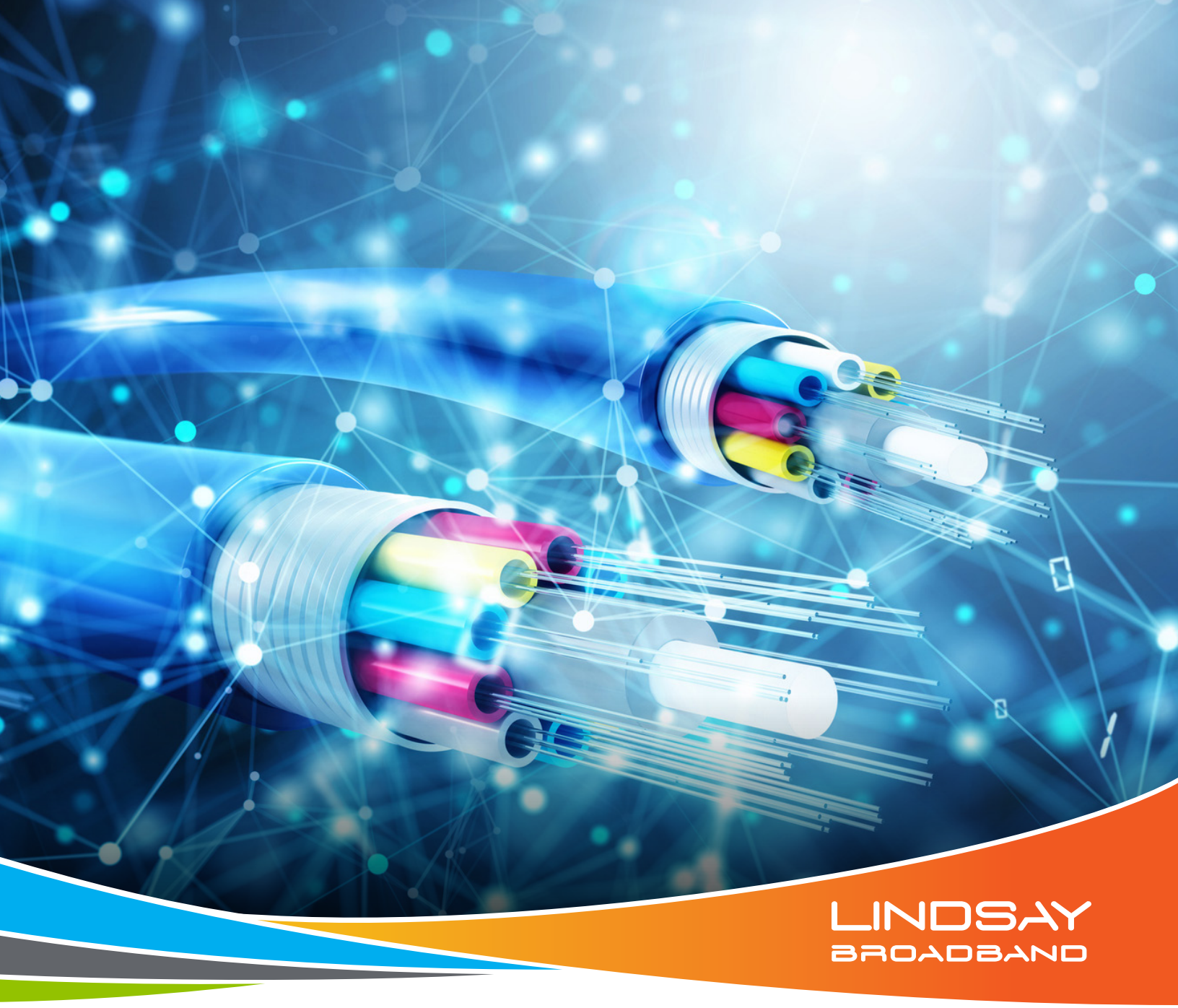


LINDSAY BROADBAND

Mitigating Techniques for OBI in an RFoG Architecture

CURRENT SOLUTIONS TO THE CHALLENGES

While RFoG offers great potential for increased capacities for FTTx, there are some challenges introduced through this technology. The RF transmissions by two cable modems at the same time generate two simultaneous optical node transmissions. If the two ONUs have identical wavelengths, optical beat interference (OBI) can be generated at the receiver. Ideally one subscriber would transmit when no one else is transmitting. However in reality, there is always more than one home required to transmit at the same time. The upstream wavelengths of two or more transmitters have to be very close or identical to create OBI.

Current solutions for mitigating the effects of OBI in the network typically rely on techniques such as limiting simultaneous upstream transmissions via the use of only a single upstream channel, utilizing CMTS (Cable Modem Termination Unit) scheduling algorithms. The scheduler in a CMTS has knowledge of which cable modems were transmitting when interference was detected. If the CMTS detects interference across several instances when two lasers are transmitting at the same time, it will mark them as having sufficiently close enough wavelengths to create OBI, and can avoid scheduling simultaneous transmissions from the two Cable Modems. In most cases CMTS detection and correction mitigates the effects of OBI.

Some vendors are introducing proprietary solutions claiming OBI free optical nodes. They basically offset the laser wavelength by a few nano meters. Thus they can set an individual subscribers wavelength on that particular ONU to be offset from other subscriber's wavelengths. There is a limited number of selectable offsets and therefore there could be two or more identical wavelengths present at the upstream receiver. It has also been noticed that temperature and laser tolerance can affect the offset benefits. This method reduces the probability of OBI but is not OBI free.

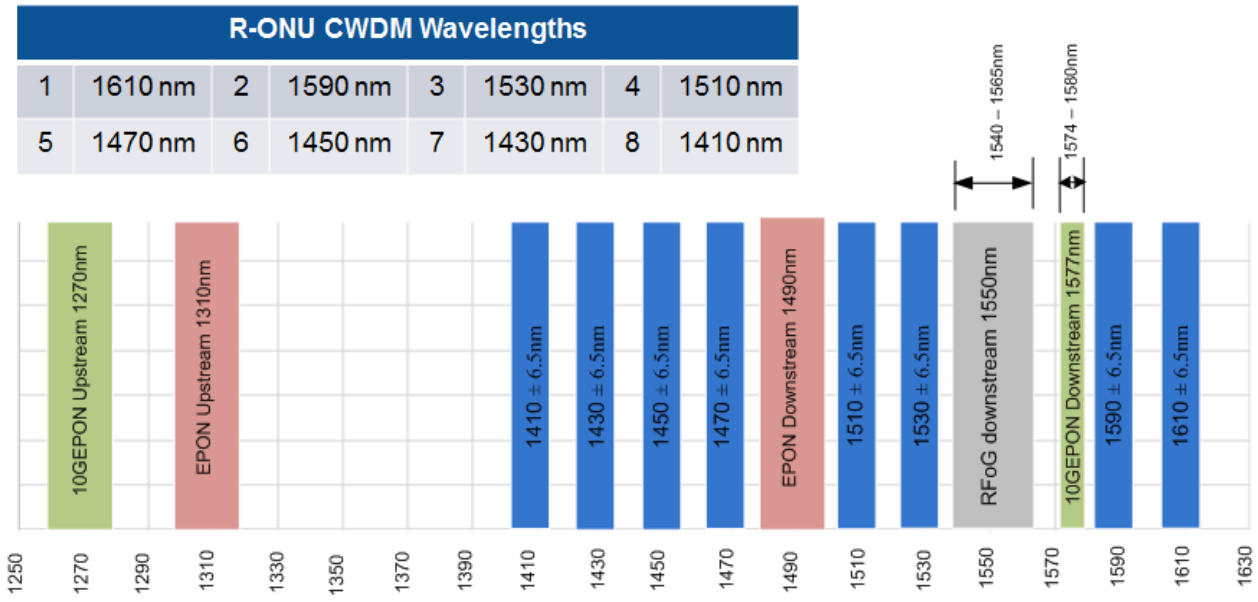
An upstream laser wavelength is influenced by manufacturers' tolerance, temperature, and drive current and in most cases, there is enough difference between laser diodes to prevent identical wavelengths, but it does happen.

Another method to lessen OBI is to reduce the number of subscribers on an upstream receiver. Reducing the splitting network from let say 1x64 to 1x32 will reduce the probability of identical wavelengths transmitting at the same time.

In the past, Lindsay Broadband has used a combination of reduced splitting networks and the implementation of multiple CWDM wavelengths from the subscriber ONUs.

The use of multiple wavelengths is very similar to offsetting wavelengths as proposed by other manufacturers, however the laser tolerances or temperature will not cause two wavelengths to interfere. This method eliminates being locked into a single vendor proprietary product. Wavelengths have been chosen that will co-exist with RFoG wavelength and future 1G and 10G EPON wavelength ranges. All R-ONU wavelengths are CWDM (± 6.5nm). **Refer to Figure 1.**

Figure 1

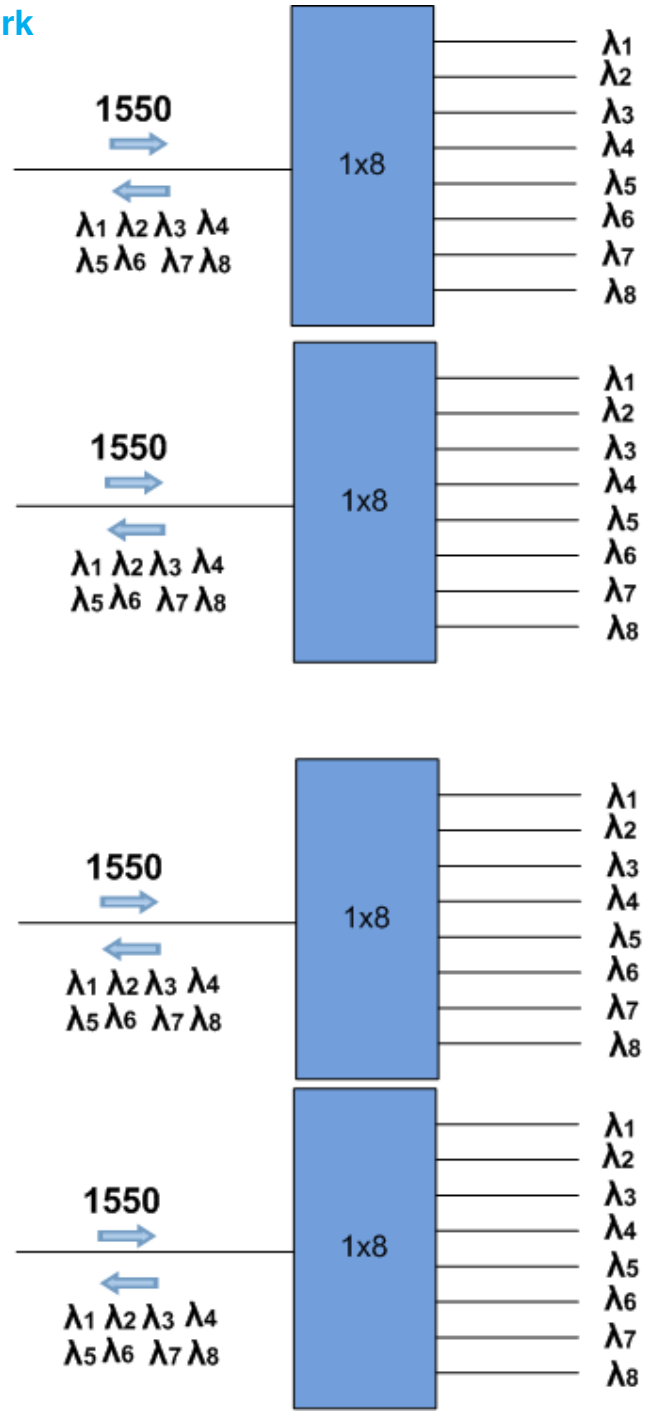


Passive optical splitting in the field will be used to insure that the same wavelength is not present at the upstream receiver. This method will require more incoming fibers to the fiber distribution hub and more optical splitter packages.

Figure 2 shows a centralized access plant approach using a network of splitters to accomplish 32 homes passed. Generally, a 256 HP centralized splitting cabinet has (8) 1x32 splitters. Total passive loss due to optical splitters is 10.2 dB compared to 16.5 dB from a 1x32.

Figure 2

Passive optical splitting network for 32 homes passed

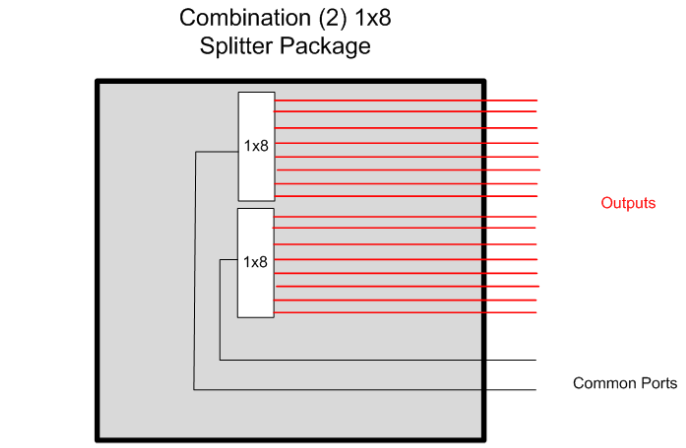


Lindsay Broadband has specially designed and built (2) 1x8 splitters in a single 100x80x10 mm package, to save space in the splitter shelf. **Refer to Figure 3.**

Figure 4 shows a decentralized access plant approach using a network of splitters to accomplish 32 homes passed.

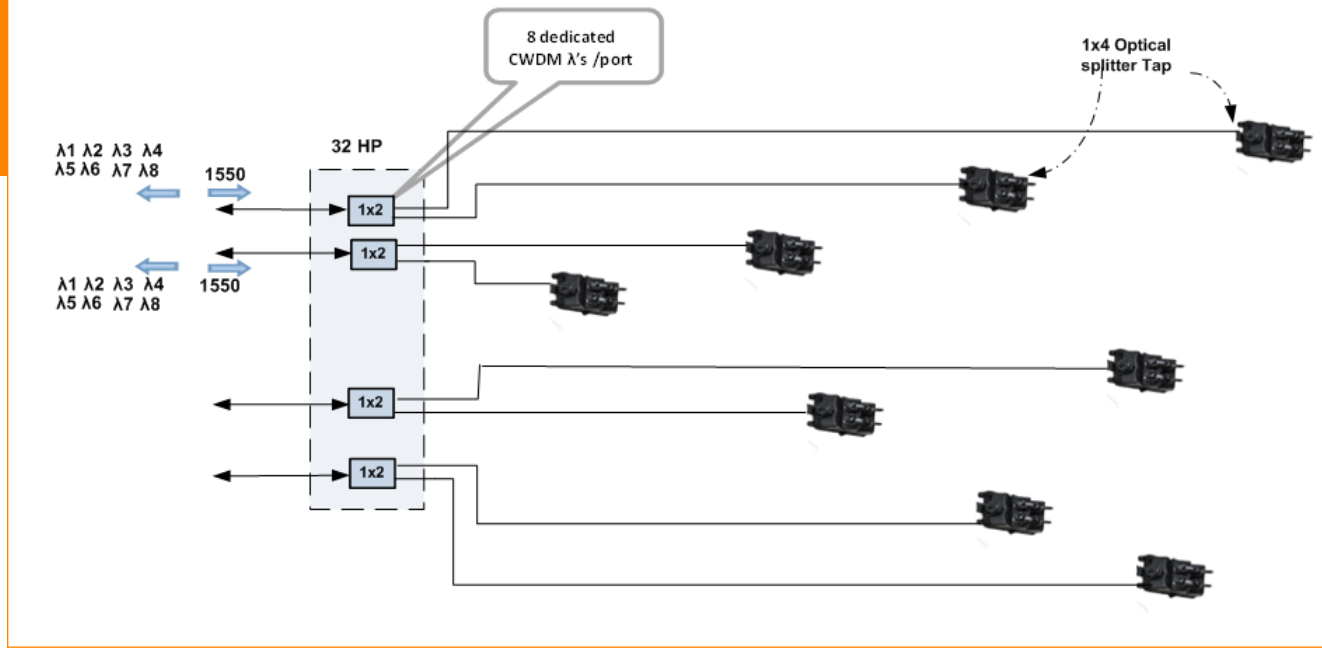
These examples of OBI mitigation do use more fibers between the distribution access point and the headend. However, it has less loss due to the splitter arrangements and it completely eliminates OBI.

Figure 3



Notes: - Package size: 100 x 80 x 10 (ABS plastic module)
- fiber pigtails, 1.5m 2.0mm Hytrel lined tubing, SC/APC connectors

Figure 4



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