

# BROCADE ETHERNET TECHNOLOGY LEADERSHIP



## IP NETWORK

## 10 Gigabit Ethernet WAN PHY Capabilities

### HIGHLIGHTS

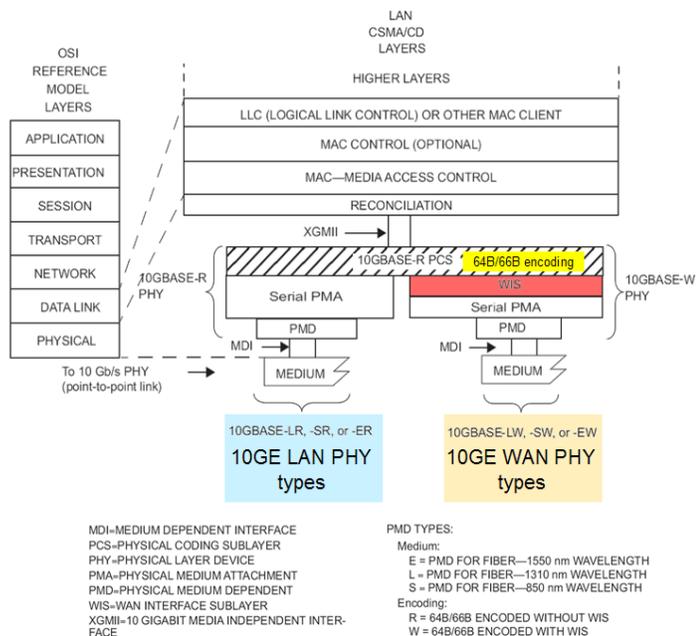
- Provides a high level overview of the 10 Gigabit Ethernet (GbE) WAN PHY defined in the IEEE 802.3ae standard
- Explains how the 10 GbE WAN PHY interacts with SONET OC-192 networks
- Highlights its differences and advantages when compared to OC-192c POS and 10 GbE LAN PHY

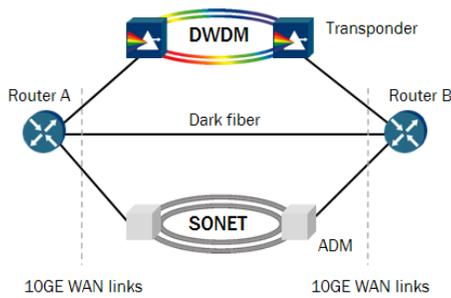
### OVERVIEW

The IEEE 802.3ae standard, which was adopted in July 2002, defines two 10 GbE main interface types: 10 GbE LAN and 10 GbE WAN (Figure 1). The 10 GbE LAN PHY carries 10 Gigabits per second (Gbps) of data traffic encoded using the 64B/66B protocol. The 10 GbE WAN PHY also uses the 64B/66B encoding protocol, but it adds a WAN Interface Sublayer (WIS) to provide a simplified SONET/SDH framer function and a SONET/SDH-compatible MIB.

The purpose of the WIS is to allow the 10 GbE WAN PHY to generate Ethernet data streams that are mapped directly to STS-192c or VC-4-64c streams at the PHY level. As a consequence, the WIS constrains the effective data traffic to the payload capacity of STS-192c/VC-4-64c, that is, 9.58464 Gbps. However, from the perspective of the 10 Gbps MAC layer, a 10 GbE WAN PHY is equivalent in functions and service interface to a 10 GbE LAN PHY, with the exception of the sustained data rate.

**Figure 1.**  
10 GbE reference model:  
10 GbE LAN and WAN PHY types  
(IEEE Std 802.3-2005, Clause 49).





**Figure 2.**  
10GE WAN PHY  
transport options.

The WIS does not render a 10 GbE WAN PHY compliant with SONET/SDH. In fact, to avoid unnecessary functions and cost, the WIS supports only the SONET/SDH overhead features required for fault isolation. For example, SONET/SDH section/line datacomm channels and the local and the express orderwire functions are not supported.

The 10 GbE WAN PHY supports serial 1310nm and 1550nm optics (or PMDs) for intermediate reach. These wavelengths are also used by SONET/SDH networks. Although the 10 GbE WAN PHY optics do not comply to SONET/SDH's grid tolerances, a 10 GbE WAN PHY signal can be connected directly to a SONET/SDH transponder, an existing DWDM equipment type. A transponder converts the relatively shorter reach and loose wavelength tolerances of 10 GbE WAN PHY optics to the longer reach and tight wavelength tolerances of SONET/SDH grid's 1550nm optics. In addition, a 10 GbE WAN PHY signal can be connected to an OC-192 tributary interface of a SONET/SDH Add Drop Multiplexor (ADM) for transport over a SONET/SDH network.

These solutions allow a 10 GbE WAN PHY signal to be seamlessly transported over an existing Layer 1 infrastructure. Transponders and SONET/SDH ADMs add

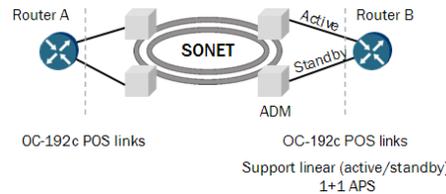
the section overheads that are used for management within the transport network. Therefore, they add the overhead features that are intentionally not supported by the WIS.

Figure 2 depicts three deployment options for 10 GbE WAN PHY: over an existing DWDM grid, an existing SONET infrastructure, and dark fiber.

**10 GbE WAN PHY & LINK PROTECTION**

OC-192c Packet over SONET (POS) supports Linear Automatic Protection Switching (APS), an active/standby 1+1 protection mechanism (see Figure 3). The 10 GbE WAN PHY does not support Linear APS, since Ethernet supports link redundancy with IEEE 802.1ad Link Aggregation (LAG) instead. LAG works at Layer 2, which means that LAG links can traverse diverse Layer 1 physical media. For example, in Figure 2, LAG can be used over the three 10 GbE WAN PHY links to provide link protection between the two routers. Linear APS, on the other hand, operates only over SONET. LAG also provides load balancing, which enables multiple 10 GbE WAN PHY links to be combined into a single logical connection.

**Figure 3.**  
Linear APS.



**NETIRON MLX AND XMR SERIES SUPPORT FOR 10GbE WAN PHY**

The Brocade® NetIron® MLX and XMR Series of routers support hot-swappable XFP optical transceivers that are software configurable to operate in LAN PHY or WAN PHY modes. The 8X10 GbE module for the NetIron MLX Series routers supports 10 GbE SR (10G-SFP-SR) and 10 GbE LR SFP+ (10G-SFP-LR) optics, which also can operate in LAN PHY or WAN PHY modes.

Available XFPs for 1310nm and 1550nm include: 1310nm serial for up to 10 km over single-mode fiber, 1550nm serial for up to 40 km over single-mode fiber, and 1550nm serial for up to 80 km over single-mode fiber. The Brocade NetIron XMR and MLX routers supports LAG with up to 32 10 GbE WAN PHY links in a LAG group, thereby providing unparalleled capacity of up to 320 Gbps on a carrier-class trunk.

**SUMMARY**

The 10 GbE WAN PHY is a viable alternative to OC-192c POS. 10 GbE WAN PHY links can be deployed over dark fiber, DWDM grids, and SONET/SDH networks. The 10 GbE WAN PHY technology does not support Linear APS like OC-192c POS interfaces. However, the 10 GbE WAN PHY supports LAG over multiple links (up to 32 links in a LAG using the Brocade NetIron XMR or MLX Series of routers) for link redundancy, and LAG supports load balancing, for active-active operation. In addition, LAG can be used with 10 GbE WAN PHY links that are deployed over diverse Layer 1 technologies, for example, dark fiber and SONET. Linear APS is limited to active-passive link protection over SONET links.

**ABOUT BROCADE**

Brocade connects the world's most important information—delivering proven networking solutions for today's most data-intensive organizations. From the data center to high-performance Ethernet networks, Brocade is extending its near-fifteen-year heritage as a leading innovator of advanced storage and networking technology.

**Corporate Headquarters**

San Jose, CA USA  
T: +1-408-333-8000  
info@brocade.com

**European Headquarters**

Geneva, Switzerland  
T: +41-22-799-56-40  
emea-info@brocade.com

**Asia Pacific Headquarters**

Singapore  
T: +65-6538-4700  
apac-info@brocade.com

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