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Vodila polaganja kablov za podporo 10 GBASE-T

Cabling guidelines in support of 10 GBASE-T

Verkabelungsleitfaden zur Unterstützung von 10 GBASE-T

Guide de câblage pour supporter le 10 GBASE-T

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Cabling guidelines in support of 10 GBASE-T

Guide de câblage pour supporter le 10 GBASE-T

Verkabelungsleitfaden zur Unterstützung von 10 GBASE-T

This Technical Report was approved by CENELEC on 2007-11-02.

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CENELEC

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

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Foreword

This Technical Report was prepared by the Technical Committee CENELEC TC 215, Electrotechnical aspects of telecommunication equipment.

The text of the draft was submitted to vote and was approved by CENELEC as CLC/TR 50173-99-1 on 2007-11-02.

This Technical Report provides guidance whether an installed generic cabling channel meeting the requirements of EN 50173-1:2007, Class E, will support 10 GBASE-T as specified by IEEE 802.3an. The Technical Report also provides mitigation procedures to improve the performance of Class E channels to the point where the application is supported. Generic cabling channels meeting the requirements of EN 50173-1:2007, Class F, will support IEEE 802.3an up to 100 m without mitigation.

The support of IEEE 802.3an includes additional parameters and an extended frequency range beyond Class E. Conformance of installed cabling beyond the original cabling specifications must be determined on a case-by-case basis, and is primarily needed due to new external noise requirements. Whether these requirements are met by a specific channel is influenced by the components and installation practices used. As IEEE 802.3an uses frequencies above those specified for Class E of EN 50173-1:2007, input from supplier and installer may be helpful to evaluate the performance of installed Class E channels.

This Technical Report takes into account the design goals for IEEE 802.3an (10 GBASE-T) equipment such as:

a) frequency signal range up to 500 MHz;

b) meet EMC limits specified for EN 55022:2006, Class A;

NOTE While IEEE 802.3an specifies an application to meet Class A on unshielded cabling, meeting Class B may require application specific equipment and/or cabling that exceeds the requirements of this TR respectively.

c) support a bit error rate of 10^{-12};

d) support operation over four-connector, four-pair balanced cabling.

It is expected that IEEE 802.3an will be supported by the following cabling channels specified in EN 50173-1:2007:

– Class F channels will support IEEE 802.3an to distances of at least 100 m;

– Class E channels using screened Category 6 components and assessed and mitigated according to the guidelines in this Technical Report will support IEEE 802.3an over distances up to 100 m;

– Class E channels assessed and mitigated according to the guidelines in this Technical Report are expected to support IEEE 802.3an over distances from 55 m up to 100 m using unscreened Category 6 components.

In order to provide normative cabling specifications in explicit support of IEEE 802.3an, an amendment to EN 50173-1:2007 is under consideration. This amendment will provide new channel specifications that will include all characteristics needed to meet and/or exceed the IEEE 802.3an requirements (Class E_A and Class F_A).

This Technical Report is derived from ISO/IEC TR 24750, which has been developed by ISO/IEC JTC 1/SC 25 as a Technical Report Type 2.

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Introduction

In order to support IEEE 802.3 10 GBASE-T (ISO/IEC 8802-3:2000/A1, at present draft) over a generic cabling systems as defined in series EN 50173, several new parameters are required to specify the electrical transmission properties of the channel.

EN 50173-1 defines ACR and ELFEXT as: The S/N ratio of the noise in the disturbed pair to the signal in the disturbing pair. The definition in EN 50173-1 is correct for cabling.

IEEE 802.3an defines these parameters slightly different: The S/N ratio of the noise in the disturbed pair to the signal in the disturbed pair. This is of course the definition of importance for electrical systems.

For equally long channels the values of both definitions are nearly the same, but if the channels have different length the values based on IEEE 802.3an and EN 50173-1:2007 are different.

To align with IEEE 802.3an it was decided in February 2006 to change the naming and definition in their cabling standard of some noise related items. The limits stay the same so backward compatibility is assured (see Table 1 for summary).

Crosstalk and power sum crosstalk are well defined in EN 50173-1:2007. As cables are laid in trays, ducts and/or are bundled together, the noise from one cable can couple into other cables. This can happen between telecommunications cables of the same category, but also between cables with different categories or even between signal or power line cables and telecommunications cables.

This type of noise is well known in telephony and existing versions of Ethernet over balanced cabling. It has not been a major issue for the systems in use up to now. However, the increased frequency range and sensitivity of the IEEE 802.3an transmission cannot neglect this external noise any more.

Only the power sum of the noise is of importance and is specified because it is irrelevant from which external pairs or cables the noise is coming from and the noise from external sources cannot be compensated for within the specific application addressed here. The power sum computation assumes that the noise is generated by other channels using the same protocol. Disturbances that are created by other protocols (like TV distribution) using the other channels are handled as background noise. To determine alien crosstalk noise, the transmitter must therefore be known.

In a channel as specified in EN 50173-1, and measured in accordance with EN 50346, the near-end (where the measurement transmitter is) and the far-end (were the measurement receiver is) are known and the terms NEXT and FEXT are easy to define.

For alien crosstalk the term ANEXT or AFEXT can be ambiguous. Therefore new definitions for power sum alien crosstalk noise (near-end and far-end) are introduced (see definitions). It appears that the worst case situation is when a short channel runs in parallel at either end of a long channel. The short channel with high signals will disturb the long channel receiver where receiving signals have been attenuated due to the insertion loss of the long channel. For this case IEEE 802.3an introduced power backoff strategies. The idea is that a system detects the length of the channel by receiving signal amplitude and reduces the transmitter voltage to decrease alien noise.

IEEE 802.3an defines two limits for each of ANEXT and AFEXT that have to be met concurrently (for values see 4.7.1):

a) The first limit applies to every pair individually within the disturbed channel;

b) The second limit applies to the average of all four pairs within the disturbed channel.

- PSANEXT average limit is 2,25 dB more stringent than the PSANEXT limit for each pair within the disturbed channel;
- PSACR-F average is 4 dB more stringent than the PSACR-F limit for each pair within the disturbed channel.

If these two limits are not met concurrently tradeoffs can be calculated as explained in Annex B.

Table 1 – Changes and additions to definitions in EN 50173-1:2007

Term used in EN 50173-1:2007	Term used in this Technical Report	Definition	Requirement
ACR	ACR-N	Revised	No change
PSACR	PSACR-N	Revised	No change
ELFEXT	ACR-F	Revised	No change
PSELFEXT	PSACR-F	Revised	No change
-	PSANEXT	New	New
-	PSAACR-F	New	New

1 Scope

This Technical Report

a) specifies the transmission performance for channels to support 10 GBASE-T as specified in IEEE 802.3an,

b) specifies the methods to assess whether installed Class E and Class F channels meet IEEE 802.3an requirements,

c) provides mitigation techniques to improve the performance of an existing installation to meet the IEEE 802.3an requirements.

NOTE 1 The channel transmission performance specified in this TR is derived from IEEE 802.3an.

NOTE 2 IEEE 802.3an specifies requirements beyond the frequency range specified for EN 50173-1:2007, Class E, and additional parameters to those specified for Class E and Class F cabling in EN 50173-1:2007.

NOTE 3 This Technical Report does not re-specify the requirements for Class E and Class F channels of EN 50173-1:2007.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 50173-1:2007, *Information technology – Generic cabling systems – Part 1: General requirements*

EN 50346, *Information technology – Cabling installation – Testing of installed cabling*

ISO/IEC 8802-3:2000/A1 [1)], *Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications - Media Access Control (MAC) parameters, physical layers, and management parameters for 10 Gb/s operation*

3 Definitions and abbreviations

3.1 Definitions

For the purposes of this document the following terms and definitions apply in addition to those of EN 50173-1.

3.1.1
alien crosstalk
the signal coupling from a disturbing pair of a channel to a disturbed pair of another channel

3.1.2
alien (exogenous) far-end crosstalk loss (AFEXT)
the signal isolation between a disturbing pair of a channel and a disturbed pair of another channel, measured at the far-end

3.1.3
alien (exogenous) near-end crosstalk loss (ANEXT)
the signal isolation between a disturbing pair of a channel and a disturbed pair of another channel, measured at the near-end

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1) Under preparation.

3.1.4
attenuation to alien (exogenous) crosstalk ratio at the far-end (AACR-F)
the difference, in dB, between the alien far-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbed pair in another channel

3.1.5
attenuation to alien (exogenous) crosstalk ratio at the near-end (AACR-N)
the difference, in dB, between the alien near-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbed pair in another channel

3.1.6
attenuation to crosstalk ratio at the far-end (ACR-F)
the difference, in dB, between the far-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbed pair of the same channel

3.1.7
attenuation to crosstalk ratio at the near-end (ACR-N)
the difference, in dB, between the near-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbed pair of the same channel

3.1.8
average alien (exogenous) near-end crosstalk loss
the calculated average of the alien near-end crosstalk loss of the pairs of a disturbed channel

3.1.9
average power sum alien (exogenous) near-end crosstalk loss
the calculated average of the power sum alien near-end crosstalk loss of the pairs of a disturbed channel

3.1.10
average power sum attenuation to alien (exogenous) crosstalk ratio far-end
the calculated average of the power sum attenuation to alien crosstalk ratio at the far-end of the pairs of a disturbed channel

3.1.11
equal level far end crosstalk ratio (ELFEXT)
the difference, in dB, between the far-end crosstalk loss from a disturbing pair of a channel and the insertion loss of a disturbing pair of the same channel

3.1.12
power sum alien (exogenous) far-end crosstalk loss (PSAFEXT)
the power sum of the signal isolation between multiple disturbing pairs of one or more channels and a disturbed pair of another channel, measured at the far-end

3.1.13
power sum alien (exogenous) near-end crosstalk loss (PSANEXT)
the power sum of the signal isolation between multiple disturbing pairs of one or more channels and a disturbed pair of another channel, measured at the near-end

3.1.14
power sum attenuation to alien (exogenous) crosstalk ratio at the far-end (PSAACR-F)
the difference, in dB, between the power sum alien far-end crosstalk loss from multiple disturbing pairs of one or more channels and the insertion loss of a disturbed pair in another channel

3.1.15
power sum attenuation to alien (exogenous) crosstalk ratio at the near-end (PSAACR-N)
the difference, in dB, between the power sum alien near-end crosstalk loss from multiple disturbing pairs of one or more channels and the insertion loss of a disturbed pair in another channel

3.1.16
power sum attenuation to crosstalk ratio at the far-end (PSACR-F)
the difference, in dB, between the power sum far-end crosstalk loss from multiple disturbing pairs of a channel and the insertion loss of a disturbed pair in the same channel

3.1.17
power sum attenuation to crosstalk ratio at the near-end (PSACR-N)
the difference, in dB, between the power sum near-end crosstalk loss from multiple disturbing pairs of a channel and the insertion loss of a disturbed pair in the same channel

3.1.18
power sum equal level far end crosstalk ratio (PSELFEXT)
the power sum of all disturbing pairs of a channel, of the difference, in dB, between the far-end crosstalk loss and the insertion loss of each disturbing pair

3.2 Abbreviations

For the purposes of this document the following abbreviations apply in addition to those of EN 50173-1:2007.

ACR-N	Attenuation to crosstalk ratio near-end
ACR-F	Attenuation to crosstalk ratio far-end
AFEXT	Alien far-end crosstalk loss
ANEXT	Alien near-end crosstalk loss
PSAFEXT	Power sum alien far-end crosstalk loss
PSANEXT	Power sum alien near-end crosstalk loss
PSAACR-F	Power sum attenuation to alien crosstalk ratio far-end

4 Channel requirements

4.1 General

This clause discusses the IEEE 802.3an requirements in relation to the minimum performance of Class E and Class F channels as specified in EN 50173-1:2007.

All requirements of this clause are met by EN 50173-1:2007, Class F.

To support IEEE 802.3an applications the channel performance limits of Class E of EN 50173-1 have been extended here to higher frequencies and two new characteristics have been added:

a) PSANEXT (see 4.7.2)

b) PSAACR-F (see 4.7.3).

The parameters specified in this clause apply to channels with screened or unscreened cable elements, with or without an overall screen, unless explicitly stated otherwise.

NOTE The term ”attenuation“ is used for definitions as it is common usage within the cabling industry. However, the correct term is insertion loss which includes the effect of impedance variations both with and between the cabling components in the channel.

For a balanced cabling installation to conform to this technical report:

1) the channel performance shall meet the requirements of this clause;

2) the interfaces to the cabling shall conform to the requirements of Clause 8 of EN 50173 series of standards with respect to mating interfaces;

3) local regulations concerning safety and EMC shall be met as applicable to the location of the installation.

Measuring the link performance of an installed permanent link can be used to assess whether the permanently installed cabling has the potential to be used as part of a balanced cabling channel to support IEEE 802.3an. This assessment does not assure conformance to this Technical Report, and shall not be used instead of the channel qualification procedure described in this clause. Annex A contains balanced cabling permanent link performance guidelines.

4.2 Return loss

The variation of the input impedance of a channel is characterised by the return loss. To support IEEE 802.3an the return loss for each pair of a channel shall meet the limits computed, to one decimal place, using the formulae of Table 2. The limits shown in Table 3 are derived from the formulae at key frequencies.

When required, the return loss shall be measured according to EN 50346. Terminations of 100 Ω shall be connected to the cabling elements under test at the far-end of the channel. The return loss requirements shall be met at both ends of the cabling.

Table 2 – Formulae for return loss limits for a channel

Frequency MHz	Minimum return loss dB
$1 \le f < 10$	19,0
$10 \le f < 40$	24-5lg(f)
$40 \le f < 400$	32-10lg(f)
$400 \le f \le 500$	6,0

Table 3 – Return loss limits for a channel at key frequencies

Frequency MHz	Minimum return loss dB
1,0	19,0
16,0	18,0
100,0	12,0
250,0	8,0
500,0	6,0

Values of return loss at frequencies for which the measured channel insertion loss is below 3,0 dB are for information only.

4.3 Insertion loss

To support IEEE 802.3an, the insertion loss α of each pair of a channel shall not exceed the limits computed, to one decimal place, using the formula of Table 4. The limits shown in Table 5 are derived from the formula at key frequencies.

When required, the insertion loss shall be measured according to EN 50346.