Fiber tests "Made in Europe" – Finding errors quickly and easily

The year is 2024 - Europe votes. Europeans are deciding whether and how the goals of the "Gigabit Society 2025" and the "Digital Compass 2030" can be achieved. These strategies for expanding the digital broadband infrastructure in Europe are indispensable for maintaining and strengthening the business location and competitiveness. As important as they are, they are also ambitious. After all, every European household should be connected with at least 100 Mbit/s by 2025 and at least 1 Gbit/s by 2030.



You don't have to be an industry expert to understand how ambitious these targets are. But: where there are goals, there is often a will to achieve them. How they are to be achieved, however, is viewed very differently by the parties: The ideas range from nationwide 5G expansion to open and free WLAN networks to the demand that fiber optics in the fixed network to the front door become the EU standard. What all these demands have in common is the need to lay more fiber optic lines. This is because mobile phone masts, which need to be much closer together in a "nationwide 5G expansion" scenario, or the access points of open and free WiFi networks also require a high-performance fiber optic connection. Above all, politicians would like to see nationwide expansion in rural areas and as little overbuilding as possible in densely populated urban areas. Sustainable and future-proof solutions are crucial.

Money for this should come from the private sector and from public funding pots by means of investment incentives. Examples include the "Connecting Europe Facility (CEF)", the "Gigabit Funding 2.0" with up to EUR 200,000 for rural districts and up to EUR 50,000 for cities and municipalities, as well as the low-interest loan for municipal companies directly from the "Kreditinstitut für Wiederaufbau (KfW)" in the amount of up to 50 million euros.

Problems with network expansion

First and foremost, of course, the expansion is being carried out by the large nationwide network operators in the respective member states, but also increasingly by many small regional municipal and public utilities. However, new companies that are not rooted in the region are now also operating across the country and are increasingly competing for customers in rural towns and municipalities.
As everyone is investing in infrastructure at the same time, the

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lack of trained specialist personnel means that construction teams operating across Europe, who are not always necessarily specialists, are increasingly being deployed. The ambitious goals and the money to be distributed are therefore attracting many different players with very different focuses. As a consequence, and this is already evident in some countries, considerable quality problems are arising in the expansion process. The awarding of civil engineering and laying work to untrained newcomers without the appropriate equipment and know-how is now increasingly leading to the fact that the work has not been done properly enough - after all, the expansion has to be done faster and cheaper.

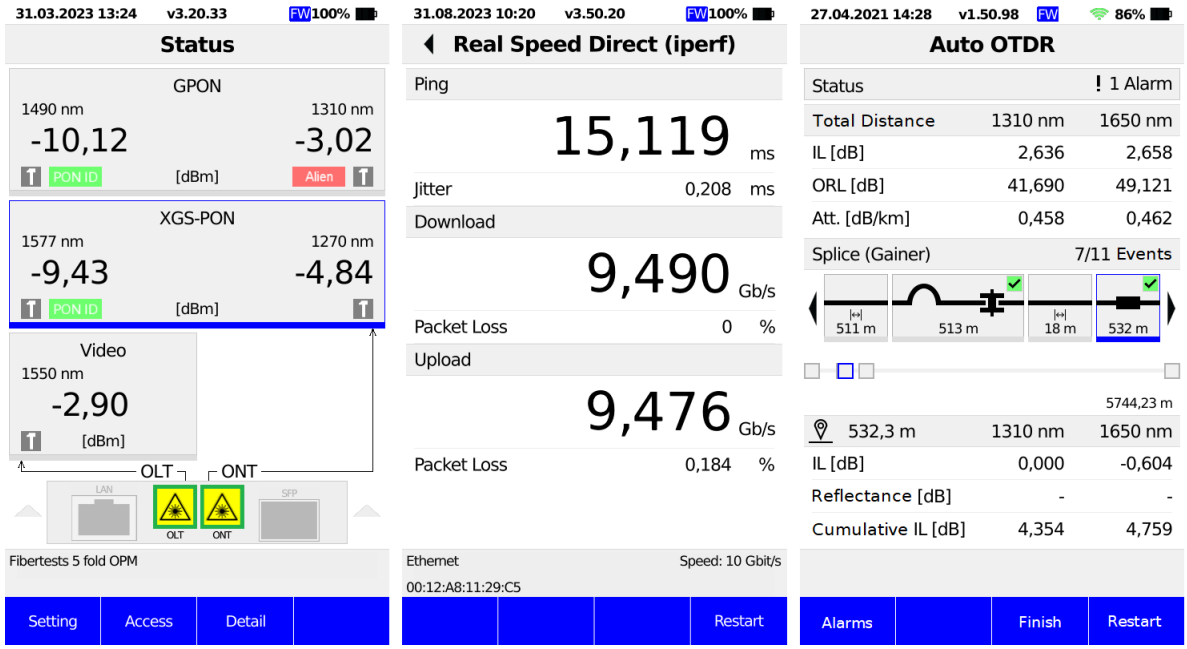
Cleanliness is a particularly important issue in fiber optic expansion. Not only with regard to the fact that connectors and fiber end faces must be free from contamination such as dust, grease and moisture and must not be damaged or scratched under any circumstances (IEC 61300-3-35, for example, sets out precise specifications here), but also with regard to laying and routing in the street cabinet, at the customer's premises and in the empty conduit. A fiber optic cable cannot be treated, laid and routed like a classic copper cable. Fibers are bent too much (bending radius violation) or even kinked - especially in the densely populated distribution box and at the customer's premises. This is something that, with luck, can still be seen with the naked eye. It becomes more difficult when fibers and connectors are permanently stressed by tension or pressure and only show signs of fatigue over time. However, good advice is often hard to come by at the latest when optical fibers are not aligned correctly during splicing or errors occur when stripping the coating or breaking and, above all, the attenuation of the finished splice is not measured.

Rapidly increasing technological progress in the form of new standards and ever higher speeds is causing a shift in optical transmission ranges. In addition, a rapidly growing complexity due to a mix of "old" and "new" technologies in combination with a lack of knowledge and tools leads to further, often even greater difficulties. Whereas just a few years ago, asymmetric GPON and occasionally active Ethernet (AON) as a point-to-point connection (PtP) were used almost exclusively in large parts of Europe, symmetric XGS-PON is now increasingly being used.

Not only are all three technologies expanded at the same time, but GPON and XGS-PON are also switched simultaneously via a splitter, i.e. on a single common PON branch (see illustration) via one and the same fiber. This means that transmission takes place simultaneously on two different wavelengths and reception on two others.

Here and there, an additional video overlay for TV applications, for example, is sent to the splitters and thus to all fibers via the wavelength of 1550 nm - only in the downstream direction, as a type of broadcast service. This is basically possible in all types of PON networks.

In some European countries, such as France or Estonia, individual providers are also relying on EPON and the downward-compatible 10G-EPON instead of GPON and XGS-PON. Although this PON, which is based directly on Ethernet, uses the same wavelengths as GPON and XGS-PON, it differs in other respects as no additional encapsulation and conversion of the Ethernet frames is required. Furthermore, a distinction is also made between symmetrical and asymmetrical applications, and instead of controlling the data packets using the PON ID and ONU ID, EPON uses the so-called LLID (Logical Link ID) and the MAC address of the ONU.



Simultaneous measurement of the optical level with a selective 5x OPM (l.), measurement of the access performance up to 10 Gbits/s in the form of an IP speed test (m.) and the typical event table of an automated OTDR measurement on two wavelengths (r.)

Solution: Measurement technology

It quickly becomes clear that without the appropriate expertise and the right tools, the ambitious goals of fiber optic expansion cannot be achieved. High-quality and modern measurement technology is indispensable as a tool and can - at least in part - also replace the missing and often expensive expertise if the right products are chosen.

Essentially, three measurement technology categories can be roughly distinguished here: On the one hand, there is the simple or

quick tester for a rather superficial test and the smaller budget, then the normal fiber optic tester with all essential functions often in the medium price segment and the universal tester or all-rounder, which, depending on the equipment, certainly has its price, but also its value.

Simple and quick testers

As is so often the case, the right choice naturally depends on the application. If you only need to determine the optical level quickly and precisely, for example to determine the optical budget, a selective power meter that either only measures the two downstream wavelengths (see above) or one that works in through mode and can determine the upstream and downstream levels may be sufficient. In combination with a suitable OLS (Optical Light Source), the presence of an OLT (Optical Line Terminal, the terminal device on the opposite side) can even be dispensed with; the tester and OLS together then form a so-called attenuation measurement set. Disadvantage: The OLS must be connected to the far end before each measurement.

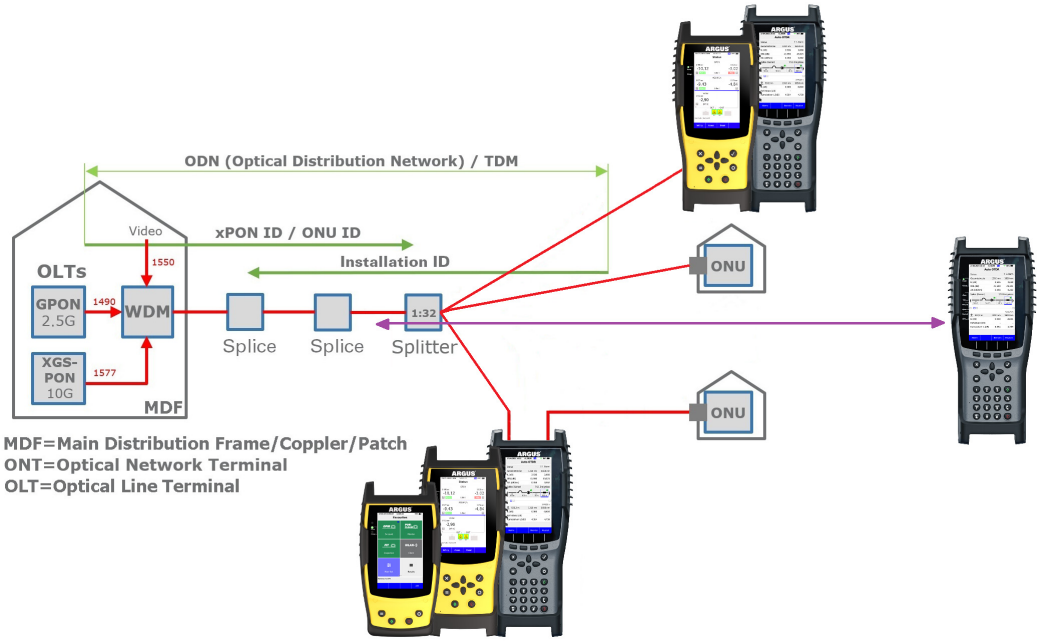
A software-guided wizard can also help to measure entire PON branches quickly and in a structured manner and archive the data in corresponding measurement logs. This minimizes errors and thus increases customer satisfaction in the long term. Despite the simplicity of such a measurement solution, the connection of a fiber microscope to check the fiber end faces (see above) should not be dispensed with. The target group for this are, for example, craftsmen and installers who need to quickly and cost-effectively commission or check PON infrastructures or entire PON branches that have already been rolled out. This is often the case during initial installation or after damage caused by fire or malicious destruction, for example.

Functional fiber testers

If the measuring device is also used to find simple faults and simulate services, which is often the case after fault messages, for example, then the options for automatically reading out the PON ID at the same time as measuring the level and performing an ONT simulation are also indispensable. Because if problems are not visible by checking the fiber end face and the optical level, they are often found in higher layers and in the protocol. Especially in areas where overbuilding is regulated or even prevented by law, which is likely to become increasingly common in the future, several network operators may share a distribution cabinet in a neighborhood. Additional splitters per network operator are quickly added in conurbations. The first developments of this kind can already be observed.

How quickly a customer is connected to the wrong PON branch - or worse still: to a competitor's splitter. A so-called alien (AON terminal in the PON), for example, can paralyze the entire PON branch; alien detection can provide a remedy. Last but not least, however, experience shows that configuration problems on the ONT are the cause; here the classic problem should be mentioned: Username or password fail when trying to establish a PPP connection with the provider, which does not always have to be the same as the network operator. Only a full ONT simulation can help here. Depending on the speed tariff offered, high-performance IP tests, such as downloading or uploading against a server with a correspondingly high-performance connection, should be possible to prove functionality to the customer.

Since errors and problems are sometimes suspected in the network operator's PON, but can be found in the customer's private network, appropriate copper and fiber-based (e.g. via universal SFP slot) Ethernet interfaces should not be missing on the measurement equipment. A WLAN interface can also be useful.



Construction of a hybrid PON network with GPON (1 Gbit/s) and XGS-PON (10 Gbit/s) with typical measuring points, as is often the case in Europe

Universal tester or all-rounder

However, if more complex faults are expected, which could possibly be on the line, such as the poor splices or bending radius violations mentioned at the beginning, there is no way around using an OTDR (Optical Time Domain Reflectometer). Although there are many providers on the market that offer high-quality OTDR solutions, only a few combine this with the other important functions of the single and field testers or have additional functions such as high-performance speed tests directly on the PON branch (up to 10 Gbit/s).

In addition, they are often so large and heavy that they are difficult to handle in the field. It is therefore important to make the right compromises, because the option of selective level measurement, reading out the PON ID, carrying out an ONT simulation for GPON and XGS-PON and performance tests should still be available.

In optical time domain reflectometry (OTDR), it is therefore particularly important to be able to measure at a wavelength that does not interfere with the live operation of the networks described above. One such wavelength is 1650 nm, because the greatest possible distance to the next live wavelength is important: in Europe this is currently generally 1577 nm (e.g. XGS-PON), but with the introduction of NG-PON2 at 1625 nm it will become even narrower.

A second wavelength is absolutely necessary if you want to be able to reliably detect if the bending radius is too small (so-called macrobend), because it is the difference between the two measurements that makes too small a bending radius visible. The wavelength 1310 nm is ideal for this purpose: This gives you a wavelength with which a measurement can be simulated under live conditions and which lies exactly between the 2nd optical window and the water peak and is therefore very low attenuation. Of course, a manual measurement with display of a fully-fledged and zoomable OTDR graph as well as an easy-to-interpret event table as the result of an auto-OTDR test should not be missing. Finally, all splices, connectors, possible breaks and, of course, the correct cable end with distance and attenuation should be correctly identified and logged.

Only very few devices on the market really offer everything beyond this, from fully-fledged triple play tests with VoIP and IPTV with moving image display, to WLAN spectrum analysis and comprehensive Ethernet tests, which can also be carried out on copper-based Ethernet interfaces.

Conclusion and outlook

The year is 2024 - and Europe is voting. But Europe's citizens are not only choosing the path to this high-speed future and when and how the ambitious broadband targets can and should be achieved. Europe's fiber optic companies and network operators are also choosing how economically attractive, but also how sustainable, they will get there. After all, investments that focus on sustainability will ultimately reap the greatest economic benefits and will also benefit European broadband customers in the long term.

"Buy cheap, buy twice" - as the saying goes. This is also true when it comes to measurement technology. There is high-quality fiber optic measurement technology from Europe. Measurement technology that is developed and produced here, tailored to the needs of European customers and marketed here in the local language with a great deal of expertise for "European fiber optic problems".

The German company "intec Gesellschaft für Informationstechnik mbH", for example, offers such a product portfolio with its ARGUS® brand F series - the "F" stands for fiber. The fiber testers ARGUS® F300, an all-in-one tester, and ARGUS® F240, a mid-range fiber optic tester, are now complemented by the new ARGUS® F200, a simple and affordable quick tester. The fiber optic experts from Germany guarantee that good on-site support and customer orientation are just as important as quality and future-proofing.

Even if the expansion of 10 Gbit/s connections, e.g. in the form of XGS-PON technology, is still in its infancy and significant availability in European cities and municipalities will certainly take many years, one thing is certain: this technology will prevail. In some regions and countries sooner, in others later. Rarely has it been so obvious in which direction the fiber optic infrastructure will develop in the future, so the moment to invest in high-quality fiber optic measurement technology has rarely been so favorable; the solutions are there and the path is clear.

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