The PacketPortal Enabled SFProbe™ and How it Differs from a Standard SFP Transceiver

PacketPortal-enabled SFProbe transceivers comply with the IEEE 802.3–2008 Gigabit Ethernet standard, are compatible with MSA SFF standards, and seamlessly replace standard 1 GE SFPs. However, there are key differences between an SFProbe and an SFP that are important to understand when deploying SFProbes in an Ethernet network. This document introduces the SFProbe and compares the similarities and differences (functional, electrical, mechanical, and operational) between Viavi Solutions SFProbes and standard SFPs.

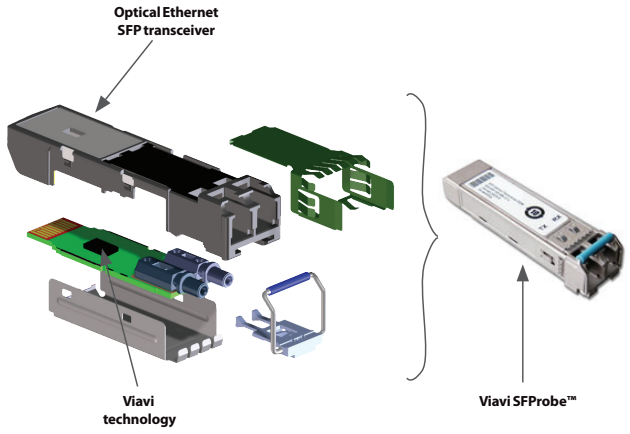
The Viavi SFProbe

The Viavi PacketPortal solution uses SFProbes as intelligent packet director (IPD) transceivers to collect packets from Gigabit Ethernet networks. They can be affordably distributed where standard SFP transceivers are used today, allowing network operators and managers to access packets and data at any point in the network where SFPs are used. This improves the effectiveness and value of existing tools and applications by extending reach to the distributed access and end points that most closely represent an end user's experience.

The SFProbe uses deep packet inspection (DPI) technology to examine packets at full duplex line rate speeds, letting the SFProbe identify packets of interest which are then selectively copied from the network, time-stamped, encapsulated into a results packet, and inserted back in-line into the network for routing to a designated PacketPortal packet routing engine (PRE). The PRE then forwards the captured data to an application or component requiring the data—all without loss or disruption to the original packet flows.

The IPD innovation is the result of a joint development initiative between Avago Technologies®, Viavi, and industry-leading network-equipment manufacturers (NEMs). The purpose of the initiative is to build intelligence into industry-standard SFP transceivers by embedding a specialized application-specific integrated circuit (ASIC). This new intelligent SFP, the SFProbe, is manufactured by Avago Technologies with Viavi DPI and packet-capture technology.

SFProbes redefine how and where operators can gather packets throughout today's networks by eliminating the limitations of SPAN port, tap, aggregator, or mirror-port availability and locations. They can be plugged into any SFP-compatible elements such as switches, routers, DSLAMs, and OLTs at the network edge, and can be used throughout the network to replace any standard 1 GE SFP. All SFProbes in the network can be globally time synchronized, to less than one millisecond, using a secure Viavi proprietary time synchronization protocol; this enables synchronized measurements and captures that were not previously possible.



Specifications

SFProbes have an equipment side and a network side. The equipment side plugs into the SFP port on a network device, and the network side transmits and receives data on the fiber optic cables. SFProbes can collect and forward both network-traffic and network-context information without disrupting the original network-traffic flow. SFProbes meet all the same safety, regulatory, reliability, and environmental specifications as standard SFPs. Operators can confidently deploy SFProbes knowing they pass GR-468-CORE, UL, RoHS, FCC, and TUV requirements and have mean-time-between-failure rates nearly identical to equivalent 1 GE SFPs.

Key Compliances

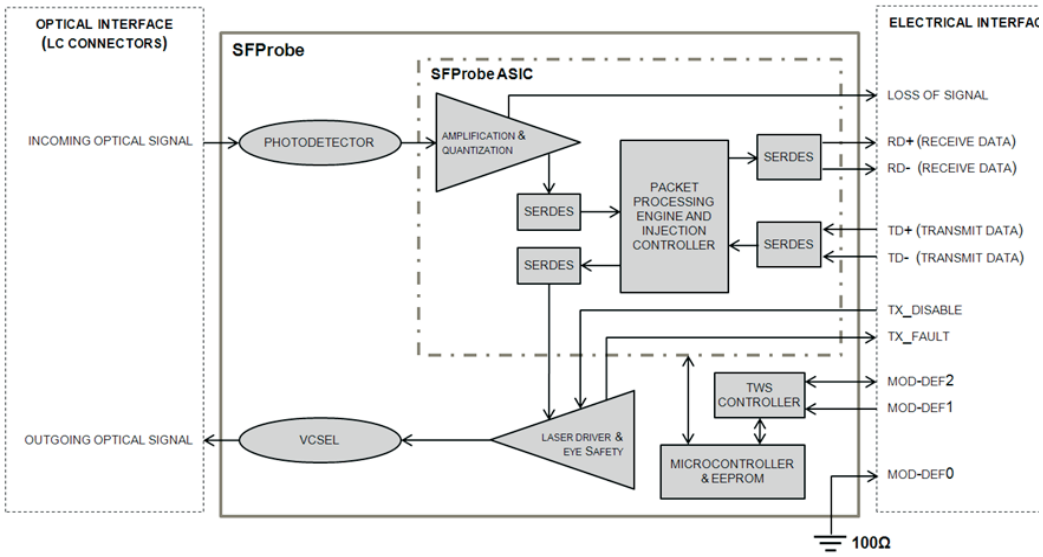
- Multi-Source Agreement (MSA) INF-8074i SFP, Rev 1.0 compatible
- MSA SFF-8472 Diagnostic Monitoring Interface (DMI) for Optical Transceivers, Rev 10.4
- Generic Reliability Assurance Requirements for Optoelectronic Devices Used in Telecommunications Equipment (GR-468-CORE) certified
- Class-1 eye safety certified

Key Features

- Line-rate deep packet inspection of any header or payload value
- Selectively copies packets of interest with four independent banks containing eight discrete protocol filters in each direction
- Automatic packet header parser eases filter configuration
- Globally accurate time synchronization enabling cross-network analysis
- Hot-pluggable with bail-wire de-latch
- Single 3.3 V DC power supply
- Industry-standard duplex LC optical connectors
- Available in two operating temperature ranges: 0~+85° C standard and –40°C ~+85°C extended
- 128-bit encrypted discovery and sequenced communications

SFProbe SX

- IEEE 802.3–2008 Gigabit Ethernet (1.25 GBd) 1000Base-SX
- 850 nm vertical cavity surface emitting laser (VCSEL)
- Supports 62.5/125 µm and 50/125 µm multimode fiber
- Up to 550 m range
- PIN photodiode receiver and custom trans-impedance preamplifier
- SFProbe LX
- IEEE 802.3–2008 Gigabit Ethernet (1.25 GBd) 1000Base-LX
- 1310 nm Fabry-Perot (FP) laser
- Supports 9/125 µm single-mode fiber
- Up to 10 km range



Compatibility

The major functional components of the IPD-SFPROBE-SX and IPD-SFPROBE-LX and the interaction of the embedded ASIC with the data flows through the IPD are illustrated below. The addition of the Ethernet SerDes requires input and output signals to be equivalent to or compatible with Ethernet 8B/10B-encoded data compliant with 802.3-2008.

SFProbes have undergone compatibility testing with many major NEM's hardware. Some NEM elements do not accept standard MSA-complaint SFPs and require the SFProbes to be keyed to work with their equipment. In some cases, the keyed SFProbes are interchangeable across the entire product line for a particular NEM. Other NEMs may require differently keyed SFProbes for different distinct products.

It is important to make sure SFProbes are compatible with the equipment and the type of fiber used at the point of deployment within the network. Individual NEMs typically publish SFP and SFProbe compatibility matrixes for their equipment and should be consulted to guarantee compatibility.

Security and Licensing

Viavi designed the SFProbe with security as a critically important requirement. Because the SFProbe is expected to be deployed into unsecured networks that are open to attack, it incorporates multiple layers of encryption and security. The system employs sophisticated, session-based 128-bit Grain cipher encryption algorithms in addition to controlled, pre-shared activation and initiation keys that are unique to every SFProbe. Activation and initiation keys are not algorithmically generated, making it impossible to programmatically determine keys even if an individual SFProbe's characteristics are known. Keys are only distributed when owners provide information proving both physical possession and network connectivity to a specific SFProbe.

Functionality built into every SFProbe ensures that keys cannot be hacked or accessed through the network or with physical access to the SFProbe. Individual sessions are protected from unauthorized access through session key hopping, command and control sequencing, and proprietary methods resulting in security comparable to military-grade standards.

Additional security can keep an operator's SFProbes from being discovered by outside systems. This feature is known as the customer network ID (CNID). During system installation, the PacketPortal System Manager is automatically configured with a unique, encrypted CNID. The SFProbes within that system can optionally be programmed to use this CNID. When an SFProbe is programmed with a CNID, it prevents the probe from being used by another System Manager or by anyone outside of the identified network. To ensure security, the CNID is not viewable in an unencrypted format.

Although using CNIDs with SFProbes is optional in PacketPortal, adding CNIDs to deployed SFProbes provides an added level of security. Programming of CNIDs requires physical access to the SFProbe, the use of a portable SFP programmer available from Viavi or TotalPhase, and the CNID configuration parameter file exported from the System Manager. The portable SFP programmer is a handheld, battery-powered device that is used to program SFProbes with the encrypted customer network identifier of a specific System Manager. The SFP programmer makes the task of programming SFProbes quick, easy, and portable.

Differences Between an SFProbe and a Standard SFP

The primary difference between an SFProbe and a standard SFP is the addition of a custom ASIC to the module. The SFProbe not only converts electrical and optical signals, but also inspects the frames and packets flowing through it. To perform these functions, an Ethernet SerDes serializes and deserializes the signals passing through the SFProbe. For this reason, an SFProbe only supports valid 8B/10B encoded Ethernet data.

Additional differences between an SFProbe and a standard SFP include:

- The SFProbe buffers and inspects every packet that passes through it to determine if it is a command and control packet specifically targeting it.
  - This adds an insignificant fixed delay of 2.464 microseconds for every packet.
  - If the packet is a command and control packet and matches the SFProbe's ID, it is removed from the line and not forwarded.
- To maintain running disparity for packet insertion, the SFProbe converts all idles passing through it to IDLE2 (/K28.5/D12.2/) code groups.
  - The SFProbe will only insert IDLE1 code groups as needed for disparity compensation.
- Similar to a switch, the ingress and egress paths of the SFProbe are on different time domains.
  - Technologies such as G.8262/Y.1362 synchronous Ethernet that require consistent time domains will not operate in this environment.
- The SFProbe injects traffic into idle periods at or above the minimum Ethernet interframe gap for communications. This results in increased bandwidth on the line during times of insertion.
- The SFProbe removes an equivalent number of Idle code groups from the line to match the size of the packet being inserted to maintain real-time packet flows.
- The SFProbe waits for 6 Idles to validate a valid Ethernet interframe gap and will begin inserting a packet after injecting another 1 Idle, which increases the Ethernet interframe gap to 14 octets during an insertion.
- If the SFProbe receives an invalid Ethernet code group or symbol, it will generate a valid Ethernet error code group instead of passing the invalid bits.
- If a packet arrives when a maximum-sized communication packet of 2,014 bytes is being inserted, the arriving packet can be delayed up to a maximum of 16.688 microseconds.
  - The length of this variable delay is directly proportional to the packet length and transmission time required for the inserted packet to leave the SFProbe.
- The SFProbe does not support MAC half-duplex mode.
- The SFProbe is a Gigabit-only solution. 10/100 Mbps is not supported.
- The SFProbe uses an additional hidden memory space within the EEPROM to store licensing, security, identification, and configuration information.
  - Every SFProbe has a unique identifiers
  - Users can configure an optional customer network ID for added security.

Conclusion

SFProbe transceivers comply with the IEEE 802.3-2008 Gigabit Ethernet standard, are compatible with MSA SFF standards, and can replace standard 1 GE optical SFPs throughout the network to add PacketPortal capabilities to elements such as switches, routers, DSLAMs, and OLTs at the network edge. SFProbes are available in both SX and LX wavelengths and are available with generic formatting or as keyed and re-branded SFProbes from major NEMs that enforce keying.

By replacing SFPs with SFProbe IPDs in an Ethernet network, operators can selectively copy packets of interest from the network and send the packets as encapsulated results packets to any routable IP address in the network.

PacketPortal redefines how and where data is accessed throughout a network. Its pervasive data reach and visibility unleashes network applications and tools, providing the insight needed to solve problems faster. It also drives additional revenue by enabling new, innovative services at significantly lower costs.

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