

**To: 3P Customers and Business Partners**

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**3P Newsletter No. 1/2005**

**10 Gigabit Ethernet over Copper**

The number of requests for information about the coming 10 Gigabit Ethernet cabling has multiplied in January and 3P concludes that this application has now got huge market attention. It seems that many producers and suppliers now try to show competence in this field to demonstrate to the market that their products and know-how are future oriented. At the present stage this seems fairly simple. The vast majority of end users probably know very little except that it is coming, and therefore even extremely optimistic statements about performance have minimal risk of being opposed or questioned.

The present 3P Newsletter is an attempt to communicate the information available at 3P and bring some thoughts from the author on how the market will develop around 10 Gigabit Ethernet in the near future.

**1. Status of 10 Gigabit Ethernet Developments**

10 Gigabit Ethernet is a new application for the impressive communication of 10 Gigabit per second over twisted pair copper cabling. The development of 10 Gigabit Ethernet is in rapid progress, but has not yet been completed. However, the cabling requirements are becoming more mature and cabling specifications from ISO/IEC, TIA/EIA and CENELEC are now in progress.

A standard proposal for 10 Gigabit Ethernet is now out for comments in IEEE. However, I have not found a public version of this document.

The following fundamental points seem now to have been decided:

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- Bandwidth will be 500 MHz (and **not** 625 MHz as earlier expected)
- Alien crosstalk is a new critical parameter (alien crosstalk is the crosstalk between neighbour cabling and includes both near and far end alien crosstalk)
- A length reduction will probably apply for **today's** traditional unscreened or badly screened cabling (compared with the 100 m cabling channels normally specified). Improved unscreened cabling is now being specified aimed to support 100 metres channels.
- Class D:2002 / Category 5e cabling is not being considered for 10 Gigabit Ethernet support

Presently standardisation activities in ISO/IEC, TIA/EIA and CENELEC concern **two fundamentally different issues**:

A: Specification for **established cabling** with respect to support to 10 Gigabit Ethernet

B: Standardisation of **new generation cabling** which will also support 10 Gigabit Ethernet

These two cases will be discussed separately below.

### **A: Established Cabling**

For obvious reasons new applications like 10 Gigabit Ethernet will be developed for installed cabling. Drawing the parallel to Gigabit Ethernet we saw that the performance of the installed base (Class D / Category 5) was then pushed to the limit and consequently a new enhanced cabling class (Class D:2002 / Category 5e) had to be developed to always support the new application. The same now applies for 10 Gigabit Ethernet. **Unscreened Class E / Category 6 cabling is stressed to the limit with respect to both performance and frequency range.** Established cabling will support 10 Gigabit Ethernet, but for unscreened or badly screened cabling only for reduced channel lengths.

Screened Class E / Category 6 and Class F / Category 7 cabling will have a potentially much more smooth extension of support to 10 Gigabit Ethernet than unscreened. Alien crosstalk and EMC problems will here hardly be an issue due to the screen (provided that it is done properly), and the extended frequency range for Class E / Category 6 from 250 MHz to 500 MHz is only a problem for some cabling products today because they have never been developed or verified for this extended bandwidth.

Typical problems could be very bad attenuation in a narrow frequency range over 250 MHz or RL / NEXT performance degrading more than usual over 250 MHz. This last problem could for instance be caused by connecting hardware with less than specified performance, which now cannot be compensated for by the cable at the extended frequencies.

The requirements for the cabling will be specified in technical reports from ISO/IEC and CENELEC, and in TIA/EIA TSB-155. None of these documents have been published. The technical reports are under preparation in the relevant working groups and TSB-155 is expected to be ready for committee ballot in February. It is important to realise that both technical reports and TSB-155 **will not specify component performance** as the specifications in principle only concern installed cabling.

A new name for established cabling in support of 10 Gigabit Ethernet is as far as I know not being

considered nor discussed. However, a name will be most useful as such cabling will have additional minimum performance and undoubtedly will be marketed and requested. Until other naming is agreed 3P has decided to identify such cabling by the denomination 10G added to the normal class or category, for instance Class E<sup>10G</sup>, Category 6<sup>10G</sup> and Class F<sup>10G</sup>. This will indicate that the cabling will have additional performance specifically in support of 10 gigabit Ethernet.

## **B: New Generation Cabling**

The wish from the cabling industry is of course to allow 10 Gigabit Ethernet to run on 100 metres of all types of **new** Class E / Category 6 cabling, including unshielded. Much effort is therefore now being put into development of new generation cabling and the performance of such **new** Class E / Category 6 cabling is extremely challenging for the producers. The development may be considered as a road to "3rd generation cabling" both with respect to requirements and bandwidth.

No specifications for this new "3rd generation cabling" have been published, but the following few requirements appear mature:

New Class E / Category 6 Cabling:

- Bandwidth: 500 MHz
- Attenuation: Improved to the present Class F / Category 7 performance

New Class F / Category 7 Cabling:

- Bandwidth: 1000 MHz

Much work is left before the standardisation of the "3rd generation cabling" is published or even mature. I expect that the new standards will be published in approx. 1 - 4 years from now, the first being from TIA/EIA (as usual).

The requirements for the cabling will most likely be specified in addendums to ISO/IEC 11801 and CENELEC EN 50173-1, and in ANSI/TIA/EIA-568-B.2-10. None of these documents have been published. The first draft of ANSI/TIA/EIA-568-B.2-10 is expected to be ready for committee ballot in February.

The name for the new generation cabling has not been decided. Names like Cat. 6A (A for augmented) or Cat. 6e have been proposed, but do not seem attractive in connection with the use of class names. Until other naming is agreed 3P has decided to identify such cabling by the denomination of the bandwidth added to the normal class or category, i.e. Class E<sup>500</sup>, Category 6<sup>500</sup>, Class F<sup>1000</sup> and Category 7<sup>1000</sup>. Such names will link, but not limit the performance to 10 Gigabit Ethernet support.

## **2. Critical New Requirements**

Every new application may inflict new problems for the cabling. For Gigabit Ethernet it was return loss becoming painful, and most companies have had problems with the demanding return loss performance in the first years after launch of the Gigabit Ethernet. For 10 Gigabit Ethernet the problem will be alien crosstalk and EMC. 10 Gigabit Ethernet will apply intelligent electronics

which analyse the channels and compensate for measured poor performance of internally generated noise. Therefore it is now not a problem to have negative ACR (unthinkable in "the good old days" where signal to noise ratio had to be positive) and poor return loss can also be improved by the electronics.

However, disturbances coming from the outside are not predictable and therefore difficult to compensate for. Such outside noise will come from neighbour cables (alien NEXT and alien FEXT) and external noise sources like mobile phones, radio transmitters, etc. Consequently the alien crosstalk and EMC parameters of cabling and cabling components have now become primary parameters. EMC performance of screened and unscreened cabling can be measured as "Coupling Attenuation" and for unscreened cabling alternatively as balance. Measurements of both these parameters are well known today and the situation is therefore just increased significance, and measurement precision and limits for these parameters. However, **the measurement and specification of alien crosstalk is a major new challenge.**

Various laboratory **measurement methods** for alien crosstalk have been proposed, but not yet agreed. In-field testing of installations for alien crosstalk is extremely difficult and not part of any installation test programme today. Alien near end crosstalk **limits** have been proposed today by IEEE and are found in TSB-155 and technical reports from ISO/IEC and CENELEC. These limits will be a function of the attenuation of the channel, as better attenuation will give higher signal level at the receiver and thus reduce the influence of the alien noise.

A significant complication is that the specified alien near end crosstalk applies for the installed channels and therefore cannot be easily verified. What can be measured is the alien crosstalk of representative sample of the channels under laboratory conditions. The correlation between laboratory test results and in-field performance needs to be established before laboratory test limits may be safely concluded.

### 3. Cabling Choices

All cabling types can support 10 Gigabit Ethernet considering more or less length restrictions. The length reductions will depend on attenuation of the channel, and presence and performance of any screening or alien crosstalk performance.

- Class F / Category 7 cabling should be able to support 10 Gigabit Ethernet without length reductions
- Well screened Class E / Category 6 cabling should have no or very little length reductions needed
- Today's installed unscreened Class E / Category 6 cabling is frequently declared always to support 10 Gigabit Ethernet for 55 metres length of channel
- "3rd generation" unscreened Class E / Category 6 cabling is aimed to support 10 Gigabit Ethernet without length reductions

Support to 10 Gigabit Ethernet by a Class D:2002 / Category 5e installation is of course also possible if a sufficient length reduction is applied. However, as the supporting length is very short this is not considered by standardisation.

The supporting length may be improved for a traditional unscreened installation. This may be done

using different **mitigation methods** reducing the effect of the alien crosstalk, including unbundling of installed cables, removing any crossconnects and use of longer length patch cords. Mitigation methods will be proposed by the future standards. Length improvements of 5-15 meters of unscreened cabling is claimed possible by use of mitigation methods. 3P has not verified effects of mitigation methods.

#### 4. Component Developments

Development of component requirements has started in standardisation committees. The major problem is the Category 6 RJ 45 connecting hardware performance over 250 MHz, where it normally degrades significantly. Extended cable performance is most often without problems and can be easily specified unless much more strict requirements are imposed to compensate for any connecting hardware limitations.

#### 5. Market Reactions

As concluded above the new "3rd generation cabling" specification is not expected soon, but the market already now requests 10 Gigabit Ethernet support for new installed cabling. This is understandable as no one would like to choose a cabling system knowing that it may be technically restricted soon after it is installed.

I therefore **expect** that most suppliers will market cabling for 10 Gigabit Ethernet already in the near future in spite of the still developing standards. Present cabling systems may or may not be improved to serve the new market needs and may have some length restrictions for support. The important point for the end user is to know if the support of a cabling system is given for the full channel length or if acceptable length restrictions apply. As a consequence any late arrival of the **new** Class E / Category 6 standards will only have little significance on the market. 10 Gigabit Ethernet cabling will develop fast based on the requirements for the **present** Class E / Category 6 cabling, possibly slightly improved, for instance by a better attenuation of the cables.

Retesting of the installed base of Class E / Category 6 cabling will of course be required before the future 10 Gigabit Ethernet is implemented on the network.

Yours sincerely,  
3P Third Party Testing



Poul Villien