FTTx/PON testing reference poster

Testing FTTx and PON networks: best practices and techniques review

Each home, school, business or other type of service provider customer has different requirements when it comes to the upstream and downstream speeds of broadband delivered over fiber—from basic to ultra-fast.

To deliver the right speed to the right customer, both next-generation and legacy PONs are being deployed by overlaying multiple new wavelengths on existing fibers, which becomes challenging for technicians out in the field.

For each cycle of the network life (deployment, activation and troubleshooting) the correct tools and techniques can be different. This poster addresses the latest trends in PON technologies and techniques on how to deploy and maintain these specific fiber optic networks in the most efficient way possible.

Best practices

Connector inspection

Since faulty or dirty connectors are the number one reason behind network failures, inspecting fiber optic connectors is the vital first step to make sure they are ready to be mated. Only a fully automated FIP will give the technician the correct pass/fail result, hassle free.

FIP-500 with fully-automated capabilities

The launch/receive fiber resides between the equipment (OTDR and/or iOLM) and the FUT

Launch and receive fibers

A launch/receive fiber, packed in a convenient SPSB, is a must-have to make OTDR and iOLM measurements. By eliminating dead zones for connector A and providing extra length of fiber for connector B, it allows technicians to accurately determine link loss and link ORL, and to fully characterize connectors A and B.

Though the length will vary when using a classic OTDR (pulse width used, etc.) a minimum of only 15 m is required when using iOLM for any type of network (P2P, PTMP) thanks to Link-Aware™ technology.

Build

Why test?

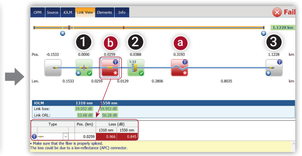
As per the ITU.G.650.3 standard, any new installation or fiber optic network upgrade should follow testing requirements to make sure the elements are within specifications and the service will be carried error-free. Testing the entire fiber network offers a strong network database for both documentation and maintenance purposes.

What to use?

▲ OTDR and/or iOLM at 1310 and 1550 nm to locate and characterize each element of the network.
A dual wavelength measurement is paramount to detect and locate macrobends (a), and an intelligent multipulse acquisition engine is key to leave no fault behind (b)

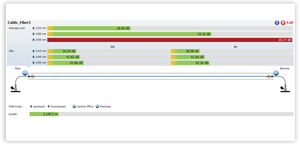
OTDR trace from the ONT to the OLT

iOLM view from the ONT to the OLT



▲ OLS with OPM or OLTS to validate Insertion loss is within network design:

FTTx view of an automated bidirectional OLTS measurement



What to look for?

Full network visibility:
- Total IL, distance
- Event mapping: splices, connectors, splitters

Faulty events to fix:
- Bad connections
- Macrobends
- Bad splices
- Unbalanced loss on splitter legs

Always inspect before connecting fiber.

FIP-500
Fiber inspection scope

Example of a next generation PON network using GPON, RF video and XGS-PON overlay.

Activate

Why test?

Testing during activation will provide a birth certificate of the link; a final acceptance verdict of the service and a reference for future maintenance.

What to use?

- PPM to be inserted through the link to let the OLT and ONT communicate and assess the optical power levels of the downstream/upstream signal at the same time. Recommended power measurement method when multiple PON technologies are on same fiber path (e.g., GPON+RF, GPON+XGS-PON) in order to provide discrete power by wavelength.

Built-in screen on device

OPM mobile application showing PPM-350D results

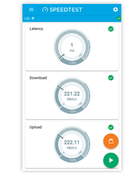
PON-aware™ software enables identification of technology under test

- Optical Explorer (OX1) to validate expected downstream power value and identify causes of failure on the spot. As the service is active, an out-of-band wavelength (1650 nm) on a filtered port must be used so as not to disturb the OLT and to avoid damaging equipment.

- Alternatively, an OPM or MPC may be used to validate expected downstream power value[a].

Mobile application for the PX1

- An EX1 to test the ODN loss, which provides the difference in optical power between the OLT TX and the ONT RX. Emulate the ONT with an EX1 to obtain GPON operational status, ONU ID, ONT Optical RX power, IP address, Speedtest over GPON.



Speedtest® by Ookla®

GPON data

What to look for?

- Bad connection at the drop terminal or the ONT
- Bad drop cable
- Faulty ONT

Troubleshoot

Why test?

Locating faults is the only way to quickly and efficiently troubleshoot the link and get the service back up. Since this is performed on live networks, tools and techniques for testing must be adapted.

What to use?

- PPM to be inserted through the link to let the OLT and ONT communicate and check if both downstream/upstream signals are up. At drop terminal, pass-through measurement will determine if a low light issue is caused by the drop side (failed upstream) or located between the splitter and drop terminal (failed downstream).
- OX1 to quickly identify any cause of failure. As the service is active, an out-of-band wavelength (1650 nm) on a filtered port must be used so as not to disturb the OLT and to avoid damaging equipment.
- EX1 to obtain the network PON ID and validate if a fiber is connected to the correct OLT card and OLT port of the card in the central office.
- Alternatively, use a live PON OTDR or iOLM to test pass the splitter up to central office.

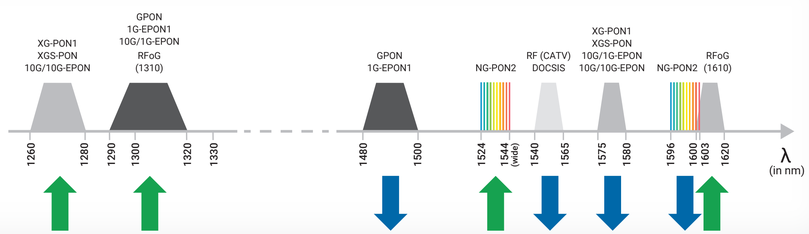
What to look for?

- Macrobends
- Fiber breaks
- Faulty splitter branches
- Bad connector mating

Trends

Available PON technologies

	Legacy and current				Next generation		
	GPON	1G-EPON1	XG-PON1	XGS-PON	10G/1G-EPON	10G/10G-EPON	NG-PON2
PON rate (down/up)	2.5G/1.25G	1.25G/1.25G	10G/2.5G	10G/10G	10G/1.25G	10G/10G	10G/10G per λ
Downstream central λ (nm)	1490 ±10	1490 ±10	1577 +3/-2	1577 +3/-2	1578 +2/-3	1578 +2/-3	1596.34 - 1597.19 1598.04 - 1598.89
Upstream central λ (nm)	1310 ±20	1310 ±50 or 1310 ±20	1270 ±10	1270 ±10	1310 ±50 or 1310 ±20	1270 ±10	1532.68 - 1533.47 1534.25 - 1535.04 (wide)
Max split ratio	1:128	1:64	1:128	1:256	1:64	1:64	1:256



Acronyms

CATV	Cable television
CO	Central office
DOCSIS	Data over cable service interface specification
EDFA	Erbium-doped fiber amplifier
EPON	**Ethernet-based passive optical network**
FDH	Fiber distribution hub
FIP	Fiber inspection probe
FTTx	Fiber-to-the-x, where x = (H)ome, (C)urb, (B)uilding, (P)remises, etc.
FUT	Fiber under test
GPON	**Gigabit passive optical network**
iOLM	**intelligent Optical Link Mapper**
IPTV	Internet Protocol television
ITU	International Telecommunication Union
λ	Wavelength
MPC	Micro power checker
NG-PON2	**Next-generation passive optical network 2**
ODN	Optical domain network
OFM	Optical fiber multimeter
OLS	Optical light source
OLT	Optical line terminal/termination
OLTS	Optical loss test set
ONT	Optical network terminal/termination
OPM	Optical power meter
ORL	Optical return loss
OTDR	Optical time-domain reflectometer
P2P	Point-to-point
PM	Power meter
PPM	PON power meter
PON	**Passive optical network**
PON-aware™	**Automatic PON detection technology**
PTMP	Point-to-multipoint
RFoG	Radio frequency over glass
RF	Radio frequency
SM	Singlemode
SPSB	Soft pulse suppressor bag
VoIP	Voice-over-internet protocol
WDM	Wavelength-division multiplexing
XG-PON	**10-gigabit-capable passive optical network**
XGS-PON	**10-gigabit-capable symmetric passive optical network**

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