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and Measurement
Technology

Fault Analysis

Documentation
and Reporting

HANDBOOK OF CABLE TESTING

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On the way to new frontiers



High-quality copper wiring in local area networks form the basis for fast and secure data communication. In the 90th users were satisfied with transfer rates of 10 & 100 Mbit/s, which is no longer enough today. Today we are talking in LANs about 1 & 10 Gbit/s and - especially in the environment of data centers - about 40 Gbit/s over copper cabling. The latest technologies in multimedia environments, such as Next-Generation Wireless LAN (IEEE 802.11ac) and HDTV with high resolutions (4K and 8K), drive the bandwidth - and therefore the transfer speeds - in copper data networks up into new heights'. To ensure the warranties and the proper function of these high-speed copper data networks, this inevitably includes measurement and testing of these cabling systems. So the field testing technology must be prepared. Meanwhile, we are talking about Cat 8 / 8.1 / 8.2 and Class I & II. So we are dealing in this brochure with these issues as well.

We continue the tradition of summarizing all issues around measuring- and testing-technology of copper data network cabling in a handy booklet. The first issue on this subject appeared already in March 2007. This new edition of "The Handbook of Cable Testing" will easily find its place in the tool box or in the case of the measuring equipment of every data cabling installer: Always at hand, quickly to look up, with comprehensive information and up to date.

We wish you smooth installations and testing of data cabling installations.

Sincerely
Dipl.-Ing.(FH) Thomas Huesch
Technical Support & Training
Psiber Data a Softing Company

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Data Transmission Technology: Standards – Installation – Measurement

Fundamentals of Network Technology This brochure takes a closer look at data transmission technology starting with the evolution of networks, standards, certification testing and troubleshooting to reporting and documentation. Did you know that the popular and widely used Ethernet celebrated its 40th anniversary and that IEEE 802 began the standardization of Ethernet as early as 30 years ago with the first 802.3T standard?

The use of computers, smart TVs, telephone systems using VoIP technology and building communications systems (door communications systems, alarm systems) has become an integral part of our modern life. But it is not long ago that separate communication networks were needed to run them: Twisted cables for the telephone, coaxial cables for the television and clumsy data cables (IBM) for the early office PC systems. Today, however, »Ethernet« has established itself as the dominant standard in communications technology and is equally used by the various disciplines. Nowadays, the term »Ethernet« describes both, the physical interface (cable, connector) and the transfer protocol, providing the basis for the universally known »TCP/IP« world – the logical functions of the network components. This brochure will focus on the physical Ethernet interface that is well known as »structured building cabling«. If you are a skilled measurement technician you will even have to consider it when it comes down to its planning, installation, certification testing and operation. For a better understanding, let us start with the basics of today's network infrastructure.

Everybody is talking about the so-called »universal structured building cabling«. What does this mean and which relevant standards do exist?

Chapter 1: Retrospective, History

Evolution of Ethernet

Let me quote Bob Metcalfe (Figure 1), the inventor of Ethernet, who is now a professor of Innovation at the University of Texas in Austin, for some historical data. He commented the happy event in 2013: »On May 22nd, we celebrated the 40th anniversary of the invention of Ethernet at Xerox PARC. Now, on June 23rd, we celebrate the 30th anniversary of Ethernet's standardization by IEEE 802.« Of course, Ethernet has been standardized many times by IEEE 802.3 since 1983 to incorporate the rapid innovations from 2.94 Mbit/s to 100 Gbit/s, from thick to thin coaxial cables to twisted-pair and to optical fiber cables and Wi-Fi, from CSMA/CD bus networks to switches and ultimately wireless access points whilst assuring a high degree of backward compatibility. »"By 1983,

there were people buying Ethernet whom I did not know personally. By 1985, there were people whom I did not know inventing Ethernet. And they continue doing so today with great success

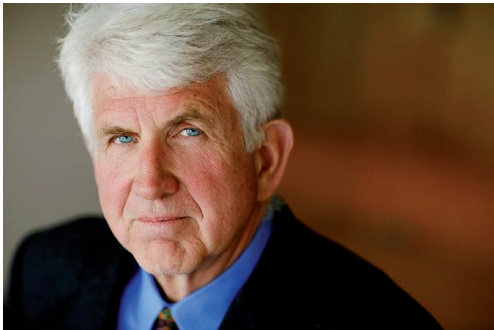


Figure 1: Ethernet inventor Bob Metcalfe is today professor for innovation at the University of Texas in Austin

using the open standardization processes of IEEE. Congratulations, and thank you», Metcalfe continued (Source: IEEE SA).

Increasing Data Rates

The same is true for the data rates which were and are increasing dramatically (**Figure 2**). The development of balanced twisted-pair cabling systems that are used today has advanced rapidly over the last decades. Whereas in 1995 networks with transmission speeds of 100 Mbit/s were installed and operated, network speeds have increased by the factor 100 to date. Since the year 2000 copper-based networks with transmission rates of 1 Gbit/s have been installed and operated, at first in data centers, followed by work place installations. For some years now, Cat

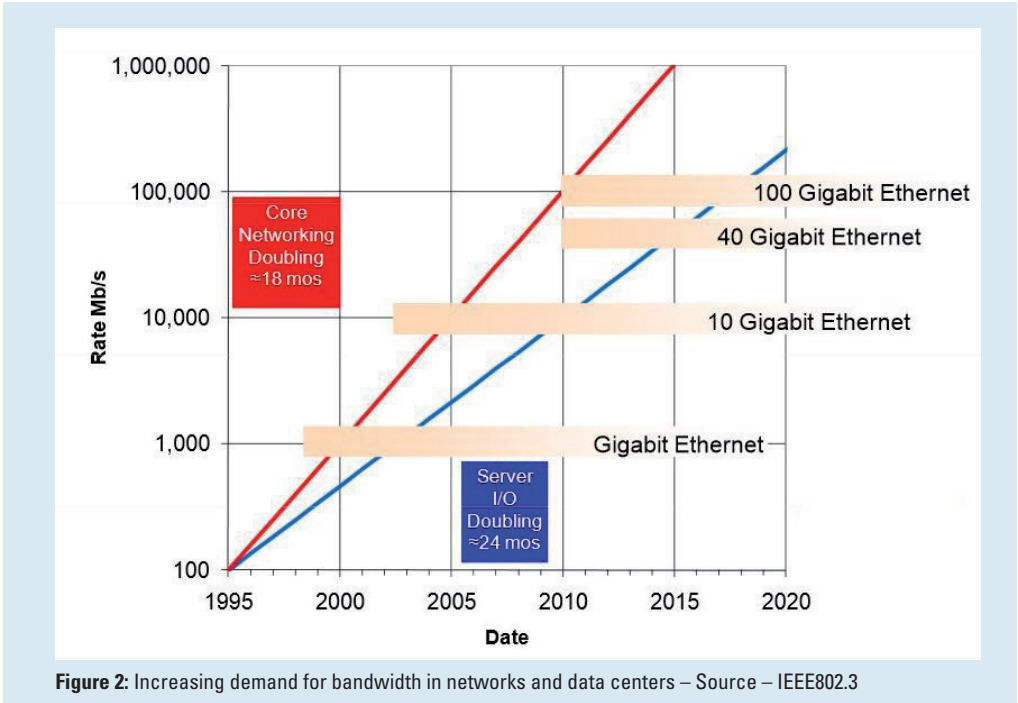


Figure 2: Increasing demand for bandwidth in networks and data centers – Source – IEEE802.3