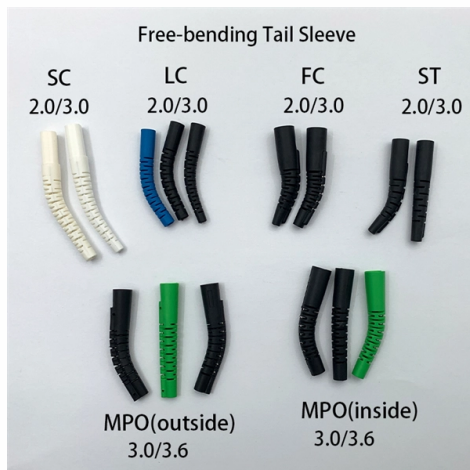


What is the latency of a fiber optic switch



Overview

Fiber Optic Latency: 5 us/km Calculator | PHILISUN Fiber latency is the time it takes for data to travel from the transmitter into the optical link and reac.

Key Takeaways

The latency of a fiber optic switch typically ranges from a few nanoseconds to tens of nanoseconds, with total fiber propagation adding microseconds per kilometer. Fiber Propagation Delay

The primary component of latency in fiber optics is the time it takes for light to travel through the fiber. Standard single-mode fiber (SMF-28) introduces approximately 4.9-5 microseconds per kilometer of one-way propagation delay due to the refractive index of the glass core, which slows light to roughly 200,000 km/s compared to its speed in a vacuum . For example, a 100 km fiber link would contribute about 0.49 milliseconds of one-way delay .

Switch and Transceiver Latency

In addition to propagation delay, fiber optic switches and transceivers introduce processing latency. Modern high-performance switches typically add a few nanoseconds to tens of nanoseconds per hop, depending on the architecture and whether Forward Error Correction (FEC) is used . FEC can increase latency further, sometimes by microseconds in high-speed links, but in ultra-low-latency environments, switches are optimized to minimize this overhead.

Total Latency Estimation



The total latency for a fiber optic switch includes:

- Propagation delay: $\sim 5 \mu\text{s}/\text{km}$
- Switch processing delay: $\sim 10\text{--}50 \text{ ns}$ per switch
- Transceiver delay: a few nanoseconds For short intra-data-center links (meters to a few kilometers), the switch latency dominates, typically in the tens of nanoseconds range. For long-haul links, fiber propagation becomes the major contributor, adding microseconds per kilometer .

Practical Example

- 1 km fiber with a single switch:
 - Fiber delay: $\sim 5 \mu\text{s}$
 - Switch delay: $\sim 50 \text{ ns}$
 - Total latency: $\sim 5.05 \mu\text{s}$
- 100 km fiber with multiple switches:
 - Fiber delay: $\sim 0.5 \text{ ms}$
 - 5 switches at 50 ns each: $0.25 \mu\text{s}$
 - Total latency: $\sim 0.50025 \text{ ms}$

Key Factors Affecting Latency

- Fiber type and refractive index: Higher refractive index increases delay.
 - Switch architecture: Cut-through switches have lower latency than store-and-forward switches.
 - FEC and signal processing: Adds microseconds in high-speed links.
 - Number of hops: Each additional switch adds nanoseconds to tens of nanoseconds.
- In summary, fiber optic switch latency is dominated by switch processing for short links and by fiber propagation for long links, with total latency ranging from tens of nanoseconds to several microseconds per kilometer of fiber .

Article Content

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Latency in Fiber Optic Networks

The term latency refers to the time delay in a particular system. For communications systems, latency is an important factor, because

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Fiber-optic latency is the time light takes to travel a particular distance through a fiber optic cable. At the speed of light, a latency of

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