

Category 6 Cabling:

A Standards and Systems Overview

Published by the Category 6 Consortium



Telecommunications Industry Association

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About the Category 6 Initiative

The following white paper was produced by participants of the Category 6 Consortium. This consortium — focused on category 6 cabling systems — has assisted in development of generic standards primarily for balanced twisted-pair cabling systems. These standards cover balanced twisted-pair cable and associated connecting hardware specifications, including test procedures, performance requirements and test instrument requirements. In development of these standards, theoretical models and controlled experimentation were used to validate link and channel specifications via component requirements.

On June 20, 2002 TIA published the category 6 addition to the TIA-568 standard, which has the official document number of ANSI/TIA/EIA-568-B.2-1. The Category 6 Consortium has been formed to promote the adoption of category 6. To begin this initiative, the Category 6 Consortium is releasing this white paper to provide industry participants with an update on category 6 cabling and applications standards, as well as additional references for finding category 6 information and products. It is important to note that any opinions expressed in this document are those of the participants of the Category 6 Consortium and are not necessarily those of the entire TIA membership.

For more information about category 6, please visit the TIA Web site at <http://www.tiaonline.org>, or contact Andy Dryden at (703) 907-7633.



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Introduction

Structured cabling has grown globally into a \$4 billion market and is expected to continue growing at about a 4 percent compound annual growth rate, according to leading independent analysts*. Category 6 cabling is the latest addition to the structured cabling standards and has twice the bandwidth of category 5e cabling. This improved bandwidth, together with vastly improved immunity from external noise, provides the potential for category 6 to support multi-gigabit applications. This white paper provides an update on category 6 cabling and applications standards together with references for finding category 6 information and products.

Topics highlighted include:

- Background for ANSI/TIA/EIA-568-B.2-1
- Quick comparison of category 5, 5e and 6 standards requirements
- Key features of the category 6 standard
- Review of standards applicable to category 6
- Category 6 market penetration
- TIA press release on category 6 standard
- References for category 6 information
- Category 6 Consortium participant URLs for product information

ANSI/TIA/EIA-568-B.2-1 published on June 20, 2002

The TIA TR-42.7 Copper Cabling Systems Committee unanimously approved the publication of the category 6 standard on June 5, 2002, and it was published on June 20. This represents the consensus of 46 telecommunications cabling manufacturers, consultants and users who submitted ballot comments during the industry ballot, as well as several others who regularly participate in the committee. The document contains category 6 end-to-end cabling specifications, component specifications, field tester requirements and measurement procedures, together with accuracy and reproducibility guidelines that ensure a reliable cabling system. The standard satisfies all the original objectives established by TR-42.1 (formerly TR-41.8.1) at the outset of the PN-3727 project including:

- Backward compatibility to categories 5e, 5 and 3
- Open standard that allows products from different vendors to work together
- Patch cord plug and jack interoperability for modular (RJ-45 type) connections
- Full system specification including testing of components, patch cords, channels and permanent links
- Twice the bandwidth of category 5e with positive Power Sum Attenuation to Cross-Talk Ratio (PSACR) up to 200 MHz
- All specifications for components and cabling are tested to 250 MHz

*CIM Volume 10 Issue 5, May 2002, Market Trends by BSRIA



The TIA press release following this white paper contains additional information on the publication of ANSI/TIA-568-B.2-1. Also attached is a list of manufacturers that contributed to early Category 6 Consortium discussions and offer category 6 cabling systems, category 6 components, field testers or other services to support category 6.

A Quick Comparison of Category 5, 5e and 6 Standards Requirements

As of 6/18/2002	TIA Cat 5 TIA-568-A Oct-95 (Obsolete)	TIA Cat 5e TIA-568-B Final May-01	TIA Cat 6 TIA-568-B.2-1 Final Jun-02
Maximum Test Frequency	100 MHz	100 MHz	250 MHz
Values @ 100 MHz:			
Insertion Loss* (The lower the number, the better solution)			
*Also referred to as Attenuation			
	(dB)	(dB)	(dB)
Cable	22.0	22.0	19.8
Connector	0.4	0.4	0.2
Channel	24.0	24.0	21.3
NEXT (The higher the number, the better solution)			
Cable	32.3	35.3	44.3
Connector	40.0	43.0	54.0
Channel	27.1	30.1	39.9
ELFEXT (The higher the number, the better solution)			
Cable	not specified	23.8	27.8
Connector	not specified	35.1	43.1
Channel	not specified	17.4	23.3
Return Loss (The higher the number, the better solution)			
Cable	16.0 (SRL)	20.1	20.1
Connector	14.0	20.0	24.0
Channel	8.0	10.0	12.0

Key Features of the Category 6 Standard

Following are the top three areas that required new development work for the category 6 specifications.

- *Test plug qualification for near-end crosstalk (NEXT) and far-end crosstalk (FEXT).* This is the fundamental basis for plug and jack interoperability between manufacturers.
- *Patch cord performance requirements and test specifications.* Patch cord testing is key to ensuring interoperability. This has been included in the category 6 standard as a fundamental requirement and not as an addendum, as was the case for category 5e.



- *Measurement procedures for connecting hardware NEXT and FEXT.* These procedures required the creation of brand new fixtures, calibration procedures and many refinements to ensure repeatability in different laboratories.

Other Standards Applicable to Category 6

ISO/IEC 11801

The second edition of the ISO/IEC 11801 standard includes category 6 components as well as cabling. In ISO/IEC 11801, category 6 cabling is referred to as "Class E Cabling." It is expected that the ISO/IEC 11801 document will be published sometime in the fourth quarter of 2002.

The category 6 specifications in the ISO/IEC 11801 document are essentially the same as in ANSI/TIA-568-B.2-1. This allows manufacturers and customers to choose category 6 cabling systems that have the same performance anywhere in the world to support all emerging applications.

CENELEC EN-50173

The second edition of the EN 50173 standard also includes category 6 components as well as cabling. It is expected that the EN 50173 document will be published sometime in the fourth quarter of 2002.

The category 6 specifications included in the EN 50173 second edition are essentially the same as in ANSI/TIA-568-B.2-1 and the ISO/IEC 11801 second edition to facilitate global compatibility of cabling and emerging applications.

ANSI/TIA-854 1000BASE-TX Standard for Gigabit Ethernet over Category 6 Cabling

The ANSI/TIA-854 standard, "A Full Duplex Ethernet Physical Layer Specification for 1000Mbit/s (1000BASE-TX) Operating over Category 6 Balanced Twisted-Pair Cabling," published in March 2001, provides a data rate of 1000 Megabits/second, similar to the IEEE 802.3ab Gigabit Ethernet standard. The main difference is that it requires category 6 cabling instead of category 5e cabling. Because of the improved performance of category 6 cabling, the ANSI/TIA-854 standard does not implement NEXT cancellation or echo cancellation, and therefore reduces the cost, complexity and power consumption of TIA-854 chipsets compared to IEEE 1000BASE-T chipsets.

ATM Forum LAN Standards

The ATM Forum published the cell-based ATM FB-PHY-0162.000 standard in January 2001. This standard provides a 1000 Megabits/second data rate over standard category 6 channels of 100 meters using the standard ATM cell format. This standard is now included in the ISO/IEC 11801 list of recognized application standards for Class E (category 6). The ATM version of the Gigabit standard provides seamless connectivity between LAN, MAN and WAN networks that use the ATM protocol.

Other Application Committees

Now that the category 6 installed base is poised to quickly overtake the category 5e installed base, there is interest in using category 6 cabling in several other application committees. This work should gain momentum in the next few months, with new projects expected to be announced to develop applications faster than 1 Gigabit over 100 meters of standardized category 6 cabling.



Category 6 Market Penetration

Gartner, Inc., in the March 3, 2000 Research Note, "Category 5e or Category 6 Cabling – Which to Bet On?" authored by Lawrence Orans, predicted that by 2003, 90 percent of all new enterprise copper cabling installations will be category 6 (with a confidence level of 80 percent). Mr. Orans, a senior analyst with Gartner, Inc., reconfirmed this assessment in June 2002. According to Gartner, Inc., the only thing holding up the acceptance of category 6 in the market was the lack of a published category 6 standard. The ratification of TIA/EIA-568-B.2-1 provides the level of confidence many organizations were waiting for in order to move up from category 5e specifications. Similar conclusions have also been reached by BSRIA, a UK-based analysis group specializing in customer-owned telecommunications networks.

A recent poll conducted by *Cabling Installation & Maintenance* magazine indicated that 84 percent of respondents to an eleven-day online poll would choose category 6 cabling.

Summary

The opportunity to take advantage of the superior performance of category 6 is very clear for customers, application developers and cabling system vendors. Category 6 will provide improved data throughput compared to category 5e because of the improved signal-to-noise ratio that is directly related to throughput. This improved performance will also increase the reliability of premises networks by reducing network errors and associated downtime. Emerging applications are much easier to implement on category 6 than on category 5e because of the superior transmission performance of the category 6 cabling system. The combined cost of category 6 cabling and network equipment should provide the most cost-effective solution to increase data rates for customers. With the publication of the category 6 cabling standard by TIA and publication of the equivalent ISO and CENELEC standards in the fourth quarter of 2002, sales of category 6 cabling will increase rapidly and become the predominant media in the structured cabling market, as predicted by industry analysts.



CONTACT: SHARON GRACE
(703) 907-7715
sgrace@tia.eia.org

FOR IMMEDIATE RELEASE
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**TIA APPROVES CATEGORY 6 TELECOMMUNICATIONS
STANDARD FOR PUBLICATION**

Arlington, Va. – The Telecommunications Industry Association (TIA) announced today that the category 6 standard for telecommunications cabling has been approved for publication as TIA/EIA-568-B.2-1. This addendum is part of the TIA/EIA-568-B series of commercial building cabling standards, which are the most successful standards published by TIA. The new category 6 standard specifies requirements for 100-ohm balanced twisted-pair cables, connecting hardware, patch cords, channels and permanent links, and provides test procedures for laboratory and field performance verification over the frequency range of 1 to 250 MHz. Because category 6 supports positive power sum attenuation to crosstalk (PSACR) margins up to 200 MHz, this new cabling system offers double the bandwidth of category 5e cabling and vastly improved signal-to-noise margins. The category 6 standard also includes cable and connecting hardware balance recommendations for improved electromagnetic compatibility performance.

Category 6 cabling recognizes advances in cabling technology and is designed to be backward compatible with categories 3, 5 and 5e. This ensures that any applications that operate on lower category cabling will be fully supported by category 6 cabling. When different category components are mixed with category 6 components, the resultant cabling will satisfy the category transmission requirements of the lower performing component. To ensure generic cabling system performance, category 6 component requirements are specified to be interoperable when products from different manufacturers are mated.

According to TIA TR-42 Committee Chair Bob Jensen, the publication of the category 6 standard represents a milestone in the history of commercial building cabling specification. "Category 6 facilitates data throughput previously unachievable over balanced twisted-pair cabling. TIA and the ATM Forum have already published gigabit applications standards to operate over category 6 cabling. We anticipate applications groups to begin development of protocols supporting even higher throughput over category 6 cabling."

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The Telecommunications Industry Association (TIA) is the leading trade association serving the communications and information technology industry, with proven strengths in market development, trade shows, domestic and international advocacy, standards development and enabling e-business. Through its worldwide activities, the association facilitates business development opportunities and a competitive market environment. TIA's standards program is accredited by the American National Standards Institute (ANSI) to develop American National Standards. The association provides a market-focused forum for its more than 1,100 member companies that manufacture or supply the products and services used in global communications. TIA represents the communications sector of the Electronic Industries Alliance (EIA). Visit us at <http://www.tiaonline.org>.

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References for Category 6 Information

Reference	Information
TIA press release	http://www.tiaonline.org/media/press_releases/
Global Engineering Publications	800-854-7179 (U.S. and Canada) 303-397-7956 (Outside U.S. and Canada) http://global.ihs.com
<i>Cabling Installation & Maintenance</i> Poll	http://cim.pennnet.com/Articles/Article_Display.cfm?Section=OnlineArticles&SubSection=Display&PUBLICATION_ID=27&ARTICLE_ID=147359
Cable Testing Issues	http://www.cabletesting.com

Category 6 Consortium Participant URLs for Product Information

3M*	www.3m.com
Avaya*	connectivity.avaya.com
Corning*	www.corning.com
CSI/Suttle**	www.suttleonline.com
Draka Comteq**	www.drakacomteq.com
Fluke Networks*	www.fluke.com
General Cable*	www.generalcable.com
Hellerman Tyton*	www.hellermann.tyton.com
Hubbell**	www.hubbell.com
Krone*	www.krone.com
Leviton*	www.levitonvoicedata.com
Molex**	www.molexpn.com
Nexans**	www.nexans.com
Nordx/CDT**	www.nordx.com
Ortronics*	www.ortronics.com
Panduit*	www.panduit.com
Siemon*	www.siemon.com
Superior Essex**	www.superioressex.com
Superior Modular Products**	www.superiormod.com
UL*	www.ul.com/lancable

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2500 Wilson Boulevard, Suite 300, Arlington, VA 22201-3834 U.S.A.
Telephone: +1.703.907.7700 • Facsimile: +1.703.907.7727
Email: gemd@tia.eia.org • www.tiaonline.org