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White Paper

Enhanced Transceiver Test Methods Increase Field Quality

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The Challenge

Third-party compatible optical transceivers offer network operators an alternative to proprietary OEM connectivity. An internet search will find an overwhelming number of suppliers from around the world claiming quality OEM-compatible transceivers. Quality claims are easy to express, but in today's global marketplace they are even more difficult to prove. Fortunately for network operators by understanding compatible transceiver test methods, it is not necessary to sacrifice quality for cost savings.

Background

The basic definition of compatible optical transceiver is that they "work as expected" meaning when installed in the target switch platform the optic is recognized, does not present any alarms and works as expected in the target switch. Transceivers fully compatible with OEM switch platforms should not require work around commands or produce alarms that appear in the OEM switchoperating system. On the surface, this basic definition seems straightforward, but it does not demonstrate the complexities of evaluating the quality of third-party compatible optics.

Reviewing hardware data sheets is the simple part of evaluating third-party compatible optics. All optical transceivers are manufactured to the same Multi-Source Agreement (MSA) specifications. The MSA drove commonality and standardization in optical technology to decrease the costs of fiber optic equipment. OEM switch vendors do not manufacture optical transceivers, as they source transceivers manufactured to MSA specifications from a global supply chain; the same supply chain used by third-party compatible suppliers!

How OEMs ensure quality through their supply chain may not be a mystery but understanding how third-party compatible suppliers control quality is important in making an informed decision.

The introduction of OEM-compatible programming presents the first level of complexity to optical transceivers. Like OEMs, third-party optic suppliers have a global supply chain and must manage quality control to account for variations in hardware. Take for example the SFP long-reach (LX) hardware profile. If a third-party compatible supplier supports 50 OEMs, it must ensure compatibility for each hardware profile and OEM programming for each code. Should the supplier have supply chain diversity, they must manage OEM programming quality control for each hardware profile and each OEM programming code.

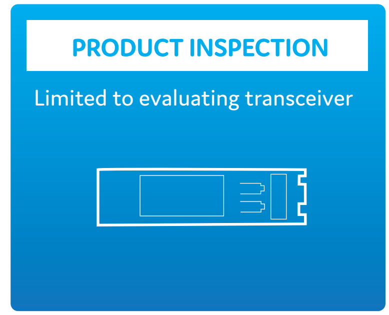
Testing is the first step in ensuring quality across programming and hardware. The compatibles industry uses a number of common test methods for quality control, including product inspection, switch testing, and application testing. Understanding these testing methods is key to understanding the impact on field quality.

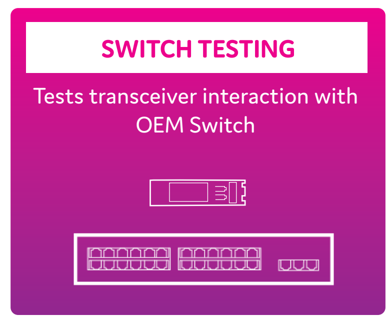
Product Inspection

Transceivers are inspected for compliance with stated specifications and requirements. For third party compatible transceiver suppliers, product inspection can take the form of simply inspecting product labeling and packaging to more advanced inspection to include measuring optical output power. Product inspection is often employed by third-party compatible transceiver suppliers who purchase pre-programmed transceivers from a global supply chain.

Switch Testing

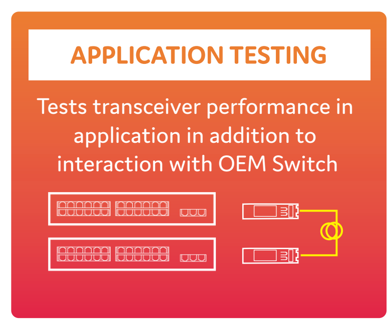
Pluggable optics are installed into a target OEM switch to test for switch recognition and the presence of alarms. This simple test verifies compatibility with the target OEM switch. Switch testing may include a loop back test to ensure that the transceiver transmitter and receiver initiate as expected. Switch testing is typically used by compatible suppliers who may or may not develop their own programming code that is applied in their facilities. Switch testing infers that the compatible supplier has made a large investment in a test bed consisting of various OEM switches. Understanding where the test bed resides (in-region or globally) will assist in understanding the operational capabilities of the compatible supplier.





Application Testing

Application testing of compatible optics builds upon switch testing to include optical performance to the intended application. The intended application is defined as network environment closely mimicking the field environment. For example, an optic intended for an OEM "C" switch, with an 80KM optical budget would be installed in an OEM "C" switched and connected over an 80KM fiber spool to another 80KM optic. This level of testing verifies not only switch compatibility, but the optic's capability of performing as specified. Established compatible suppliers that have their own test bed and qualify their own optics can conduct application testing.



The test sample rates used by third-party compatible suppliers should also be reviewed. Measuring production from a high variability environment that involves various combinations of OEM programming and hardware profiles is far different than a mass production environment turning out thousands of the same configuration at a time.

Batch Testing

Batch testing of small volumes of products (1% to 10%) is a common test method for high volume production with little or no product variation. Batch testing is common among compatible suppliers as it assists in keeping costs low by limiting the labor required to produce target units. Thus, these compatible suppliers can rely upon labor in low cost regions to program optics and employ limited operations staff in higher cost regions.

100% Testing

Complete testing of optical transceivers is not common among compatible suppliers. The practice is expensive, requiring high investment in capital equipment and skilled labor. The high variability of compatible transceiver configurations does not lend itself to batch testing. Individual production runs for a given configuration may not be large enough for a batch test to be statistically relevant. Thus, 100% testing is the best method for ensuring quality in compatible optical transceivers.

Impact on Field Quality

The impact to field quality can be felt by large scale network operators. At quantity 50 units shipped, a 98% quality rate will result in a 64% likelihood of a experiencing a failure. Whereas a 99.98% quality rate introduces a 1% likelihood of a field failure. On the other extreme, at 1,500 units shipped, operators can expect 100% likelihood of a field failure at a 98% quality rate, as only 26% with a 99.98% quality rate. Network operators can quickly understand the economic realities represented by even a less than 2% quality improvement.

To demonstrate the significance, this graph indicates the stark difference quality rates can have on field failures. At 100 units, at a 98% quality rate, there is an 87% likelihood of experiencing a failure. At a 99.50% quality rate the likelihood drops to 39%. Yet with only a half percent difference, 99.98%, a 2% likelihood of failure. Larger network operators that purchase hundreds or thousands of transceivers every year are aware of the relevance that quality rates and failure probabilities have on the impact to their network.

Wavelength Stabilization

Transceivers in the outside plant offer new considerations over those deployed in traditional head end or hub sites. Transceivers rated for industrial operating temperatures (-40C to +85C) are the right choice to ensure Remote PHY network performance over temperature and time.

The transceiver marketplace offers two approaches to maintaining operating temperatures. First is the 'should be good enough' approach. In this approach, transceivers are screened in the factory for characteristics that indicate performance temperatures. The screening may include reading optical test results or perhaps placing the transceiver in an environment chamber.

Screening is a point in time analysis that may or may not be backed up by a statistical analysis citing the transceiver's performance over time. The result is that perhaps one out of every 3 to 5 transceivers produced will meet specifications that should be good enough over temperature, over time in the network. The key point for network operators to consider is that the transceiver may perform at temperature at 'birth', but it does not consider the effect of temperature cycles over time on the transceiver.

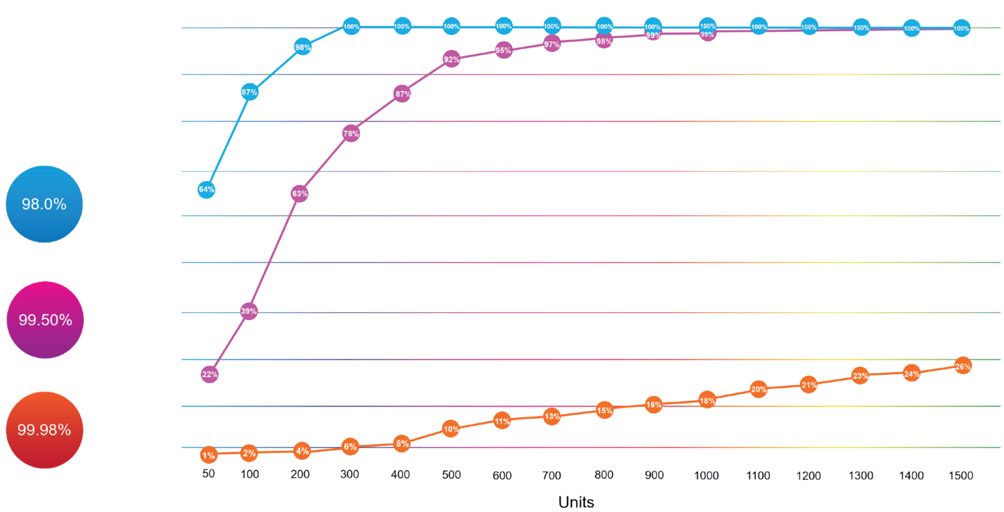
The second approach is transceivers that incorporate wavelength stabilization technology to ensure WDM wavelengths remain in their 'swim lanes' over time and temperature.

Thermo-electric cooling (TEC) is the ideal choice for Remote PHY deployments using 10G WDM pluggable transceivers. TEC is a robust, proven technology that stabilizes WDM wavelengths by cooling the laser at high temperatures and warming it at cold temperatures. TEC seamlessly integrates with transceiver digital diagnostic monitoring (DDM) or digital optical monitoring (DOM), allowing full monitoring of transceiver temperature and power.

Summary

Remote PHY requires introducing SFP-based transceivers to the outside plant. In specifying transceivers for Remote PHY, consideration of transceiver operating temperatures, wavelength drift, and stabilization is critical. Selecting transceivers rated for the Industrial Temperature range and with integrated wavelength stability are concrete steps to assure network performance over temperature, over time.

Likelihood to Experience Field Failure by Quality Rate



Real World Results

Historically the third-party compatible industry has experienced a 98% quality rate. For third-party suppliers shipping low volumes, this quality rate was 'good enough,' especially considering the relative value in comparison to OEM transceivers. However, as both volumes and variability in product mix grew, a 98% quality rate could no longer be considered 'good enough.' The failure potential became an operational issue for customers and suppliers alike.

Realizing the significance of quality to their customers, ProLabs, follows a rigorous qualification and testing process.

Product Qualification

ProLabs qualifies hardware from each part of its supply chain against the data sheet specifications. Optical power, electrical power, and operating temperatures are tested and confirmed with in-house lab capabilities. Next, compatible OEM programming is qualified with each hardware profile. With diversity in supply chain, ProLabs qualifies and maintains version control of each OEM compatible programming and hardware combination.

Should the OEM compatible coding change or hardware change, the combination must be re-qualified prior to being introduced to production.

100% Application Test

ProLabs tests each and every transceiver in the intended application, shipping out of the Tustin, CA facility. Meaning that each optic is programmed to the target switch platform, tested in the switch for compatibility, then over a fiber link to ensure it meets data sheet specifications. Given the variation in the transceiver product mix, batch testing would not have the desired impact on preventing field failure. ProLabs practices 100% application testing to identify failures caused by human error in programming and catch hardware issues, such as failed lasers. This adds a level of quality that stops failures before they get to the field.

The result of the investment in process and testing methods is a field failure rate of less than 0.02% or a 99.98% quality rate, putting ProLabs in a class of its own in the third-party compatibles industry.

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