Challenges of Power Measurement During 100G Service Turn-up

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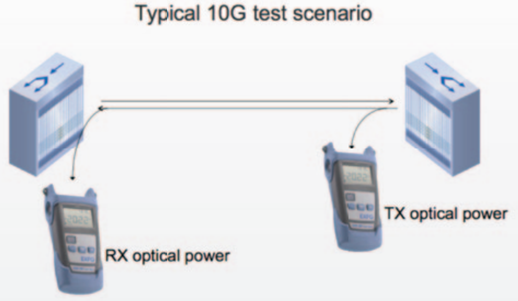
Deploying networks using CFP transceivers presents a set of challenges that did not exist with previous generations of Ethernet. Any CFP-based 100G Ethernet deployment will commonly use a WDM interface*. This, in itself, is enough to require a new set of skills and tools to support network deployments. When deploying networks that use CFP transceivers, challenges arise where there were none in previous Ethernet generations.

Typically, in an Ethernet turn-up activity, one of the most basic tests to be carried out is optical power measurement. Optical power would be measured both on the output of the transceivers being used and on the received fiber, to ensure that the power level is within the appropriate limits for the transceiver. This simple test is no longer possible when deploying and testing 100G Ethernet circuits.

TRADITIONAL TURN-UP ACTIVITY

Basic optical power measurements are included in typical 1G or 10G turn-up activities. Initially, transceiver output power measurements verify that the transmitter is functioning within specification. At the receiving end of a link, the optical power is measured to check that it is within receiver tolerances and is corresponding with the expected loss over the fiber.

Due to the use of WDM technology within the CFP, taking a simple power measurement does not prove that the CFP is operating properly. While it may be possible to measure the aggregate optical power – verifying that each wavelength is transmitting at the correct power – there is no value in doing this. Consider the case of an LR10 CFP, where 10 WDM wavelengths are in use. If one of the lasers within the CFP has an output power of only 50% of the expected power, how would this present in an aggregate power measurement? It would only represent a 5% change in aggregate power level and this would be unlikely to be recognized by an engineer in the field.



THE PROBLEM WITH BUILT-IN MEASUREMENTS

Instead of making accurate power measurements, early 100G network deployments have relied on the measurement capabilities of the CFP itself. While this approach has allowed technicians to turn up and test 100G Ethernet circuits, it presents several challenges.

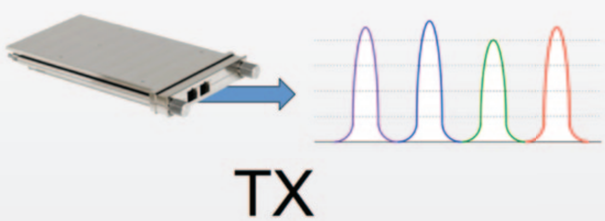
1. Power measurement is not a mandatory function of the CFP. While some CFPs may support it, others may not, so it is not guaranteed that the measurement will be available.
2. A CFP is not a calibrated measurement device. Therefore measurements taken with it should be considered as indicative only.
3. The accuracy of the measurement will vary from product to product; the field technician or the installation manager is unlikely to know the measurement accuracy and thus, unable to judge if it is within acceptable levels.

One of the biggest challenges of 100G Ethernet deployment has been the cost of the CFP transceivers. It represents a significant portion of the total cost of the network. As such, CFP vendors have been under significant pressure to reduce their prices. Now, as an answer to this mounting pressure, some vendors have started developing and offering "cost-reduced" CFPs, in which as much cost as possible has been taken out. One of the functions that can be removed from the CFP without affecting its core functionality is the power measurement functions.

As this trend continues, the availability in the field of the measurement functions will decrease.

100G SERVICE DEPLOYMENT CHALLENGES

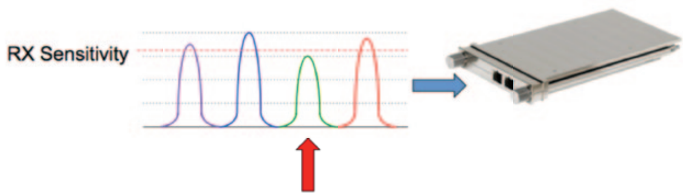
CFP transceivers contain 4 or 10 separate transmitting lasers, each with its own optical characteristics. For example, each transmitting laser will have its own transmit power levels. In fact, the IEEE 802.3ba standard, that defines the 100G interfaces, states that lanes may have up to a 5 dBm difference in power levels.



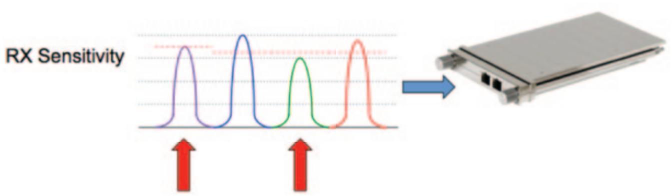
* Except when using SR10 CFPs

Increasingly, network service providers have started offering 100G Ethernet as a service to customers. In this case, the CFP interface will be used over a much longer distance, all the way to the CPE location. In this case, receiver sensitivity can become much more of an issue, especially as the length of the link starts approaching the limits of the CFP.

Since CFP wavelengths will have different power levels, some of the lanes will receive power levels below that of the CFP manufacturers stated sensitivity level. This may prevent the CFP from operating error-free and cause the Ethernet link to fail.



In fact, it is not even this simple. Each receiver also has its own characteristics; this includes the sensitivity level. While some of the received power levels may be thought to be within the power limits of the CFP, some channels that may be receiving a higher power level may also have a receiver sensitivity limit that is higher than other channels and may not be able to operate error free.



In 1 Gbit/s or 10 Gbit/s deployments, where engineers were unable to test a long distance link successfully due to problems with receiver sensitivity, it was easy enough to replace the transceivers at either end of the link in hope of finding a pair that had a high enough optical specification to operate error-free. Due to the multiple components that would now all need to have a high enough tolerance, chances of locating a pair of CFPs in this manner is virtually nil. Add to this the high cost of the CFP that will prevent an engineer from having a stock of CFPs on hand... Therefore, understanding the optical link budget and the exact transmitted power levels from the CFP will be crucially important when turning up such links, which, as previously discussed, cannot be reliant on the internal diagnostics of the CFP or an optical power meter.

So how can these challenges be overcome?

The answer is the use of an instrument that is typically not used in Ethernet turn up activities; the optical spectrum analyzer (OSA).

An OSA is typically used for testing DWDM networks, making power, wavelength and optical signal to noise ratio (OSNR) measurements, and it is the power and wavelength functions that would be useful in field deployment of CFPs. As the majority of deployed CFPs today are using WDM technology and DWDM CFPs are looming on the horizon, an OSA should soon become part of the essential toolkit for field engineers.

During the deployment of a CFP into the network, an OSA should be used to verify that wavelengths themselves are correct and that, by measuring the optical power for each wavelength, the CFP is operating within its specifications. Typically, an OSA may be a complex instrument to use and would include many features and measurements that would not be required during a 100G Ethernet or 100G OTN turn-up activity. This may put the use of the OSA outside the skill set of the engineer that would typically be turning up Ethernet services. As only the power and wavelength measurements would be required, it is possible that low-end OSA instruments could be used that would minimize the complexity of using the instrument in the field. Still, additional training may be required for the engineers responsible for deploying the 100G CFP interfaces.

In an ideal environment, the OSA would be included within the same test equipment that field engineers are using for the 100G Ethernet services testing, combining both the Ethernet service activation measurements and the optical measurement functions into a single portable instrument.

SUMMARY

The deployment of WDM CFPs as a network interface presents additional turn-up costs compared to traditional interfaces, first in terms of OSA that needs to be used to verify the CFP in place of a low-cost power meter, and second, the training and support needed by field engineers to carry out OSA measurements on the CFP interface.

It is essential to fully qualify the link optically, using an OSA to measure channel power levels on the interface before proceeding with the Ethernet service testing. Only test instruments that support both optical and Ethernet analysis in a single device provide the flexibility needed in the field to turn up Ethernet services to a CPE location.

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