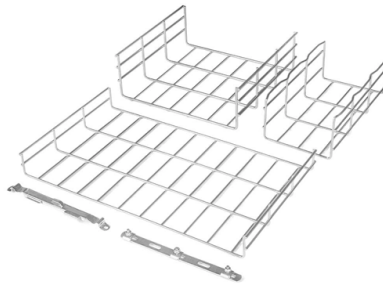


Optical Module Requirements in the 6G Era



Article Overview

6G optical modules must support ultra-high data rates, microsecond-level latency, nanosecond synchronization, and AI-driven network orchestration to meet IMT-2030 standards.

Key Performance Requirements

Data Rate and Bandwidth: 6G optical modules are expected to handle terabit-per-second capacities to accommodate projected mobile data growth, with user data consumption rising from 5 GB/month in 2020 to over 250 GB/month by 2030 .

Fronthaul interfaces may require 100 Gbit/s per Remote Unit (RU) or higher, often over a single bidirectional fiber . **Latency and Synchronization:** Modules must support microsecond-level latency and nanosecond-level synchronization using protocols like Precision Time Protocol (PTP) to enable ultra-reliable low-latency communications (URLLC) and integrated sensing and communication (ISAC) scenarios .

Optical Technologies: Enabling technologies include:

- Coherent Passive Optical Networks (CPON) for high-capacity, long-reach links.
- Spatial Division Multiplexing (SDM) and Hollow-Core Fiber (HCF) for low-latency, high-bandwidth transport.
- Free-Space Optics (FSO) for flexible deployment in dense urban or remote areas.



Article Content

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PHY and MAC layer becomes of paramount importance. This approach can break the frontiers of wireless communications and facilitate

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Among all possible solutions for implementing 6G fronthaul, optical technologies will remain crucial in supporting the 6G fronthaul, as

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This tutorial will provide an overview of 5G and 6G architectural structures and will concentrate on how Optical Networking can

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