Transmission rates up to 10Gbit/s

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As the desire and need for increased bandwidth grows, the demands on network testing will inevitably follow suit

The hunger for more bandwidth is steadily growing in the Wi-Fi environment. New standards and technologies struggle to meet the increasing requirements. Today, modern access points already offer bandwidths of several Gbit/s per client. Tricks are used like sending multiple simultaneous streams over multiple antennas or beamforming to cope with the increasing number of clients. Highly bizarre, is the fact that the connection speed to access points was limited to 1Gbit/s for many years. Although some devices were able to aggregate multiple 1Gbit/s links over multiple ports, or used fibre optic cabling instead, these devices never succeeded in penetrating the market due to the higher cost of installation associated with them.

In 2017, standards were published that define transmission rates of 2.5Gbit/s over Cat 5e cabling, 5Gbit/s over Cat 6 cabling and up to 10Gbit/s over Cat 6A cabling. This solves several problems in one go, especially with regard to the connection of high-speed Wi-Fi access points. On the one hand, only a single cable is needed per access point for new installations, which entails significant cost savings. On the other hand, existing installations can be upgraded without interfering with the cabling infrastructure.

For many years now, the standard procedure for new installations has been a service-independent certification of the installed components. This means the electrical properties of the passive transmission components are determined and compared with the specifications defined by international standards. This task is mainly conveyed to external service providers who hand over the installation, virtually, as a turnkey system.

Qualifiers for performance parameters

What happens when no complex certification is required? In contrast to conventional new installations, in-house system administrators are increasingly involved, and often don't have a cabling certifier and the expertise required for it. It's rather necessary here to test the functionality and localise faults quickly. The demands placed on the documentation of the test results, however, are similarly high as those placed on certification measurements performed with certifiers.

These challenges gave birth to a new generation of testers in the world of data networks. These devices are used to determine the transmission capabilities of structured cabling, which are now well known as qualifiers, and were developed with the objective to provide an easy and cost-efficient method to verify the performance parameters of data links after installation. Moreover, qualifiers should be able to perform simple tests during commissioning and troubleshooting in existing installations. Unlike a certification tester, these qualification testers don't provide any service independent evaluation, as specified by the classic standards for structured cabling. Instead, they allow for simple OK/fault tests compliant with specific application standards. These qualifiers, just like the active network components available, were limited to a maximum transmission rate of 1Gbit/s.

New transmission rates

As transmission rates have increased, so have the demands placed on the qualifiers. Today, we find a new generation of qualifiers on the market that enable the end user to quickly and easily qualify cabling links up to 10Gbit/s and to document this. As before, the manufacturers of network qualifiers were agreed on the supported data rates, however, they were not agreed on the required combination of tests and measurements. Simple cable tests, for example, are supported by all devices but there are considerable differences between the individual qualifiers with regard to tests aiming at qualification. Apart from the simple cabling tests, three different tests or rather measurements have established in the field of qualification:

1 Signal to Noise Ratio (SNR)

The level of the useful signals and of the noise signals in the transmission link are measured and compared. If the ratio becomes too small, the receiver of the data will no longer be able to distinguish the data from the noise. Particularly in unshielded cables, noise can quickly become a problem due to the lack of shielding and will ultimately impair the quality of data transmission.

2 Bit Error Rate Test (BERT)

The easiest method to test the transmission rate is the bit error rate test. While data is sent at maximum speed from a main unit to a remote unit and back, it analyses if and how many bits are erroneous or lost. In this test, 10 seconds have to pass without any erroneous bits to be considered as passed.

3 Delay Skew

The difference in signal propagation delay between the individual pairs is measured. Since Gigabit Ethernet has been put into operation, all four pairs have been used simultaneously for data transmission. The sender fragments the data packet and sends the individual pieces in parallel over the four pairs. The receiver then has to reassemble the packet. If the delay skew between the individual pieces of the packet is too large, the receiver will be unable to reassemble the packet correctly and will discard it.

The different approaches of these three tests clearly show that only a combination of all the three tests, in addition to the simpler cabling tests, and a length measurement can provide a reliable evaluation of the passive components used. The qualifiers currently available in the market, however, often support only one or two of the mentioned tests.

Power over Ethernet

A test that's getting increasingly important is the test of Power over Ethernet (PoE) supplies. Today, a growing number of network devices are powered by PoE. The benefit is that only one single cable, the network cable, is needed to connect each device, thus eliminating the need for separate power supplies. Power is often supplied via central injections and there are more and more switches offering this functionality.

Due to the complexity of the many PoE configurations that are possible, pure voltage measurements with conventional measurement devices are no longer sufficient. A problem frequently occurring in PoE supplies is that the amplifiers provide the correct voltage in idle state, which, however, will drop to a fraction as soon as a load is added. High-quality devices detect a voltage drop by applying loads to a PoE link. Moreover, which PoE classes (modes of operation) are supported needs to be tested. This helps to avoid the problem of the IP camera that was working perfectly during its configuration at the desk, won't work at its final installation location.

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Active tests and troubleshooting

Another important aspect, apart from the pure qualification of passive components, is that qualifiers allow for troubleshooting active systems and for documenting their state. In general, traditional functions are used for this, which are well known and are preferred by system administrators. The user needs to be able, for example, to get an overview of the running network and to test availabilities; for this purpose, the qualifier should be able to connect to the active network and clearly display all information about the capacity of the connected ports as well as additional data such as DHCP server and gateway address.

A comprehensive Ping test should be available for the commissioning of new systems and the troubleshooting of existing systems. If it's possible to create a Ping list containing IP and URL addresses, the user will be able to verify the connectivity of a port at the touch of a button and check whether all servers and printers needed for the specific place of work are available. This is an important feature, in particular for MACs (Moves, Adds, Changes) in the enterprise environment.

Likewise, a specific search for individual devices is possible. This quickly determines whether individual terminal devices, such as email servers for instance, can be accessed. When problems occur in the communication with the outside world, the Trace Route function complementing the Ping search is useful and provides information on the devices on the route to the destination address, which can also be located outside of one's own local network. In this way, problems to access the Internet can be uniquely identified as either internal or caused by the provider.

VLAN identification and analysis

Today, large modern local networks are often subdivided into smaller individual virtual unities using VLAN tags (Virtual LAN tags). Well-equipped qualifiers can identify these VLANs and display their IDs and priorities. To receive more information on the individual switch ports, these testers are able to perform an analysis of CDP (Cisco Discovery Protocol) and LLDP (Link Layer Discovery Protocol), whereas the content of information is highly dependent on the switch used.

It can be stated that at any place where the existing network infrastructure is subject to the constant change of new technologies, where components are often renewed or replaced, or troubleshooting needs to be performed, modern qualifiers should be an integral part of the test equipment. And where, for various reasons, certification of cabling isn't required, qualifiers are an indispensable alternative to the class of certifiers, when it comes to the test and documentation of the installed network. When choosing a modern qualifier, it's important that it combines all these features to offer everything a network technician needs for his job today – from the qualification of passive components to the troubleshooting of installed networks. ■