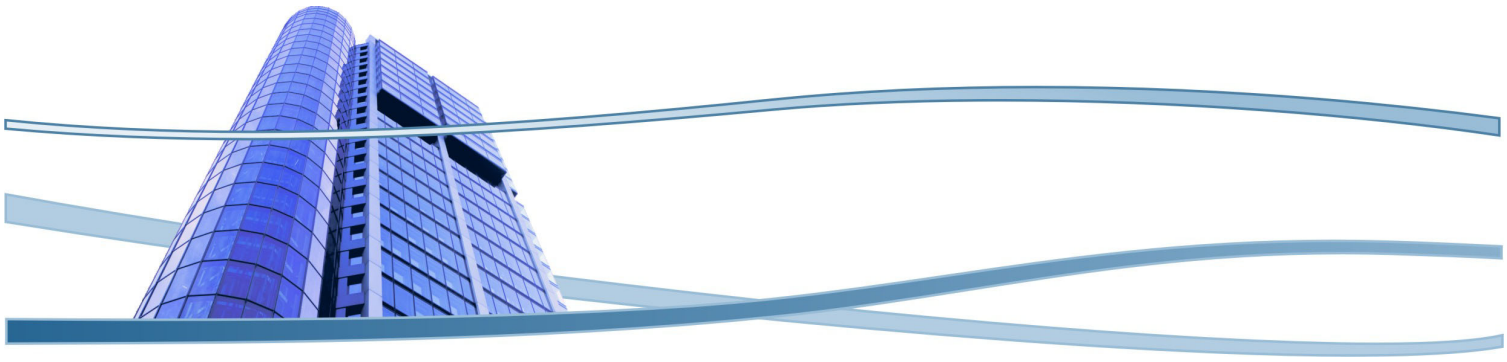
IEEE 802.3ah OAM



FOR CARRIER-CLASS OPTICAL ETHERNET IN THE FIRST MILE

The functions, goals and benefits of 802.3ah OAM Ethernet Fiber Access with Network Interface Devices

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Introduction

Operations, Administration and Maintenance (OAM) was originally developed to increase the reliability and streamline the maintenance of TDM and SONET/SDH networks. The OAM mechanisms became crucial to network operations and were so effective that they enabled carriers to deliver the famous five nines (99.999%) of network reliability.

Ethernet is now becoming the preferred broadband access technology. This is due to the market demand from small and medium size businesses, the low cost of Ethernet equipment and the ability to deliver exponentially more bandwidth.

The challenge to carriers is the ability to maintain and troubleshoot Ethernet networks with the same effectiveness as traditional TDM and SONET/SDH networks. Ethernet networks in the enterprise are managed with Simple Network Management Protocol (SNMP). Although a flexible LAN management tool, SNMP relies on IP connectivity, and assumes devices are IP accessible. When the underlying network is non-operational and management is needed most, SNMP is not a viable management method for carriers.

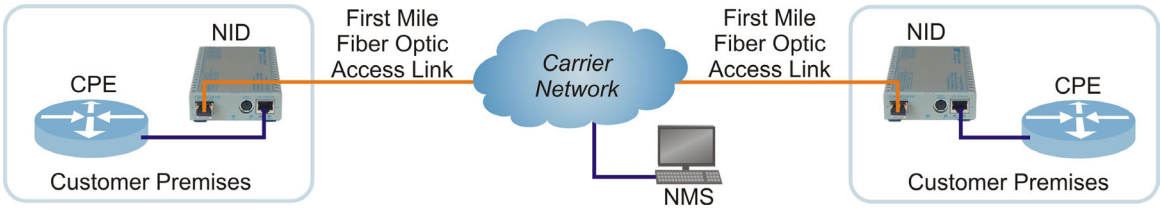
To address this, organizations such as the IEEE, the ITU and Metro Ethernet Forum (MEF) are developing standards for packet-based OAM mechanisms. The IEEE 802.3ah OAM is such a standard, and overcomes the limitations of SNMP by detecting problems in Ethernet access links in the First Mile.

Ethernet 802.3ah OAM fiber access reduces the total cost of ownership, accelerates time-to-revenue and increases customer satisfaction.

802.3ah OAM addresses all EFM technologies, including Copper and Fiber. This paper addresses fiber in the First Mile.

The EFM access link connects the edge of the carrier network to an Network Interface Device (NID) at the Customer Premises, where the fiber is converted to copper and connected to Customer-owned Equipment. The NID is an intelligent, securely managed device that performs OAM functionality and provides testing and notification of link status from the Customer Premises Equipment to the edge of the carrier network.

Some equipment vendors, like Omnitron, extend the capabilities of 802.3ah OAM with Organization Specific Extensions to include additional monitoring and discovery information, configuration, provisioning and trap notifications.



Goals of 802.3ah EFM OAM

- Minimize Operating Expenditures (OPEX) by reducing maintenance costs
- Maximize profits by optimizing and documenting network performance, enabling quantifiable SLAs
- Enabling new revenue by servicing a growing market for carrier-class Optical Ethernet in the First Mile (EFM)

Overview of 802.3ah OAM Functions

EFM OAM is designed to detect network problems, provide performance monitoring and simplify network maintenance.

The 802.3ah OAM functions are:

- Discovery
- Link Performance Monitoring
- Remote Loopback
- Fault Detection
- Collecting Performance Statistics
- Organizational Specific Extensions for additional capabilities

Discovery

Discovery is the first phase of 802.3ah OAM protocol and identifies the 802.3ah-capable link partner. Since 802.3ah is a multi-vendor, non-proprietary protocol, Discovery is necessary for link partners to communicate their OAM capabilities and configurations.

Link Performance Monitoring

Link monitoring tools are for the detection and notification of link performance (quality) faults. Link monitoring uses the Event Notification OAM Protocol Data Units (OAMPDUs) which are sent to OAM capable devices when problems are detected.
Since Ethernet data performance can deteriorate slowly before disrupting service, the 802.3ah standard enables a user to set the level of threshold that generates an event OAMPDU. The error events defined in the 802.3ah standard are:

- Errored Symbol Period: the number of symbol errors within the last predefined number of symbols has exceeded a threshold.
- Errored Frame: the number of frame errors detected during a specific period has exceeded a threshold.
- Errored Frame Period: the number of frame errors within the last predefined number of frames has exceeded a threshold.
- Errored Frame Seconds: The number of Errored Seconds (one second intervals with at least one frame error) within the last predefined number of seconds has exceeded a threshold.

Remote Loopback

An 802.3ah OAM-capable device can put its remote link partner into loopback mode using a loopback control OAMPDU. Every frame received is transmitted back on the same port to ensure the quality of links during installation or troubleshooting.

Fault Detection

An OAMPDU flag allows an 802.3ah-capable device to convey severe events and failure conditions to its OAM link partner. 802.3ah OAM Detects and indicates the following conditions:

- Link Fault: Loss of link is detected by receiver.
- Dying Gasp: Unrecoverable condition such as power failure is sent to the remote link partner.
- Critical Event: Organization specific critical event or major failure.

Collecting Performance Statistics (MIB Variable Retrieval)
A Management Information Base (MIB) is a database of variables that can be used for measuring a link's capability to support an SLA. 802.3ah OAM supports the retrieval of MIB variables and provides read-only access.

Omnitron's Implementation of 802.3ah Organizational Specific Extensions
Additional capabilities and proprietary management functions can be achieved with 802.3ah Organizational Specific Extensions. Omnitron's *NetOutlook*® Network Management Software utilizes 802.3ah extensions to provide comprehensive management, configuration and trap notification of *iConverter*® Network Interface Devices.

Monitoring:
- Comprehensive status monitoring including temperature and power
- Customer facing port status (the source of many service calls)
- Optical port parameters including temperature, power, voltage, etc.
- Comprehensive MIB statistics above and beyond the basic set

Configuration:
- Network and customer facing ports (speed, duplex mode, etc.)
- Provisioning capabilities including Quality of Service prioritization and bandwidth control
- VLAN (SP-VLAN/Q-in-Q and Block C-VLAN)

Trap Notification:
- Customer facing port faults
- Temperature and power deterioration
- Security and intrusion detection alarms

Secure Management
802.3ah OAM management is an IP-less management protocol that eliminates the need for IP addresses in the first mile. The IP address of the Network Management Station is isolated to a secure part of the carrier's management network. This increases network security and prevents denial of service attacks by removing access to the carrier's management from the CPE. 802.3ah OAM provides securely managed demarcation that overcomes vulnerabilities of IP-based network services.

802.3ah OAM Management of *iConverter* Network Interface Devices

Ethernet presents a significant revenue opportunity for carriers, and Omnitron's products support the OAM features of the 802.3ah standard to successfully deliver carrier-class optical Ethernet in the First Mile.
iConverter NIDs are 802.3ah OAM-ready, and support Vendor Specific OAM extensions to enhance 802.3ah functionality and provide comprehensive management capabilities.

iConverter NIDs Feature Set

- Service Multiplexing
- VLAN with Q-in-Q for Ethernet Virtual Connections (EVCs)
- 802.3ah Link OAM
- 802.1ag Connectivity Fault Management
- Y.1731 Performance Monitoring
- QoS prioritization for real-time voice/data/video
- Rate limiting on all ports
- Port Access controls
- Compact and flexible demarcation configurations
- Standard and CWDM Small Form Pluggable (SFP) Transceivers

iConverter NIDs

iConverter NIDs enable Carrier Grade Ethernet Services with comprehensive OAM, fault management and performance monitoring capabilities.

Omnitron is committed to accelerating the delivery of carrier-class optical Ethernet in the First Mile and reducing the cost of service. *iConverter* intelligent NIDs with comprehensive 802.3ah OAM functions provide "out-of-the-box" carrier-class Ethernet in the First Mile. *iConverter* OAM access link monitoring supports customer SLA requirements and minimizes OPEX costs by reducing maintenance man-hours and truck rolls associated with CPE equipment problems.

CARRIER ETHERNET MEF Certified Compliant

iConverter fiber access products are MEF 9, MEF 14 and MEF 21 certified, and backed with a Lifetime Warranty and free 24/7 Technical support.

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