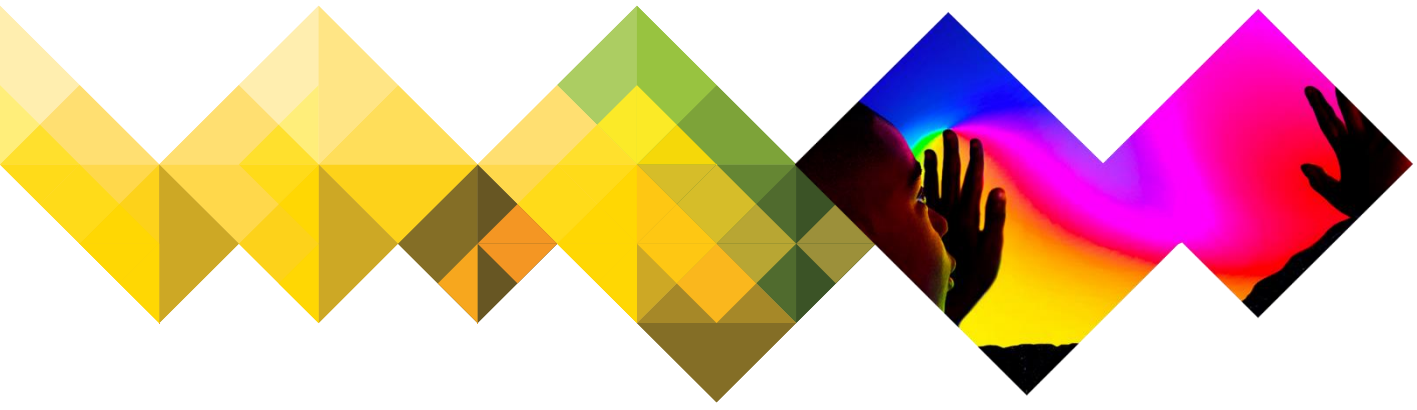
PacketLight™ NETWORKS

White Paper

Active Vs. Passive DWDM Solutions

An active approach to your growing optical transport network & connectivity needs



Introduction

Building dark fiber network infrastructure using WDM technology used to be considered a complex challenge that only carriers have the means to implement. Due to this complexity, many enterprises implemented passive solutions, limiting future growth and binding them to an inferior technical solution for essential network infrastructure.

There are two main methods for building DWDM networks:

1. **Active solution,** where DWDM infrastructure is built using transponders and muxponders agnostic to the routers and switches in the network, and provide the full optical demarcation point, and full performance monitoring and diagnostic tools for all optical ports.
2. **Passive solution,** which includes passive filters and ADMs (add/drop multiplexer), and colored optics plugged into equipment such as routers and switches

Active Solutions

Active DWDM solutions are not limited by network topology or distances between sites, and provide flexible network expansion and add/drop capabilities, as well as dark fiber utilization by any service/rate and any bandwidth up to 19.2Tb/s per fiber pair. In contrast, Passive solutions are mostly limited by distance and point-to-point topology without flexible service add/drop capabilities.

Active solutions enable better spectral efficiency of the network utilizing muxponder capabilities, which map multiple client service interfaces over a single wavelength. For example, 20 x 10Gb Ethernet client interfaces are mapped over a single 200G DWDM wavelength. This results in fewer wavelengths between sites, significantly reducing operational costs, simpler management of the network, savings in DWDM optics cost, and reduced number of channels within the DWDM mux/demux (see Figure 1).

Active solutions support Layer-1 optical encryption while delivering full data throughput without any degradation to the link performance, an important aspect in today's security-conscious market. The solution ensures the confidentiality and integrity of data, based on GCM-AES-256 encryption standards, supporting Diffie-Hellman (DH) key exchange. The solution supports multiple protocols including 1G/10G/40G/100G Eth LAN, 4G/8G/16G/32G FC, OTU2/2e/3/4 and STM64/OC192.

Figure 1: Active Network Connectivity

Characteristics of Active solutions

1. Central management system of the optical layer.
2. Layer-1 encryption based on GCM-AES-256 encryption standards, with full data throughput, lowest latency and no degradation to the link performance.
3. Provides the entire link diagnostic tools such as full Layer-1 performance monitoring for all optical ports (client services, uplinks, amplifiers, optical switches, ROADMs), optical power, PRBS and loopback capabilities and Layer-2 performance monitoring for Ethernet client services.
4. Enables the use of standard low cost short reach optics on the client side (between transponders/muxponders and client switches/routers) and inexpensive WDM system vendor's colored optics (for the DWDM uplink ports).

5. Uses standard OTN protocol to map different services such as Ethernet, Fibre Channel and SONET/SDH, to common standard-based optical transport layer with FEC (forward error correction).
6. Fibre path protection and switchover under 50ms.
7. Centralized optical transport layer demarcation capability, enabling optical performance monitoring and swift fault isolation.
8. Increased spectral efficiency by mapping several services into a single wavelength, reducing deployment and management costs.
9. Enables signal amplification and significant OSNR enhancement using OTN FECs, overcoming the link budget and distance limitations of passive networks.
10. Enables simplified topology changes and expansion using OADM and ROADM technology.
11. Enables provision of SLA managed services to third party clients.
12. Non-intrusive fiber monitoring and diagnostics using OTDR and OSA.

Passive Solutions

Passive solutions solve simple network connectivity needs. However, they impose significant difficulties when the network grows, for example, when adding another site in a ring topology, or when fiber protection is needed and evolves (see Figure 2). Passive networks tend to be very complex to manage as they expand, due to the dispersion of the optics in several different Layer-2 switches, routers and ADMs at different physical locations and/or departments in the organization. This results in demanding maintenance, challenging network growth and difficult fault isolation down the road.

In addition, Passive solutions introduce many restrictions, such as the requirement to use vendor-specific optics in switches/routers that are often very expensive, and prevent the WDM backbone infrastructure from being vendor-agnostic.

Figure 2: Passive Network Connectivity

Characteristics of Passive solutions

1. Dispersed management of the optical layer.
2. Vendor-specific high cost optical modules used in the switches/routers.
3. Limited optical performance monitoring and fault isolation, increasing MTTR (mean time to repair).
4. Each service requires a dedicated WDM colored optics, which increases the complexity of installation and management.
5. Limited link power budget and distance.
6. Manual power balance of channels using attenuators.
7. Effective mostly in short, point-to-point topologies.

Scalable Networks

Building a scalable carrier grade Layer-1 active network infrastructure provides various benefits to organizations in the long-term:

First, it enables a flexible remotely-managed WDM backbone infrastructure with a full view of the optical performance and the service level performance.

Second, the network becomes agnostic to Layer-2 and Layer-3 and other devices in the network.

Third, network managers and operators can detect any failure in the system from a central management tool. Alarms detect and alert any distortion in the performance of the optical network before it causes performance degradation.

Fourth, it is significantly easier to debug and troubleshoot the system through the SNMP remote management tool and native debug capabilities, such as loopbacks, PRBS tests and performance monitoring on each service.

Fifth, it adds many technical benefits for the transmission such as AES-256 Layer-1 encryption with full-throughput low latency, and OTN FECs added to the link, significantly improving the end-to-end OSNR and link budget capabilities of the network.

Sixth, it enables fiber protection switchover, fast rollout of new services and wavelength routing in linear add/drop, ring and mesh topologies.

Integrated Solutions

PacketLight's integrated solutions simplify building a modular, managed Layer-1 DWDM network infrastructure, at an affordable cost. The network is able to grow with the organization's needs, topology can be upgraded from point-to-point to ring and can gradually expand from single wavelength to 96 wavelengths of any capacity (10G/100G/200G/400G) while maintaining high ROI.

PacketLight's modular active solutions can be installed, managed and maintained easily, without extensive knowledge in DWDM technology. The products are designed with enterprise and data center needs in mind, including simple operation, low power consumption, 1U compact footprint that saves rack space and is stackable for easy growth, protection, redundancy, remote management and performance monitoring.

About PacketLight

Established in 2000, PacketLight Networks™ offers a suite of leading 1U metro and long haul CWDM/DWDM and OTN solutions, as well as Layer-1 optical encryption for transport of data, storage, voice and video applications over dark fibre and WDM networks. PacketLight provides the entire optical layer transport solution within a highly integrated compact platform, designed for maximum flexibility, easy maintenance and operation, with real pay-as-you-grow architecture, while maintaining a high level of reliability and low cost. PacketLight works with an international network of resellers and partners to provide you with a complete set of network services, with installations worldwide.