

Application Note

# Phase Two of White Box Networking: Disaggregation of DWDM Optical Networks

Internet Content Providers (ICPs) have been hard at work to disaggregate hardware from software within data centers by taking the functions of a network off of proprietary hardware and putting them on less expensive servers and switches that also meet their unique needs. This has led to several benefits including: lowering the cost of equipment, lowering power consumption, and creating more flexibility in the way systems operate. This initiative, originally created by Facebook as a way to collaborate with other ICPs, has become known as the Open Compute Project (OCP).

OCP is now a global phenomenon and includes most of the ICPs throughout the world along with many hardware suppliers. The result has been a complete change to the data center model and has created an unprecedented amount of innovation – all of which has happened through collaboration between groups that used to view each other as competitors. The members of OCP have quickly realized that the collaboration has moved each company forward by leaps and bounds in a relatively small amount of time. They have also realized that they never could have achieved the same results on their own while fighting over intellectual property rights.

The disaggregation of the data center has been such a success that the industry is now setting its sights on another major feat – disaggregation of the Dense Wavelength Division Multiplexing (DWDM) optical networks that connect the data centers. While the first phase of disaggregation happened in the controlled environment of the data center, disaggregating the optical network will have much different obstacles that must be overcome. Let's look at what makes disaggregation of the optical network different and the challenges the industry will face as it moves into this second phase of white box networking.



## TIP and the Disaggregation of Optical Networks

Riding on the success of OCP within the data center, in 2016 Facebook launched the Telecom Infra Project (TIP) to create the same type of sharing and collaboration within the telecom market. According to the group, TIP "is an engineering-focused initiative driven by operators, suppliers, developers, integrators, and startups to disaggregate the traditional network deployment approach". The main goal is to create the same level of innovation and flexibility that was created by OCP for the data center. The group is not only confronting the same type of hardware issue that was conquered within the data center, they are also looking to disaggregate the terminals from the optical line systems.

As this new initiative gains momentum, it is important to look at what the disaggregation of terminals from line systems will mean for ICPs. In other words, what will be different that the operators will need to take into consideration before making the leap into disaggregation?

In a traditional optical network, all of the components in an optical line system are designed and optimized by a vendor based on a set of proprietary standards. When an ICP needs to create a new network line system, that vendor is relied upon to design a network and ensure its end-to-end performance. But under the initiative of disaggregation, ICPs will now need to do all of the stress and performance testing themselves for every aspect of a network to ensure its end-to-end performance and reliability. This will create challenges that most ICPs have never dealt with in the past.



## Overcoming the Challenges of Optical Networks

The flexibility created by the disaggregation of optical networks is great, but so are the challenges that ICPs face. Most have never had to test the performance and interoperability of an optical network, but instead, have relied on the vendor to "make it right". There is some talk of using a strategy of putting newly designed terminals together and hoping for the best, but this will be the surest path to failure and could cost ICPs much more time and money than using the technology in a traditional network. For ICPs to succeed in the new area of disaggregation, there are several obstacles that must be overcome during installation and turn up, while running live traffic, and while troubleshooting when something goes wrong.

## Install and Turn-Up

The first obstacle will be the compatibility of each new component in a disaggregated network. Vendors currently make sure that all components within a line system work well together, but with new open source standards, it will be imperative that ICPs do this testing. The easiest way to test for compatibility is by doing a link loss test using an agreed upon set of parameters. The parameters could be agreed upon by the members of TIP, or could be parameters the ICP sets for its own objectives.

Do all of the components work together? If not, is the problem a misconfigured network switch, a rate-shaping issue, or incorrect buffer settings? Is a newly designed component out of specification? Can the problem be isolated and resolved? Also, who is responsible if a certain component is not working properly or is not compatible with the other components? This is something the industry needs to think about before getting too far into deployment.

Once compatibility of the individual components has been reached, ICPs will need to test the physical layer of a network. The fiber itself should be inspected to make sure the connections are clean. The fiber should also be tested for insertion loss, Polarization Mode Dispersion (PMD) and Optical Time Domain Reflectometer (OTDR) to ensure the integrity of the fiber. After the physical layer has been tested, ICPs should test for throughput to make sure they are getting the highest levels of traffic over a network. At this point in the install, the throughput test is done using synthetic traffic.

Success of the install tests will mean that ICPs are ready to turn-up the connection and introduce live traffic to the line system. These tests will also create a baseline of performance that will be critical to record so that when a problem arises in the future, the ICP will know what the performance should be for a network. It is critical that the ICP is diligent in conducting these tests during install as it is much easier to fix the problem now than once live traffic is introduced.



## Monitoring Live Traffic

Most of the tests up until this point have been specific ways to ensure the integrity of the transport layer and the anticipated performance of the service. Once live traffic is introduced, it is important that a monitoring solution be in place to constantly monitor the performance of a network and service, and to determine if the performance of both is staying at consistently high levels.

Why is this important? As demand for capacity continues to increase, ICPs need optical networks that can provide the highest level of performance and throughput. This goes back to the main goals of TIP which are to increase the flexibility and speed of optical networks to meet current and future demands on a network. The only way to know if a network is continuing to meet performance goals is to monitor its traffic.

Monitoring solutions can also be used to see transport and service performance degradation before they become a problem for live traffic. For example, an ICP would know of a fiber degradation issue in a network relatively quickly as the performance levels would start to decline on the monitoring solution's dashboard, which would sound alarms. The monitoring solution should also be able to locate the source of the degradation to a specific location and see how far performance has dropped. This is where the baseline performance tests from the install phase become critical as they give an ICP the knowledge of what the performance levels should be for this particular line system.

Once the fault has been located, an ICP should be able to fix the problem in a relatively short period of time. This is a much faster way to solve the issue versus sending technicians out to manually find the problem. Monitoring solutions should also be able to determine if the problem is with the fiber itself or with a specific piece of equipment. Being able to pinpoint what the problem is, and where it is located, before it becomes a severe enough problem to affect live traffic lets an ICP be preemptive with network performance issues.

## Troubleshooting

Monitoring solutions are a great preemptive strategy for any optical network, but what should happen to fix a problem when things do go wrong? This is where troubleshooting the problem with testing comes into play. The tests for troubleshooting an issue are the same tests used during the install and turn-up phase, but now they must be done much faster to quickly resolve the issue.



For example, a monitoring solution detects a problem and sounds an alarm. As mentioned before, it can usually locate a problem, but what if that problem is only one of several? The solution will find the largest problem, but that problem might be masking the fact that there are additional problems in play. This is why active testing is so important.

Let's say that the monitoring solution found a large problem such as a fiber cut that has created a complete loss of service. Once the problem has been fixed, technicians should run the same tests that they ran during install and compare the new results with the baseline performance results. Normally, this would ensure that performance levels have returned to normal. If performance levels are not back to normal, then there is another issue to fix.

To stay with this example, testing determines that the next issue is with a specific router. Technicians will need to run the performance tests again to help determine the problem with the router. Has the router stopped working altogether or is it something more minor such as the settings have been changed slightly, but enough to affect the traffic? Testing will help figure this issue out quickly. Once the router has been swapped out or the settings have been changed, depending on the problem, then technicians should retest to make sure performance levels are back to normal. The retest is critical as it will determine if all of the issues have been identified or not. This same test/retest strategy should be done until all of the issues have been identified and performance levels have returned to normal.

## Conclusion

The innovation and collaboration that has happened within data centers has been impressive. Companies have joined together for the common good of the industry and created solutions that would not have been possible otherwise. The enthusiasm created by this success has made some wonder if the same is possible with optical networks. Such innovation in optical networking could create much more flexibility and speed for ICPs, but also comes with the added responsibility to make sure it works properly.

There will be many aspects to optical networking that ICPs will not have control over – such as fiber degradation – that must be accounted for in a successful disaggregation strategy. Testing and monitoring will play a major role in helping ICPs account for and deal with all aspects of network performance, including the issues outside of their control.

Most ICPs are new to testing, so it will be important to incorporate testing into their strategy now while they are still in the design stage to ensure the smoothest transition to disaggregation. It will also be important to proactively use the testing solutions and become familiar with how they work so that ICPs are ready when a problem does arise in the future.