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TECHNICAL REPORT

Information technology – Generic cabling for customer premises – Part 9909: Evaluation of balanced cabling in support of 25 Gbit/s for reach greater than 30 metres

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

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

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colour inside

**Information technology – Generic cabling for customer premises –
Part 9909: Evaluation of balanced cabling in support of 25 Gbit/s for reach greater than 30 metres**

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GENERIC CABLING FOR CUSTOMER PREMISES –**

Part 9909: Evaluation of balanced cabling in support of 25 Gbit/s for reach greater than 30 metres

FOREWORD

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The list of all currently available parts of the ISO/IEC 11801 series, under the general title *Information technology – Generic cabling for customer premises*, can be found on the IEC and ISO websites.

The text of this Technical Report is based on the following documents:

DTR	Report on voting
JTC1-SC25/2932/DTR	JTC1-SC25/2948/RVDTR

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.

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 document provides an evaluation of balanced cabling in support of 25 Gbit/s data transmission. The evaluation covers enhanced balanced cabling channel specifications, which are based on Category 8.1 and Category 8.2 balanced cabling components. The enhanced channel specifications are intended to support extended reach greater than 30 m.

The extended reach evaluation is intended to support various emerging use-cases including

- 25 Gbit/s LAN,
- extended reach high definition audio/video,
- Wi-Fi®[1] application greater than 10 Gbit/s, and
- 5G intrabuilding sites.

1 Wi-Fi is a registered trademark of Wi-Fi Alliance. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO or IEC.

INFORMATION TECHNOLOGY – GENERIC CABLING FOR CUSTOMER PREMISES –

Part 9909: Evaluation of balanced cabling in support of 25 Gbit/s for reach greater than 30 metres

1 Scope

This part of ISO/IEC 11801, which is a Technical Report, covers evaluation and recommendations for achieving extended reach, greater than 30 m, for 25 Gbit/s applications over balanced cabling channels.

This document covers channel reference implementations, based on Category 8.1 and Category 8.2, 2 000 MHz, components.

The channel and component category specifications covered in this document are not intended to be normative.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO/IEC 11801-1, *Information technology – Generic cabling for customer premises – Part 1: General requirements*

3 Terms and definitions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 11801-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.2 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO/IEC 11801-1 and the following apply.

SNR	signal to noise ratio
NVP	nominal velocity of propagation

4 Extended reach channel specifications

4.1 General

Balanced cabling channels in accordance with ISO/IEC 11801-1:2017, Class I and Class II, are intended to support link data rate operating at 25 Gbit/s – for example, ISO/IEC/IEEE 8802-3:2017/AMD3:2017 25GBASE-T – with link reach up to 30 m.

NOTE 1 ISO/IEC/IEEE 8802-3:2017/AMD3:2017 25GBASE-T link segment specifications are referenced, see ISO/IEC TR 11801-9905.

Class I and Class II balanced cabling channels in accordance with ISO/IEC 11801-1:2017 are implemented using Category 8.1 and Category 8.2 balanced screened cabling components, respectively.

NOTE 2 ISO/IEC/IEEE 8802-3:2017/AMD3:2017 25GBASE-T is defined using Category 8.1 and Category 8.2 (Class I and Class II, respectively) up to 1 250 MHz.

ISO/IEC 11801-1 allows for variation in channel implementation configurations that maintain conformance to channel specifications.

Enhanced channel reference implementations use two connections, with two 2 m, 20 % derated cords attached to the ends of a permanent link, so that the permanent link length is equal to the channel length (in metres) minus 4 m.

Enhanced channels can provide additional SNR margin-to-capacity, which can potentially support additional reach, see Annex B.

NOTE 3 The possibility of additional reach can be verified with manufacturers of specific equipment before deployment.

Extended reach channel reference implementations, greater than 30 m, are evaluated over four reach ranges: ≤ 40 m, ≤ 50 m, ≤ 67 m, and ≤ 100 m; see Table 1.

Balanced cabling covered by this document:

a) is specified in accordance with ISO/IEC 11801-1;

b) is tested in accordance with ISO/IEC 11801-1, i.e. as specified in IEC 61935-1.

4.2 Channel performance enhancement methods for increased SNR

4.2.1 General

Table 1 shows the enhancement method considerations for 25 Gbit/s and 25GBASE-T operation over various extended reach cabling channels using Category 8.1 and Category 8.2 components.

NOTE 25GBASE-T can be supported only by channels which fully conform to the ISO/IEC/IEEE 8802-3:2017/AMD3 25GBASE-T link segment specifications, see 4.2.2.

Table 1 – Enhancement methods for 25 Gbit/s extended reach

	Channel length, L m			
Reach range	30 < L ≤ 40	40 < L ≤ 50	50 < L ≤ 67	68 < L ≤ 100
Application supported	25 Gbit/s and 25GBASE-T	25 Gbit/s	25 Gbit/s	25 Gbit/s
	Recommended channel enhancement method			
Channel component Category 8.1	Reduced delay and delay skew in accordance with 4.2.2.	Reduced delay and delay skew in accordance with 4.2.2, and Enhanced cable in accordance with 4.2.3.	Reduced delay and delay skew in accordance with 4.2.2, Enhanced cable in accordance with 4.2.3, and Enhanced connector in accordance with 4.2.4.	Reduced delay and delay skew in accordance with 4.2.2, Enhanced cable in accordance with 4.2.3, and Enhanced connector in accordance with 4.2.4.
Channel component Category 8.2	Reduced delay and delay skew in accordance with 4.2.2.	Reduced delay and delay skew in accordance with 4.2.2, and Enhanced cable in accordance with 4.2.3.	Reduced delay and delay skew in accordance with 4.2.2, and Enhanced cable in accordance with 4.2.3	Reduced delay and delay skew in accordance with 4.2.2, Enhanced cable in accordance with 4.2.3, and Enhanced connector in accordance with 4.2.4.

4.2.2 Reduced delay and delay skew

Using components with improved propagation delay and delay skew performance compared to those specified in ISO/IEC 11801-1 for Category 8.1 and 8.2 components can provide longer channel lengths than the reference implementations of 30 m, see Annex A.

NOTE Engineered channels made from cable with higher NVP thus have inherently lower delay and delay skew characteristics; thus they can support more physical length, e.g. more than 30 m, while still conforming to all 25GBASE-T link segment specifications, including maximum delay specifications, i.e. 185 ns.

4.2.3 Enhanced cable

Using cables with enhanced RL, IL, TCL, ELTCTL and coupling attenuation compared to ISO/IEC 11801-1 Category 8.1 and 8.2 components specifications can provide longer channel lengths than the reference implementations of 30 m, see Annex B.

4.2.4 Enhanced connector

Using connecting hardware with enhanced RL, IL, TCL, ELTCTL and coupling attenuation compared to ISO/IEC 11801-1 Category 8.1 and 8.2 components specifications can provide longer channel lengths than the reference implementations of 30 m, see Annex B.

4.3 Example channel specifications with length scaling

4.3.1 General

Two informative example extended-reach enhanced channel transmission parameters specifications are given:

a) 50 m using Category 8.1; and

b) 50 m using Category 8.2.

Category 8.1 and Category 8.2 balanced screened cabling components are specified in ISO/IEC 11801-1:2017.

The two example channel reference implementations have 50 m total channel length, including two connections, and 4 m total cord length from two 2 m cords using 20 % derated cord cable IL.

4.3.2 Return loss (RL)

The return loss for each pair within the example 50 m channel specifications is computed, to one decimal place, using the formulae of Table 2. The return loss specification applies to both ends of the cabling.

Table 2 – Formulae for return loss specifications for example 50 m channel

Frequency MHz	**Return loss channel component Category 8.1 and Category 8.2** dB
$1 \leq f \leq 10$	19,0
$10 < f \leq 40$	$24 - 5 \lg(f)$
$40 < f \leq 130$	16
$130 < f \leq 1\,000$	$35 - 9 \lg(f)$
$1\,000 < f \leq 2\,000$	8,0

4.3.3 Insertion loss (IL)

The insertion loss for each pair within the example 50 m channel is computed, to one decimal place, using the formulae of Table 3.

Table 3 – Formulae for insertion loss specifications for example 50 m channel

Channel component	**Frequency** MHz	**Insertion loss** dB
Category 8.1	$1 < f \leq 500$	$0{,}508\left(1{,}8\sqrt{f}+0{,}005f+\frac{0{,}25}{\sqrt{f}}\right)+2\times 0{,}02\sqrt{f}+0{,}0324\sqrt{f}$
	$500 < f \leq 2\,000$	$0{,}508\left(1{,}8\sqrt{f}+0{,}005f+\frac{0{,}25}{\sqrt{f}}\right)+2\times\left(0{,}00649\sqrt{f}+0{,}000605f\right)+0{,}0324\sqrt{f}$
Category 8.2	$1 < f \leq 2\,000$	$0{,}508\left(1{,}8\sqrt{f}+0{,}005f+\frac{0{,}25}{\sqrt{f}}\right)+2\times 0{,}02\sqrt{f}$

IL-channel-length-factor (scaling 100 m channel specification) = $L/100(K(M/L) + (L - M)/L)$

where

L is the total channel length;

M is the total cord length;

K is the cord cable IL derating factor.

EXAMPLE IL-channel-length-factor = $L/100(K(M/L) + (L - M)/L) = 0{,}508$

where $L = 50$, $M = 4$, $K = 1{,}20$

4.3.4 Near-end crosstalk loss (NEXT)

4.3.4.1 Pair-to-pair NEXT

The pair-to-pair NEXT for each pair combination within the example 50 m channel are computed, to one decimal place, using the formulae of Table 4.

Table 4 – Formulae for pair-to-pair NEXT specifications for example 50 m channel

Channel component	Frequency MHz	NEXT dB
Category 8.1	$1 \le f \le 500$	$-20\lg\left(10^{\frac{75{,}3-15\lg(f)}{-20}}+1\times10^{\frac{94-20\lg(f)}{-20}}\right)$
Category 8.1	$500 < f \le 2\ 000$	$-20\lg\left(10^{\frac{75{,}3-15\lg(f)}{-20}}+1\times10^{\frac{40-38\lg(f/500)}{-20}}\right)$
Category 8.2	$1 \le f \le 1\ 000$	$-20\lg\left(10^{\frac{105{,}4-15\lg(f)}{-20}}+1\times10^{\frac{116{,}3-20\lg(f)}{-20}}\right)$
Category 8.2	$1\ 000 < f \le 2\ 000$	$-20\lg\left(10^{\frac{105{,}4-15\lg(f)}{-20}}+1\times10^{\frac{56{,}3-90\lg(f/1000)}{-20}}\right)$

4.3.4.2 Power sum NEXT (PS NEXT)

The PS NEXT for each pair combination within the example 50 m channel are computed, to one decimal place, using the formulae of Table 5. For details of calculation see ISO/IEC 11801-1.

Table 5 – Formula for PS NEXT specifications for example 50 m channel

Channel component	Frequency MHz	PSNEXT dB
Category 8.1	$1 \le f \le 500$	$-20\lg\left(10^{\frac{72{,}3-15\lg(f)}{-20}}+1\times10^{\frac{91-20\lg(f)}{-20}}\right)$
Category 8.1	$500 < f \le 2\ 000$	$-20\lg\left(10^{\frac{72{,}3-15\lg(f)}{-20}}+1\times10^{\frac{37-38\lg(f/500)}{-20}}\right)$
Category 8.2	$1 \le f \le 1\ 000$	$-20\lg\left(10^{\frac{102{,}4-15\lg(f)}{-20}}+1\times10^{\frac{113{,}3-20\lg(f)}{-20}}\right)$
Category 8.2	$1\ 000 < f \le 2\ 000$	$-20\lg\left(10^{\frac{102{,}4-15\lg(f)}{-20}}+1\times10^{\frac{53{,}3-90\lg(f/1000)}{-20}}\right)$

4.3.5 Attenuation to crosstalk loss ratio near-end (ACR-N)

4.3.5.1 Pair-to-pair ACR-N

This value is calculated from NEXT and insertion loss. For information, see ISO/IEC 11801-1.

4.3.5.2 Power sum ACR-N (PS ACR-N)

This value is calculated from PS NEXT and insertion loss. For information, see ISO/IEC 11801-1.

4.3.6 Attenuation to crosstalk ratio far-end (ACR-F)

4.3.6.1 Pair-to-pair ACR-F

The ACR-F for each pair combination within the example 50 m channel are computed, to one decimal place, using the formulae of Table 6.

Table 6 – Formulae for ACR-F specifications for example 50 m channel

Channel component	**Frequency** MHz	**ACR-F** dB
Category 8.1	$1 \le f \le 2\ 000$	$-20\lg\left(10^{\frac{79{,}0-15\lg(f)}{-20}}+2\times10^{\frac{83{,}9-20\lg(f)}{-20}}\right)$
Category 8.2	$1 \le f \le 1\ 000$	$-20\lg\left(10^{\frac{100{,}6-20\lg(f)}{-20}}+2\times10^{\frac{103{,}9-20\lg(f)}{-20}}\right)$
Category 8.2	$1\ 000 < f \le 2\ 000$	$-20\lg\left(10^{\frac{100{,}6-20\lg(f)}{-20}}+2\times10^{\frac{43{,}9-90\lg(f/1000)}{-20}}\right)$

4.3.6.2 Power sum ACR-F (PS ACR-F)

The PS ACR-F for each pair combination within the example 50 m channel are computed, to one decimal place, using the formulae of Table 7.

Table 7 – Formulae for PS ACR-F specifications for example 50 m channel

Channel component	**Frequency** MHz	**PSACR-F** dB
Category 8.1	$1 \le f \le 2\ 000$	$-20\lg\left(10^{\frac{76{,}0-20\lg(f)}{-20}}+2\times10^{\frac{80{,}1-20\lg(f)}{-20}}\right)$
Category 8.2	$1 \le f \le 1\ 000$	$-20\lg\left(10^{\frac{97{,}6-20\lg(f)}{-20}}+2\times10^{\frac{100{,}9-20\lg(f)}{-20}}\right)$
Category 8.2	$1\ 000 < f \le 2\ 000$	$-20\lg\left(10^{\frac{97{,}6-20\lg(f)}{-20}}+2\times10^{\frac{40{,}9-90\lg(f/1000)}{-20}}\right)$

4.3.7 Alien (exogenous) crosstalk

4.3.7.1 PS ANEXT

The PS ANEXT for each pair combination within the example 50 m channel are computed, to one decimal place, using the formulae of Table 8.

Table 8 – Formulae for PS ANEXT specifications for example 50 m channel

Channel component	Frequency MHz	PS ANEXT dB
Category 8.1 and Category 8.2	$1 \le f \le 1\ 00$	$105 - 10\lg(f)$
	$100 \le f \le 2\ 000$	$115 - 15\lg(f)$

4.3.7.2 PS AACR-F

The PS AACR-F for each pair combination within the example 50 m channel are computed, to one decimal place, using the formulae of Table 9.

Table 9 – Formulae for PS AACR-F specifications for example 50 m channel

Channel component	Frequency MHz	Minimum PS AACR-F dB
Category 8.1 and Category 8.2	$1 \le f \le 2\ 000$	$101 - 20\lg(f)$

4.3.8 DC loop resistance

The maximum DC loop resistance in an installation is 10 Ω.

The maximum DC loop resistance at 20 °C of each pair within the cable is 0,14 Ω/m.

4.3.9 Propagation delay

The propagation delay for each pair within the example 50 m channel are computed, to three decimal places, using the formulae of Table 10.

Table 10 – Formulae for propagation delay specifications for a 50 m channel

Channel component	Frequency MHz	Maximum propagation delay µs
Category 8.1 and Category 8.2	$1 \le f \le 2\ 000$	$0{,}5 \times \left[\dfrac{0{,}534 + 0{,}036}{\sqrt{(f)}}\right] + 2 \times 0{,}0025$

4.3.10 Delay skew

The maximum delay skew between all pairs within the example 50 m channel are computed, to three decimal places, using the formulae of Table 11.

Table 11 – Delay skew specifications for a 50 m channel

Channel component	Frequency MHz	Maximum delay skew µs
Category 8.1 and Category 8.2	$1 \le f \le 2\ 000$	$0{,}5 \times 0{,}025 + 2 \times 0{,}00125$

4.3.11 Unbalance attenuation near end (TCL) and far end (ELTCTL), and coupling attenuation

4.3.11.1 Unbalance attenuation near end (TCL)

The TCL for each pair within the example 50 m channel are computed, to one decimal place, using the formulae of Table 12. The values are defined for MICE E_1 in accordance with ISO/IEC 11801-1.

Table 12 – TCL for example 50 m channel

Channel component	**Frequency** MHz	**TCL** dB	
		Channels using cables with unscreened pairs	**Channels using cables with screened pairs**
Category 8.1 and Category 8.2	$1 \leq f \leq 2\ 000$	$60 - 17\lg(f)$ ffs	$50 - 17\lg(f)$ ffs

4.3.11.2 Unbalance attenuation far end (ELTCTL)

The ELTCTL for each pair within the example 50 m channel are computed, to one decimal place, using the formulae of Table 13. The values are defined for MICE E_1 in accordance with ISO/IEC 11801-1.

Table 13 – ELTCTL for example 50 m channel

Channel component	**Frequency** MHz	**ELTCTL** dB	
		Channels using cables with unscreened pairs	**Channels using cables with screened pairs**
Category 8.1 and Category 8.2	$1 \leq f \leq 2\ 000$	$44{,}6 - 20\lg(f)$ ffs	$34{,}6 - 20\lg(f)$ ffs

4.3.11.3 Coupling attenuation

The coupling attenuation for each pair within the example 50 m channel are computed, to one decimal place, using the formulae of Table 14. The values are defined for MICE E_1 and E_2 in accordance with ISO/IEC 11801-1.

Table 14 – Coupling attenuation for example 50 m channel for E_1 and E_2

Channel component	**Frequency** MHz	**Coupling attenuation** dB
Category 8.1 and Category 8.2	$30 \leq f \leq 100$	50,0
	$100 \leq f \leq 2\ 000$	$50 - 20\lg(f/100)$

Annex A
(informative)

Reduced delay and delay skew

A.1 Reduced delay relation to extended reach

A.1.1 General

Engineered channels made from cable with higher NVP, thus having lower propagation delay and delay skew, can support more physical length, e.g. more than 30 m, while still conforming to all 25GBASE-T link segment specifications, including maximum delay specifications, i.e. 185 ns.

NOTE The term "dielectric constant" is deprecated. In current standards, it is replaced by "relative permittivity" for clarity.

A.1.2 Example reduced delay evaluation

In accordance with ISO/IEC/IEEE 8802-3:2017/AMD3:2017 25GBASE-T link segment specifications, the maximum delay is 185 ns, for 30 m maximum reach. This equates to an NVP of about 55 % and an effective relative permittivity of about 3,4.

Category 8.1 and Category 8.2 cables can have relatively high NVP, thus improved delay and delay skew values.

A 40 m long channel requires using cable with an NVP of about 72 %, which equates to an effective relative permittivity of about 1,9.

A.2 Delay relation to insertion loss (IL)

A.2.1 General

Channel IL related parameters are affected by cable attenuation, due to variation of relative permittivity (ε_r) and dissipation factor (tanδ).

NOTE 1 Delay is related to attenuation (dB/m), which has direct length dependency; which in turn is related to IL, which has indirect length dependency.

Cable design factors that are used in the IEC 61156-9 attenuation formula can be substituted by alternative cable design factors, which are calculated using alternative relative permittivity (ε_r) and dissipation factor (tanδ), for simulation and comparison.

Consider the cable component attenuation term of the channel IL formula, in accordance with Formula (A.1); see Table 3.

$$\alpha = a\sqrt{f} + b(f) + c/\sqrt{f} \qquad \text{(A.1)}$$

where

α is the attenuation coefficient (dB/100 m);

f is the frequency (MHz);

a, b, and c are coefficients representing the specific cable design factors.

Essentially, the attenuation formula's first term represents the conductor loss, which is primarily affected by relative permittivity and proportional to $\sqrt{f}$; the second term represents the dielectric loss, which is primarily affected by dissipation factor and proportional to f; the third term is a small compensation for the low end of the frequency range, where the attenuation increases at a lower rate than $\sqrt{f}$; see IEC 61156-5. Reduced relative permittivity reduces attenuation and delay. Reduced dissipation factor further reduces attenuation.

A.2.2 Relation of variable relative permittivity to attenuation

The implicit maximum relative permittivity used for standard Category 8.1 and Category 8.2 balanced cable is 2,75, for 4 MHz, which is derived from the standard phase delay limit in accordance with Formulas (A.2) and (A.3) (see IEC 61156-9).

$$\tau = 534 + 36 / \sqrt{f} \tag{A.2}$$

$$\varepsilon_\mathrm{r} = \left(\tau / \tau_0\right)^2 \tag{A.3}$$

where

τ is the delay time (ns/100 m);

τ_0 is the delay time for ε_r = 1, i.e. 333 ns/100 m;

ε_r is the relative permittivity;

f is the frequency (MHz).

NOTE 2,75 (NVP = 60 %) is a practical value corresponding to a medium quality dielectric material. It applies to all standard categories of balanced cables, which also use the same phase delay limit formula.

For Category 8.1 and Category 8.2 cable, in accordance with the standard phase delay, ε_r = 2,75 is used as the standard "BASE" relative permittivity, which is factored into the attenuation formula "a" coefficient (a = 1,8, see Table 3). The "a_BASE" coefficient can be changed to an "a_calc" coefficient using Formula (A.4):

$$a_\mathrm{calc} = a_\mathrm{BASE} \sqrt{\varepsilon_\mathrm{r\ calc} / \varepsilon_\mathrm{r\ BASE}} \tag{A.4}$$

A.2.3 Relation of dissipation factor to attenuation:

The explicit dissipation factor ($\tan\delta$) used for Category 8.1 and Category 8.2 balanced cable is 0,005. The relation of dissipation factor ($\tan\delta$) and the attenuation formula "b" coefficient is given by Formulas (A.5) and (A.6).

$$b(f) = \pi f \tan\delta (C)(Z_0) \tag{A.5}$$

$$b \approx \tan\delta \tag{A.6}$$

where

$\tan\delta$ is the dissipation factor;

f is the frequency (Hz);

C is the capacitance (F/100 m);

Z_0 is the characteristic impedance.

NOTE Very conveniently, $\pi fCZ_0 \approx 1$, for typical category cable, which is specified at 1 MHz, as 100 Ω, for 100 m, so the attenuation formula's coefficient b practically equals tanδ.

For Category 8.1 and Category 8.2 cable, in accordance with the standard phase delay, tanδ = 0,005 is used as the standard "BASE" dissipation factor, which is factored into the attenuation formula "b" coefficient (b = 0,005, see Table 3). The "b_{BASE}" coefficient can be changed to a "b_{calc}" coefficient using Formula (A.7):

$$b_{calc} = b_{BASE}\left(\tan\delta_{calc} / \tan\delta_{BASE}\right) \qquad (A.7)$$

Annex B
(informative)

Enhanced capacity

B.1 Enhanced cabling components

B.1.1 General

Balanced cabling channels implemented using Category 8.1 and Category 8.2 balanced screened cabling components in accordance with ISO/IEC 11801-1 have various levels of channel SNR margin performance.

For more information on the relation of SNR margin, capacity and reach, see ISO/IEC TR 11801-9901, ISO/IEC TR 11801-9904 and ISO/IEC TR 11801-9905.

B.1.2 Enhanced cable

Cabling channels, constructed using Category 8.1 and Category 8.2 cables with higher NVP (e.g. low twist-loss cable), provide more SNR margin, which provides greater capacity.

Channels using cable with improved return loss (RL) and/or NEXT by using fully shielded cable construction, e.g. S/FTP, provide more SNR margin, which provides greater capacity.

B.1.3 Enhanced connector

Cabling channels, constructed using Category 8.1 and Category 8.2 type screened-pair connectors, provide more SNR margin, which provides greater capacity.

B.2 Channel SNR margin-to-capacity

B.2.1 General

Channel SNR margin-to-capacity is an expression for the difference in decibels (dB) between the channel maximum (Shannon) capacity in bits per second (bit/s) and a specific application data rate in bits per second (bit/s); for example, a Class II channel transmitting 25 Gbit/s, using a specific bandwidth frequency in hertz (Hz), and a specific channel reach in metres (m).

B.2.2 Margin-to-capacity calculation and comparison

Margin-to-capacity is calculated for specific channel implementations; for example, 25 Gbit/s over Category 8.1 and Category 8.2.

For margin-to-capacity calculation formula see ISO/IEC TR 11801-9901.

Example margin-to-capacity calculation, channel specifications used:

- 50 m (when fixed) using Category 8.1;
- 50 m (when fixed) using Category 8.2;
- 50 m (when fixed) using Category 6_A and Category 7_A are also included for comparison.