Understanding cabling quality with EXFO Advisor

EXFO

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Introduction

Testing optical links is generally based on pass/fail parameters indicating whether a link is functional; however, this gives no insight into the quality of the optical cabling. With fiber going deeper everywhere to lay the foundation for 5G services, understanding cabling quality is now vital to plan and perform network upgrades correctly to ensure forthcoming high reliability requirements.

What is EXFO Advisor?

EXFO Advisor is a groundbreaking feature on the Optical Explorer, the industry's first optical fiber multimeter. This feature is unique in that it allows any technician to obtain an end-to-end link quality assessment within seconds. The process is fully automated and simple to carry out. As the name suggests, EXFO Advisor advises on the link quality, adding on to the capabilities of the Optical Explorer for standard pass/fail link verification and automated fault tracking.
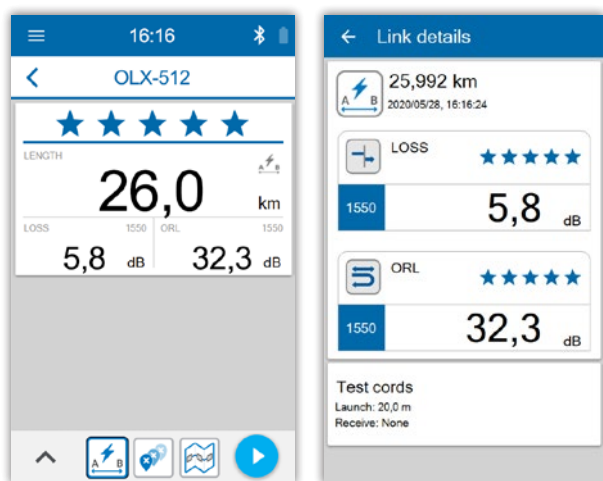
How does it work? EXFO Advisor dynamically compares the link's total insertion loss (IL) and optical return loss (ORL) to the values that would be expected for a given length of fiber optic cabling. Based on this comparison a rating is given. This rating applies to the **global link performance**, and not to individual connectors or splices (The latter are tested as usual by measuring against standard thresholds values).

A rating system using five stars ★ ★ ★ ★ ★

EXFO Advisor uses a five-star system to rate cabling quality. Bear in mind that the star rating is NOT a pass/fail threshold (it does not determine a go/no go) but a **qualitative indicator** against the expected loss of an optimal link. This expected link loss corresponds to the optimal link health, including good quality optical fiber (i.e., minimal attenuation at tested wavelength), well executed splices/connections (i.e., loss corresponding to typical values) localized at reasonable distances (spaced at every ten kilometers).

The star rating is based on the difference between measured and expected values for the link's total IL and ORL. The greater the difference, the more the link is underperforming and the lower the star rating. A rating of 1 is the worst and 5 stars is the best rating possible.

EXFO Advisor performs a **dynamic evaluation**, which means that the star rating (number of stars) adapts and changes according to the link length. Even if there is no fault on the link, the total IL and ORL of the entire link could result in a low rating due to a high number of marginal connections.

What does the rating mean?

When EXFO Advisor returns a high rating, the technician may assume that the link does not contain any high loss events. Based on this safe assumption, technicians may quickly test and process a high volume of fibers.

A low rating indicates an opportunity to improve link performance. Switching to Fault Explorer mode will detect high loss events, locating and identifying link elements that can be improved. A low rating may also be due to a design issue whereby the link has too many connectors or splices, even if they are all functioning properly and the total loss is within budget.

Generally speaking, a four-star rating corresponds to a typical link design, properly installed.

Examples of good and bad links

- A 10 km link with 15 connectors of 0.3 dB each would get only 2.5 stars since the number of connections is high. The link has no faults but is it is far from its optimal health from a total loss standpoint.

- Likewise, a 2 km link built with splices of 0.2 dB distributed every 100 m will not get more than 3 stars.

- A 20 km link with 15 splices will get more stars than a 20-km link with 15 connectors. Because splice loss is typically lower than connector loss.

- A 10 km link having 35 dB of ORL will get 4 stars if all ORL is due to intrinsic fiber backscattering.

- A 100 m link with 35 dB of ORL will not be ranked high because the ORL is caused by bad connector reflectance, the short fiber span is a small contributor to ORL.

- A link with very good first and last connectors (<0.25 dB) but with a middle connector showing a loss of 1.4 dB will obtain 4 stars from a total loss standpoint.

A four-star rating corresponds to a typical link design, properly installed.

Understanding IL and ORL values

The total IL analysis gives an assessment of the link quality in terms of optical signal transmission, regardless of the number of connections. If the total IL is high relative to link length, this suggests the presence of a high-loss single connection, closely spaced connections or multiple low-loss connections. In the first case, switching to the Fault Explorer mode will help identify the fault(s). The second case will not contain faults; improvement of the rating, will require Link Mapper measurement, available on the PRO version of the Optical Explorer to identify and locate the worst connections.

The total ORL analysis gives an assessment of connector quality. A high value on a very short link indicates the presence of dirty/damaged connectors or a bad mating which can (i) cause a rapid degradation of the connections (and therefore of the link) over the time, especially due to changing weather conditions; (ii) create echoes on the link and; (iii) destabilize the source. A high value on a long link may be normal if generated only by fiber backscatter or include bad connectors. The ORL rating discriminates all scenarios.

Example:

- A 200 m link with a bad UPC connection can give an ORL of 30 dB which is too high for such a short fiber. However, the IL of this connection can be low and therefore the overall star for IL can be high. Thus, to catch the bad connection, ORL assessment is very useful.
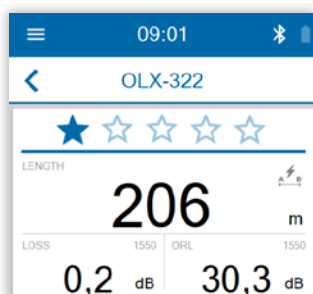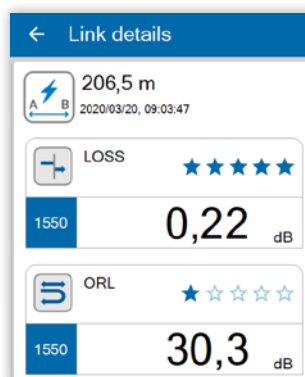
Figure 1. Flash Advisor result

Figure 2. Flash Advisor details confirm that an excessive ORL degraded link quality
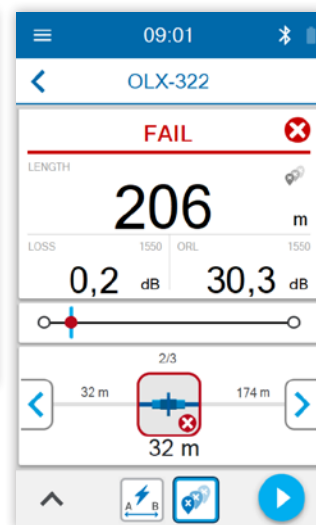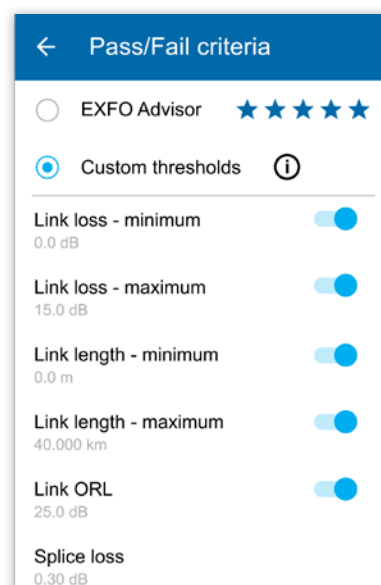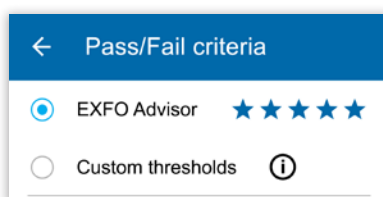

Figure 3. Fault Explorer identifies the weak spot, to facilitate the improvement of overall link quality (if desired)

Hence, by leveraging the star rating, we can identify these weaknesses and act on making the link more robust in anticipation of potential risks and network upgrades.

Automated thresholds

Adjusting pass/fail thresholds requires knowledge and experience in testing optical fiber. Wrong parameters will skew decisions. For novice users, pass/fail is a binary result and doesn't give a qualitative idea of the link health. For individual connections of the link, EXFO Advisor mode uses fixed thresholds that are not editable and that comply with international standards.

Examples:

• Let's suppose we are testing a link of 4 km with two connectors, each with a 2 dB loss. Considering the attenuation of the fiber, first and last connectors, the total link loss is at 6.5 dB. If connector loss threshold is disabled, and the link loss limit is set to 15 dB, then we will get a pass. However, for this case, the EXFO Advisor method will systematically return 2.5 stars and two failed connectors.
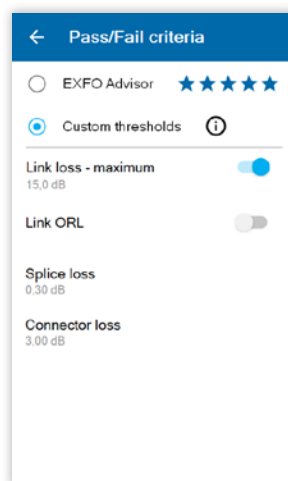
EXFO Advisor removes human error in link quality assessment.

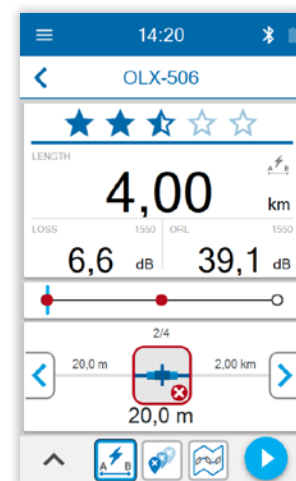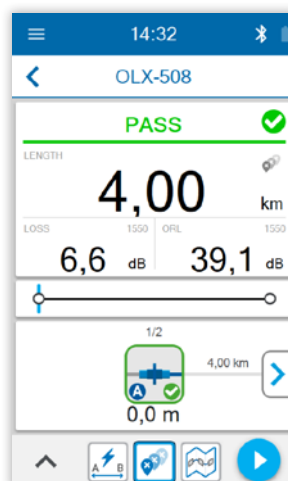Figure 4. Results with use of custom thresholds of 15 dB link loss and 3 dB connector loss

Figure 5. Results with EXFO Advisor

• The ORL is set to 30 dB to have a pass on long links, where fiber backscatter returns a large amount of non-damaging light. This same threshold on a short link would accept a connector close to −30 dB of reflectance that could create more BER and reliability issues.

Simply put, EXFO Advisor removes human error in link quality assessment. Custom thresholds settings remain available for those who need to apply specific criteria.

Summary

The star rating feature is a comparative and qualitative approach that qualifies end-to-end link performance against optimal expectations. It does not indicate whether the tested link globally passes or fails specific IL and ORL thresholds. A link that has been properly designed and constructed will get a high rating. If the analysis yields a low rating (under 4 stars), the Fault Explorer mode can locate and identify the loss events. This opens up opportunities to improve the quality of the link. Reducing IL and ORL will improve the star rating.

EXFO Advisor delivers unprecedented visibility into the health of optical links. This insight will play a key role as network upgrades pick up speed in the race to 5G.

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