

# xPON

## Enabling QoE & SLA Monitoring

### Features...

- Captures all upstream and downstream traffic
- Minimizes insertion loss ( $\leq 2\text{dB}^*$  on network path)
- Enables automated selection of subscriber traffic for monitoring
- Works on any xPON
- Provides access to  $\leq 256$  xPONs for monitoring ( $\leq 8,192$  subscribers) in one system

### Benefits...

- Enables cost-effective QoE and SLA Monitoring
- Unobtrusive and real-time monitoring
- Eliminates proprietary monitoring methods
- Scales from 8-256 xPONs
- Increases customer retention and satisfaction

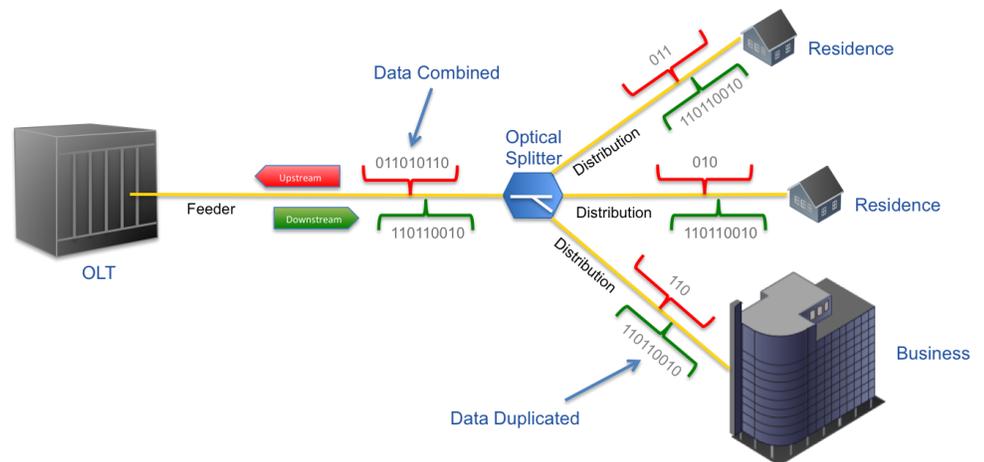
\* Does not include connectors

xPON (GPON, EPON, WDM-PON, etc.) networks are used throughout the world to deliver either residential service or business access. Each xPON consists of an Optical Line Terminal (OLT) port at the central or head-end office and an ONU (Optical Network Unit) at the subscriber. In some cases, the OLTs and ONUs may both be installed in a multi-dwelling/multi-tenant (MDU/MTU) building to provide service to an entire building. Since xPON networks were first deployed, network monitoring has always been a subject of heated debate.

### The Problem

The architecture and passive nature of xPON networks in general make monitoring and troubleshooting these networks a difficult task because every subscriber's traffic, both upstream and downstream, is delivered over the same feeder fiber through a bidirectional, passive splitter. As a result, each fiber between the splitter and the subscriber (distribution fiber) contains the same downstream traffic. In the upstream direction, each subscriber's traffic is combined at the splitter onto the feeder fiber.

Figure 1: xPON Network Example with Data

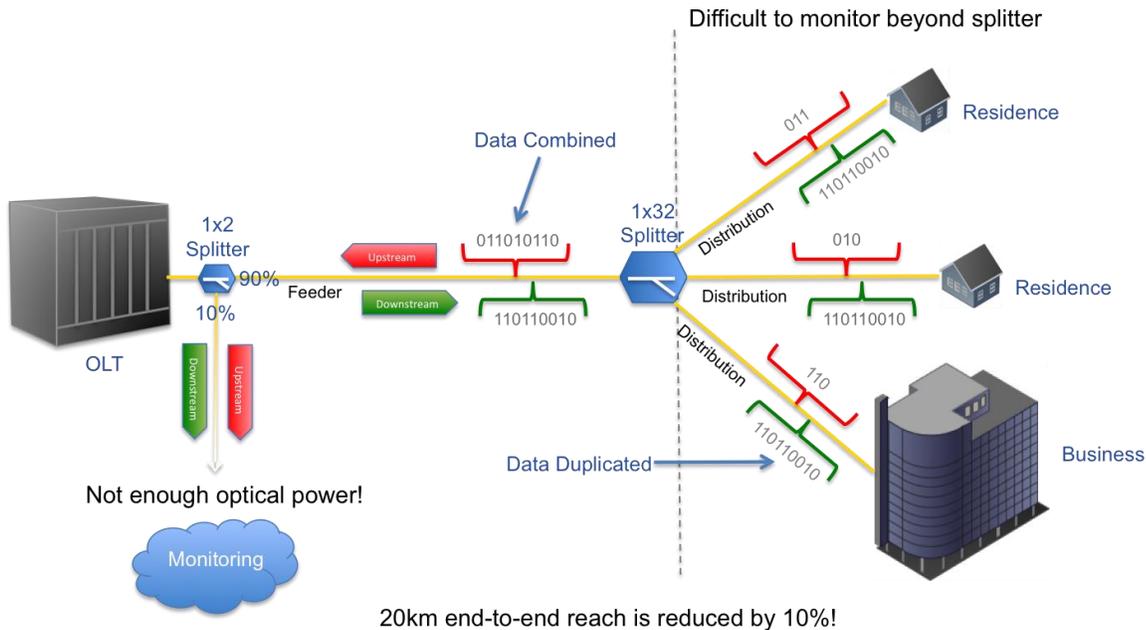


The passive splitting renders traditional telco techniques for monitoring the network nearly useless. Unfortunately, while various techniques have been tried over the years, most fail to deliver the monitoring capabilities needed without drastically increasing the cost of the xPON. Since the advantage of a xPON network is mainly high-bandwidth, low-cost service, implementing anything at the subscriber side drastically increases the cost-of-service per subscriber. So, the ideal monitoring solution would allow traffic to be monitored in both directions at the Optical Line Terminal (OLT) port.



The OLT xPON port generally provides limited statistics on the health of the network and no real QoE information. Of course, one might think that the simple solution would be to do a 1x2 split at the OLT port and simply replicate the xPON at the central or head-end office solely for monitoring purposes; however, this cannot be accomplished either because the added insertion loss, even using a 90:10 split ratio, would likely reduce the reach of the xPON too much and all but eliminate the light on the monitor path after going through another splitter. Also, this solution would double the cost of the xPON.

Figure 2: xPON Monitoring Difficulties



## The Solution

As mentioned before, ideally, the monitoring point should be at the OLT port. Using M2 Optics' patent-pending SWITCHLIGHT™ and SPLITLIGHT™, enables real-time QoE, SLA, or general network monitoring of any subscriber's service on the xPON. First, the SPLITLIGHT™ is deployed on all xPON feeder fibers using a 99:1 split ratio. This virtually eliminates the insertion loss issues on the network described above. Then, the SWITCHLIGHT™ is used to select which of the feeder fibers to monitor. Most optical switches could not meet the insertion loss requirements to switch the selected traffic without reducing the output signal to an undetectable level, but the SWITCHLIGHT™ only incurs about 1dB of insertion loss. At this point, all traffic from both directions on the selected xPON has been switched to either the appropriate monitoring device, which may be another OLT port or ONU dedicated to monitoring. From here, the service provider can implement their tool of choice for QoE monitoring or SLA monitoring.

The primary advantages of M2's solution are as follows:

- Enables QoE or SLA monitoring without drastically driving up the per subscriber cost
- Allows unobtrusive monitoring with minimal network design or architecture impact
- Provides real-time monitoring of all upstream and downstream traffic
- Eliminates the need for adding any standard or proprietary traffic or wavelengths to the network for monitoring purposes
- Scales from 8 xPON s to 256 in 1-4RUs

