

## The “Quantum” Effect

*Optimizing 400G+ Link Margin with High Performance Fiber Solutions – Leads to Reduced Trouble Tickets and Cost while Unlocking Flexibility and Performance*

### Bandwidth Appetites Continue to Grow

Growing demand for bandwidth consumption continues to challenge the data communications industry on a global level. As 400G transceiver shipments scale to significant volumes in 2021 and beyond, 800G optics are already slated to hit the market in 2022. This accelerated turnover of port speeds, along with reduced link budgets, results in constant pressure on semiconductor and optoelectronic players to deliver reliable technologies at highly competitive prices. **In a space dominated by the balance between cost and performance, the quality of optical fiber installations is critical.**

### Link Margins Yield Cost Savings

The transition from 100G to 400G+ ecosystems has introduced new complexities. Modern datacom optics produce high bit error rates by design, meaning that FEC (Forward Error Correction) encoding schemes are necessary to sustain stable connections<sup>1</sup>. Optical loss budgets are also lower than ever due to advanced modulation techniques like PAM4 imposing stricter requirements on optical component performance. Network operators must hence look towards high-performance fiber solutions like the Legrand Quantum<sup>2</sup> fiber solution to leverage as much optical headroom as possible. **With a superior fiber infrastructure in place, users can pursue more cost-effective transceivers tailored to their network environments. This has paved the way for relaxed-performance, competitively priced standards like DR-Lite and more.**

### Optimizing Network Expenditures

Ensuring that a high-capacity network runs efficiently is already a costly and complex operation without the threat of link failures. **Most failures can be tied to contaminated connector end faces and ports, transceiver laser degradation, or fiber bends/stress. The previously mentioned failure modes will benefit from high performance fiber, as this will boost link lifetimes and reduce expensive operator trouble-tickets.** Consequently, there is an inevitable correlation between maximizing optical performance margins (optical headroom) and optimizing overall costs from both an operational and procurement perspective.

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<sup>1</sup> The Bit Error Rate (BER) of a system is the total number of errored bits (a ‘1’ interpreted as a ‘0’ or vice versa) divided by the total number of transmitted bits. This metric is tied directly to FEC, which is an encoding scheme that appends information bits with additional parity bits. The FEC mechanism employed by most modern optics can correct an error rate of up to 2.4E-04 (IEEE802.3bj Clause 91).

<sup>2</sup> [The Infinium Quantum Fiber System | Legrand](#)

## In Focus: Physical Layer Performance

The below description is a summary of a physical layer experiment, demonstrating the benefits of adopting Quantum fiber for network buildouts.

### Experiment Overview

400GBASE-DR4 transceiver link performance was measured with an industry-standard fiber connectivity solution in comparison to Legrand’s Quantum high-performance solution, made possible via the MultiLane ML4054B<sup>3</sup> 400G transceiver test platform.

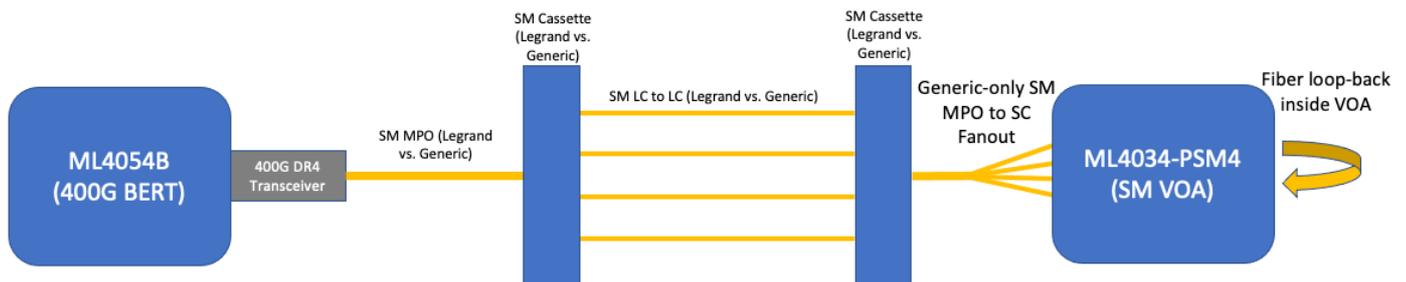


Fig. 1: Physical layer test setup

### Test Setup

The 400G transceiver was populated into the QSFP-DD host port of the MultiLane BERT (bit error rate tester). After connecting the fiber assembly under test to the MPO port of the transceiver, a variable optical attenuator (VOA) and fiber loopback are connected at the remote end. The VOA was included to emulate real-life impairments like span loss, transceiver laser degradation, contaminated insertion points, and fiber bends typical to a data center environment.

### Results

Upon driving traffic through the transceiver and fiber topologies, **Quantum fiber demonstrated a 1 dB improvement in span loss, a significant BER improvement, and a notable reduction of corrected FEC codewords.**

	Industry Standard Pre-Terminated Solution	Infinium Quantum Solution	Quantum Improvement
Bit Error Rate (errors over time)	2.35E-07	6.52E-08	3.6 x
Total Link Loss (dB)	7.20 dB	6.16 dB	1.04 dB
FEC Corrections (codewords)	5.93E+05	3.36E+05	1.77 x

Table 1: Fiber performance comparison

<sup>3</sup> <https://multilaneinc.com/products/ml4054b/>

## Flexibility and Futureproofing

Cost-effective standards at 400G, followed by cutting edge solutions at 800G+, will soon be available in the optical transceiver market. As system integrators continue to navigate the challenge of scaling network capacity and balancing cost, fiber selection can just as easily be an inhibitor or enabler. **Investment in superior fiber infrastructure yields improved optical headroom and physical layer performance, subsequently unlocking greater flexibility in pursuing competitively priced pluggables. Upon reducing the rate of link failures and associated trouble tickets, network managers can rest assured that the migration to Quantum fiber solutions will be compatible with upcoming generations of optoelectronic technologies.**

## About Legrand

Legrand is a global specialist in electrical and digital building infrastructures. Its comprehensive offering of solutions for use in commercial, industrial, and residential markets makes it a benchmark for customers worldwide. Legrand has a strong presence in North and Central America, with a portfolio of well-known market brands and product lines that includes Approved Networks, C2G, Cablofil, Champion 1, Chief, Da-Lite, Finelite, Luxul, Middle Atlantic Products, Milestone AV, Nuvo, OCL, On-Q, Ortronics, Pass & Seymour, Pinnacle, Projecta, QMotion, Raritan, Sanus, Server Technology, Solarfactive, Starline, US Critical, Vaddio, Vantage, Wattstopper, and Wiremold.

<https://www.legrand.us/>

## About MultiLane

MultiLane Inc. is a leading provider of High-Speed IO and Data Center Interconnect test solutions from 10G to 800G. Products include BERTs, TDR, optical and electrical oscilloscopes, optical switch boxes, and a host of MSA-compliant development tools for QSFP28, QSFP-DD, OSFP, and other standards. MultiLane's products are used to test semiconductors, DACs, AOCs, optical transceivers, and system switch cards. MultiLane also offers compliance test services and fully automated, turn-key test solutions. In addition, MultiLane develops high speed ATE modules that fit in wafer-scale automated test systems such as Advantest's V93K platform.

<https://multilaneinc.com/>