VIAVI Solutions

Application Note

Data Center Interconnect
Getting the Most Out of 16 QAM

Internet Content Providers (ICPs) are currently in hyper-growth mode to keep up with demand for social media applications and cloud computing. This growth has pushed ICPs to add storage and transport capacity at an unprecedented rate. One area of expansion is Data Center Interconnects (DCIs) that connect their data centers around the world.

Most ICPs have hundreds of interconnects between data centers that use up to 100G over a single wavelength. But to keep up with demand – and the unpredictability of that demand – upgrades are being made to 16 QAM modulations to gain 200G out of a single wavelength. This is a cost-effective and flexible way to add the needed capacity and make a DCI as efficient as possible, but ICPs currently have no way to know if the connection is performing to its full capacity. Without this knowledge, ICPs can never reach the true efficiency or cost savings they hope to achieve.

The best way to see if 16 QAM modulations are working efficiently is to test the DCI connection. Testing is the only way to know if all the available capacity can be used. Gaining full capacity is much less expensive than buying additional DCI connections and testing creates a clear picture of how the 16 QAM modulation is performing.

Testing should be used during turn up of DCI traffic running 16 QAM modulations to make sure the DCI connection is working properly from the start. If the full capacity is not being achieved, testing can quickly pinpoint the problem so that it can be resolved in the least amount of time. Testing also allows the ICP to intentionally stress the DCI connection to find potential issues before a fault happens with live traffic. If a fault does occur, testing can help the ICP locate and troubleshoot the issue so traffic can be restored.

Testing units are available that can easily test 16 QAM modulations. There are two main tests that can be performed to ensure 16 QAM modulations are working efficiently: RFC 2544 and RFC 6349 TCP Throughput. Below is a description of each test, when it should be used and what it measures.

RFC 2544

What it is:

RFC 2544 is a widely-used test methodology to verify Key Performance Indicators (KPIs) at the Ethernet or IP level for a single service of data traffic. The standard calls for measurements of throughput, latency, and frame loss. In addition to these, ICPs should also test for packet jitter and Committed Burst Size (CBS).

When to use it:

RFC 2544 is the ideal test to ensure Layer 2 (Ethernet) or Layer 3 (IP) connectivity when only a single stream or single Class of Service (CoS) of traffic is present. A single stream could be defined as untagged Ethernet frames, a single Ethernet VLAN, or a single IP DSCP/ TOS.

What it measures:

- Throughput — the maximum sustained rate of Ethernet or IP traffic that can be passed through the network without frame loss.
- Latency — the average time that it takes for Ethernet frames or IP packets to traverse the network; latency can be measured either round trip or separately for each direction — upstream and downstream.
- Packet jitter — the average inter-frame delay variation over the course of the test per RFC 3550 Appendix A.8.
- Frame loss — the ratio of the number of frames lost to the number of frames transmitted over the course of the test.
- Committed burst size (CBS) — the configured number (the CBS parameter) of bytes of Ethernet frames that can be sent as a burst at line rate without frame loss.

RFC 6349 TCP Throughput

What it is:

RFC 6349 TrueSpeed is a test to measure TCP throughput in both the upstream and downstream directions. TCP throughput (measured at Layer 4) can often be dramatically worse than Ethernet or IP throughput (measured at Layer 2 or 3) because packet loss, network congestion, or changing delay can cause TCP retransmissions. Passing RFC 6349 results ensure that ICPs will get the data throughput that they expect.

When to use it:

RFC 6349 is the industry standard for TCP throughput measurements. ICPs should perform an RFC 6349 TrueSpeed test on all connections because poor transmission results could mean it's customers are also having problems.

What it measures:

- TCP throughput — the maximum rate that TCP traffic can traverse the network when taking any retransmissions into account; this measurement is compared with the ideal TCP throughput to generate a pass/fail result.
- TCP efficiency — an indication of how efficiently TCP connections work over the network by calculating the percentage of payload bytes that did not need to be retransmitted to the total number of bytes transmitted (transmissions plus retransmissions).
- Buffer delay percentage — the increase in TCP round trip time (RTT) over the course of the test; this measurement combined with the TCP efficiency metric can indicate if packet loss or network buffer congestion are contributing to poor TCP throughput.

Conclusion

For ICPs, adding efficiency and flexibility in their DCI network creates the needed capability to scale up and down with cloud and social media traffic as it changes throughout a given period. Upgrading to a 16 QAM modulation is a great way to add that efficiency and flexibility, but only if it can reach full capacity.

Testing before traffic turn up and once the traffic is live will keep 16 QAM modulations working at peak performance and allow ICPs to gain the highest efficiency and cost savings. The two tests mentioned above will help get the most out of 16 QAM modulations and create the most reliable DCI connection possible. As the need for capacity continues to grow, testing can help make a smooth transition as ICPs add additional DCIs and scale with future throughput rates.

VIAVI Solutions offers the T-BERD® 5800 100G, the industry's smallest handheld, dual-port 100G test instrument. The T-BERD 5800 has the built-in capability to stress test a 200G 16QAM wavelength, making it the only one-tester, one-person solution on the market.

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