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TR-42 – Engineering Committee on User Premises Telecommunications Cabling Infrastructure

Date: October 6, 2006
To: **Bob Grow, Chair IEEE 802.3 (bob.grow@intel.com)**
cc: Michael McCormack, Chair IEEE 802.3at (mike_mccormack@ti.com)
Wael Diab, Secretary IEEE 802.3at (wdiab@broadcom.com)
David Law, Vice-chair 802.3 (David_Law@3com.com)
Bob Jensen, Vice-chair TIA TR-42 (robert.jensen@flukenetworks.com)
Stephanie Montgomery, TIA (smontgomery@tiaonline.org)
Valerie Rybinski, TIA TR-42 Liaison to IEEE (valerie_rybinski@siemon.com)
Chris DiMinico, IEEE to TIA TR-42 Liaison (cdiminico@ieee.org)
Shadi AbuGhazaleh, Chair TR42.7/TR42.1 DCTG (sabughaz@hubbell.com)
From: **Herb Congdon, Chair, TR-42 (hvcongdon@tycoelectronics.com)**

Subject: Cabling Maximum Current Carrying Capacity

In response to the liaison letter dated September 1, 2006, the following update on developing the current carrying capacity limits of category 5e, 6 and 6A cabling and the responses to the inquiries are provided.

A task group under TR-42.7 *Telecommunications Copper Cabling Systems* has been formed to compile a set of recommendations regarding the application of DC power over category 5e, 6 and 6A cabling, with consideration for heating and its effect on life cycle and performance of cabling. This task group has reviewed several proposed test procedures and has developed a project plan and a test methodology. The task group is collecting and analyzing data from multiple cable and connector manufacturers.

Recognizing that the current capacity specifications need to be established in a way that will not degrade or damage the cabling plant, the task group is currently recommending that a temperature rise of 10 degrees C is an appropriate limit in developing the guidelines for current capacity. This limit was developed considering a variety of environments and installation conditions.

A 10 degree C temperature rise over installed ambient temperature results in approximately a 4% increase in channel insertion loss. Most installed channels will still support a broad range of applications, including Ethernet, under this additional temperature rise. With regard to life cycle, a 10 degree C temperature rise is expected to reduce the life of cabling materials by 50%. The task group is recommending this as the maximum acceptable reduction in the life cycle of cabling installations, which are typically expected to last 10 to 25 years.

TR-42.7 will be meeting in December 2006 and has scheduled a review of the task group data. We plan to provide the conclusions on current capacity, including an update on the allowable temperature rise, by the IEEE meeting in January 2007.

As for the inquiries, the following responses are provided.

1. The actual channel loop resistance is a topic of debate, and we would appreciate some guidance for Medium Dependent Interface (MDI) to MDI links on what the loop resistance applies to and applicable operating conditions.

   Reply: The channel loop resistance is specified in both TIA and ISO. Actual channel loop resistance will require an investigation of the installed cabling performance. This work will be added to the task group agenda and reported separately.

2. What is the current carrying capacity when all pairs in a bundle are powered and 50% of the pairs in a bundle are powered?

   Reply: The current carrying capacity when all pairs in a bundle are powered and when 50% of the pairs in a bundle are powered should be considered the same. The rationale is as follows:
   - The heating concerns relate to the temperature rise on each conductor as well as the overall bundle temperature.
   - Although a single application may attempt to power only two pairs, it is possible that users and applications developers may run multiple applications over the same cable.
   - There are cable types that do not utilize 4-pair configurations.

3. We need to understand if there can be any improvement in conductor to conductor DC unbalance within a pair in any channel.

   Reply: The task group is investigating this issue and will provide a more complete response in January. Meanwhile, please be advised that the current dc resistance unbalance (DCRU) values are based on physical constraints that cannot be changed for existing category 5e and 6 channels. We are considering the best possible DCRU for the new category 6A cabling.

4. What temperature rise should we expect in installations (including typical and worst case) and could you provide the bundle size and installation environment (conduit, etc) used for these?

   Reply: Our goal is to provide recommendations on the current capacity that can be supported by generic cabling given no specific knowledge of the installation. We also intend to provide a full report of our findings, including possible means for increasing the current level within the constraints of the allowable temperature rise, if the installation and ambient conditions permit.

5. Our understanding is that the maximum cable operating temperature is 60C for PVC. Is this a reasonable assumption?

   Reply: The maximum operating temperature specified in commercial building cabling standards is 60 degrees C. There are several guidelines and special considerations for installations that operate at temperatures higher than 20 degrees C. These include significant reduction in channel lengths (by up to 16 meters), the use of higher-performance cabling, and more frequent replacement of the cabling infrastructure. It cannot be assumed that an existing installation that operates at a given ambient temperature can be driven to the maximum temperature of 60 degrees C. There is a limit to the acceptable tradeoff between current and temperature rise.

6. Can we assume that we can operate at a mathematical sum of ambient plus cable heating provided the total is equal to or below 60C?

Reply: In general, the operating temperature can be assumed to be [ambient + temperature rise]. Please see the response to 5 above for restrictions on this implementation.

7. Can we receive a specification for channel pair to pair DC unbalance?

   Reply: There is currently no specification for pair-to-pair DCRU. The task group is investigating this issue and will provide the information as it becomes available. It is our expectation that pair-to-pair DCRU will be greater than the intra-pair DCRU. Also, please be advised that the specification of pair-to-pair DCRU for existing cabling categories is not feasible.

8. What differences do you expect between stranded patch cable and solid horizontal cable?

   Reply: The current carrying capacity will be specified for channels based on the performance of all components (cables, connectors and cords), and not for individual components.

9. Is there anything else that you believe we should be investigating or consider in developing our specifications?

   Reply: We'll advise of further considerations as they arise.

We want to thank the members of IEEE 802.3at who participated in our joint meeting on October 3rd, 2006.

We look forward to further cooperation as both IEEE 802.3 and TR-42 complete this critically important work.

Best regards,

Herb Congdon