Don Staddon
John Staats
Paul Standish

Tracy Steelhammer
Chuck Stoup
Mike Strang
Yoshihisa Suda
Ed Sullivan
Steve Suzuki
Henry Takahashi
David Talaski
Nanette Talaski
Kenny Tam
Nina Taneja
Kenzaburo Tanemura
Peter Tarrant
Mark Taylor
Ronald Tessier
Pat Thaler
Walter Thirion
Geoff Thompson
David Thorne
James Torgerson
Andre Tracol
John Trites
Alan Truman
Howard S. Tsai
David Tsao
Koichi (Kent) Tsuno
Jayshree Ullal
Jim Umphrey
G Ungerboeck
Bhooshan Urva
Todd Vafiades
Jeanine Valadez
Ed van Adelung
Dono Van-Mierop
Jim Vogt
Paul Volk
Chuck Waite
Nate Walker
Peter Walsh
Harvey Waltersdorf
Yun-Che Wang
Peter Walsh
Jeff Warren
Jerry Wasinger
Akira Watanabf
Alan J. Weissberger
Joe Wenker
J.J. Werner
Rob Wessols
Dean Westman
Peter Williams
John S. Williamson, III
J.M. Wincn
Michael Wentz
Mark Wolter
David Wong
James Wong
Mark Wood
Lynn Woods
Charles Yager
Gene Yao
Yukio Yokoyama
Nariman Yousefi
Hiroyoshi Yuasa
Robert J. Zecha
Jamie Zartman
Arie Zimmerman
Glen Zoerner

American National Standard
for Information Technology –

Fibre Distributed Data Interface (FDDI) – Token Ring Twisted Pair Physical Layer Medium Dependent (TP-PMD)

1 Scope

This standard specifies Twisted Pair Physical Layer Medium Dependent (TP-PMD) requirements for the Fibre Distributed Data Interface (FDDI).

FDDI provides a high-bandwidth (100 Mbit/s), general-purpose interconnection among computers and peripheral equipment using fibre optics and twisted pair as the transmission media. FDDI can be configured to support a sustained data transfer rate of at least 80 Mbit/s (10 Mbyte/s). FDDI provides connectivity for many nodes distributed over distances of several kilometers in extent. Default values for FDDI are calculated on the basis of 1 000 physical links and a total fibre path length of 200 km (typically corresponding to 500 nodes and 100 km of dual fibre cable).

FDDI consists of:

a) a Physical Layer (PL), which is divided into two sublayers:

1) A Physical Layer, Medium Dependent (PMD) sublayer (ISO/IEC 9314-3), with several alternative medium choices, which provides the digital baseband point-to-point communication between nodes in the FDDI network. The PMD provides all services necessary to transport a suitably coded digital bit stream from node to node. The PMD defines and characterizes the medium drivers and receivers, medium-dependent code requirements, cables, connectors, power budgets, optical bypass provisions, and physical-hardware-related characteristics. It specifies the point of interconnectability for conforming FDDI attachments.

The original PMD standard (ISO/IEC 9314-3), called PMD, defines attachment to multi-mode fibre up to 2 km, while this TP-PMD defines low-cost attachments to twisted pair up to 100 m. Additional PMD sublayer standards are being developed for attachment to single mode fibre (SMF-PMD), and multi-mode fibre up to 500 m (LCF-PMD);

2) A Physical Layer Protocol (PHY) sublayer (ISO/IEC 9314-1), and its enhancement, (PHY-2), which provides connection between the PMD and the Data Link Layer. PHY establishes clock synchronization with the upstream code-bit data stream and decodes this incoming code-bit stream into an equivalent symbol stream for use by the higher layers. PHY provides encoding and decoding between data and control indicator symbols and code bits, medium conditioning and initializing, the synchronization of incoming and outgoing code-bit clocks, and the delineation of octet boundaries as required for the transmission of information to or from higher layers. Information to be transmitted on the medium is encoded by the PHY using a group transmission code;

b) a Data Link Layer (DLL), which is divided into two or more sublayers:

1) An optional Hybrid Ring Control (HRC) (ISO/IEC 9314-5), which provides multiplexing of packet and circuit switched data on the shared FDDI medium. HRC comprises two internal components, a Hybrid Multiplexer (H-MUX) and an Isochronous MAC (I-MAC). H-MUX maintains a synchronous 125 µs cycle structure and multiplexes the packet and circuit switched data streams, and I-MAC provides access to circuit switched channels;