

Tech Tip

Testing PON in Deep Fiber Applications

In the previous tech tip, [Testing DWDM in Deep Fiber Applications](#), we spoke about testing and troubleshooting Dense Wave Division Multiplexing (DWDM) and Coarse Wave Division Multiplexing (CWDM) in cable network applications. In this tip, we look at Passive Optical Network (PON). PON is different from CWDM and DWDM in that it consists of a point-to-multipoint architecture and relies on passive optical splitters. There are several PON standards defined by both the ITU-T and IEEE as can be seen below.

	G-PON	XGS-PON (sym)	NG-PON2	GE-PON	10G-EPON	100G-EPON
Standards	ITU-T G.984 (2003)	ITU-T G.9807.1 (2016)	ITU-T G.989 (2015)	IEEE 802.3ah (2004)	IEEE 802.3av (2009)	IEEE 802.3ca (2019 TBD)
DS / US Data Rates	2.4 / 1.2 GBps	10 / 10 GBps	40 / 10 GBps	1.25/1.25 GBps	10 / 10 GBps	Up to 100 /100
Splitting Ratio	up to 1:64 (128)	up to 1:128 (256)		up to 1:64	up to 1:128	Tbd
Fiber Type	G.652	G.652 / G.657 (for new inst.)		G.652	G.652 / G.657 (for new inst.)	
Max Loss	32 dB	35 dB	35 dB	29 dB	29 dB	Tbd
Co-existence	N/A	YES with G-PON		N/A	Yes with GE-PON	

With PON, the majority of the route is over a common distribution fiber, and the splitter is placed in a node near the subscriber, keeping the drop length and amount of fiber deployed to a minimum. The most common splitter is a 1x32, but you may encounter splitters as high as 1x128. Because of the shared common fiber and passive splitter, PON is more cost effective than other network technologies, but it's not without its challenges when testing or troubleshooting.

First, passive splitters have a high loss. For example, a 1x32 splitter can have as much as 15-17db of loss. Because of this, you'll need a PON specific OTDR tester with high dynamic range, high resolution and sophisticated software to properly identify and test through the splitters. Second, testing through an optical splitter is typically only performed from the subscriber (premise) side.

Testing from the headend side with an OTDR would produce a trace with the combined paths of all 32 branches using a 1x32 splitter as an example, making it very difficult to identify a problem. From the premise side, a single path is tested and plotted. When a single customer is down, it is also most likely an issue within the drop from the splitter to that customer.

As with CWDM and DWDM, it's important to note that a network running PON is always live and service can't easily be re-routed as multiple customers are being served. You'll need to isolate the problem without disrupting other subscribers. With this information, you're ready to test.

1) Inspect the Optical Connectors and Check the Power Levels

You'll use a PON-specific power meter for this, such as the VIAVI OLP-87 or OLP-88 series. A PON power meter is different than a standard broadband power meter as it is wavelength-specific and features two optical ports. The downstream input port features an internal tap that directs some of the signal power to a receiver to measure the downstream power level. The remainder of the signal is passed through and exits the second port for delivery to the Optical Network Terminal (ONT).

To perform the test, disconnect the fiber from the subscriber ONT and plug it into the input/downstream port of the PON power meter. Using a fiber jumper, connect the other port of the PON power meter to the ONT. After a few seconds, the ONT will resume transmitting the upstream signal back through the PON power meter toward the Optical Line Terminal (OLT) in the headend or hub. You can now verify the downstream signal is present and of the correct level, as well as the upstream power level being generated from the ONT.

If you have a downstream signal but no upstream power, it's likely a bad ONT. No or low downstream power indicates a fiber issue that we will troubleshoot in the next step. The ITU-T and IEEE standards are already loaded into the testing device for you. This means the tester can give you simple pass/fail results by taking the results of your test and comparing them to the standards.

2) Troubleshoot with an OTDR and Fix Problem

Use a PON-capable OTDR such as the Viavi T-BERD 2000/4000 or SmartOTDR with Fiber-to-the-Home Smart Link Mapper (FTTH-SLM) that optimizes the OTDR to properly identify and test through the splitters. The tester will show a map of the fiber route and identify where problem(s) are located. Fix the problem and go to the next step. There could also be more than one problem. In this case, fix the largest problem identified and go to the next step.

3) Retest with an OTDR Tester

Once the problem, or the largest problem, is fixed, retest with the OTDR. If all characteristics are now within acceptable ranges, close the ticket. If not, isolate the problem, fix it and retest. Keep doing this until all problems are resolved.

There are several variations of PON, as seen in the chart at the beginning of the tip. The most common is G-PON, however newer generations of PON can be deployed simultaneously with G-PON. As with any testing challenge, having the right equipment can greatly simplify the process and make anyone an expert.

Learn more about testing PON by reading [Maintenance and Troubleshooting of a PON Network with an OTDR](#). There is also a great [OTDR poster](#) that illustrates the capabilities of the testers.

Products You'll Use for Testing:

[FiberChek Probe Microscope](#)

[T-BERD 2000](#)

[T-BERD 4000v2](#)

[OTDR 4100 Series Modules](#)

[FTTH-SLM](#)

[OLP-87](#)