

802.3ah Operations Management: Requirements From A Diverse Services Provider

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OAM

- Need to support wide diversity of services
- Use existing OH where possible, add where not
- Single level of service overhead
- Bidirectional performance monitoring/reporting
- Bidirectional fault monitoring/reporting
- Configuration management from head-end
- Remote link management
- Remote “facilities alarms”
- Comm channel for upper layer functions
- Inband to PHY – Out-of-band to Data traffic

Need to Support a Wide Diversity of Services

- Private Line – extend management edge of enhanced private line services (P2P/Cu)
- Virtual Private Line – extend management edge of segregated data services over shared bandwidth (P2MP)
- Best Effort – extend management edge of shared “Internet” type shared access services (P2P/P2MP/Cu)
- Virtual Private Network – extend management edge of data insulated traffic over best effort facilities
- Value added content services – manage facilities and user service insertion/interfaces (TV, HDTV, Pay/View)
- High value interactive services – voice (VOIP/POTS), video (broadcast quality video conferencing)

Use Existing OH where possible, add where not

- Existing subscription network service infrastructure uses inserted frames or inserted bits to provide OAM functionality “out of band” to revenue bearing traffic
- For Optical GbE add overhead to existing coding/signaling sublayers
- For Copper PHY use same OAM as Optical PHY at reduced overhead rate relative to Copper signal rate

EFM: A Closed System

- At extreme edge of service network
- Services do not have to feed through to, be managed by or be direct layer 1 clients of networks beyond this L1 architecture & environment.
- 802.3 PHY layer signaling only - P802.3ah
- OAM overhead is inband to PHY and Out of Band to link level data (not part of Ethernet frame stream).

Single Level Of Service Overhead

- Closed System from Head-end (OLT) Master System to tail end (CPE/ONU) Slave System
 - No encapsulation through multiple topology layers: “Path” level only, no “Section” or “Line” level functional topology support for P-2-P
 - Separate “Section” layer for P-2-MP may be needed if active optics (DWDM, amplifier, or other optical signal segregation) is put in “splitter” (repeater)
- (Currently no full duplex repeater defined in 802.3)

Bidirectional performance monitoring/reporting

- Bit Error Rate to determine media signal quality
 - Physical signal level only
 - Fixed bit count required for BER detection
- Frame Error Rate to determine data transmission quality
 - Data link signal level
 - Monitoring relative to data stream frame count
- BER and FER are both required; BER/FER comparison enables trouble-shooting that's otherwise impossible:
 - distinction between constant single bit errors indicates degradation of media signal
 - burst errors are normal in even high reliable systems

Bidirectional fault monitoring/reporting

- Simplex reporting from tail end to head end systems: indicates downstream link loss, fault, etc.
- Remote physical and services layer reporting – status, conditions, etc.
- “Last Gasp” Fault/conditions reporting
- Key aspect of SLA requirements
- Potential future integration with upper layer fault reporting schemes (voice traffic isolation, etc.)

Configuration management from head-end

- Head end system is master of tail end systems for all OAM functionality and reporting
 - All remote systems provisioning, admin, functionality are through head end system, whether Cu P2P, Optical P2P or Optical P2MP
 - Tail end systems must be slaves for administrative purposes
 - Physical level addressing does not require Ethernet MAC, head end always known, only tail end systems need addressing for OAM

Remote “facilities alarms”

- Equivalent to ‘order wire’ in existing dta com services/transmission systems
- Physical environment points
- Lets system implementors ID physical facilities problem without truck rolls (ref. Grant County presentation)
- Consumes very little overhead bandwidth

Comm channel for upper layer functions

- Equivalent to DCC in existing data com/services transmission systems
- Physical system config./provisioning such as remote data link ports on/off
- Provides upper layer alarming outside of Ethernet data channel
- Low to moderate bandwidth ~64kbps

Inband to PHY – Out-of-band to Revenue Data traffic

- P802.3ah defines physical layer functionality only
- Many service definitions and SLAs demand all overhead to be segregated out of band from the revenue service payload
- No performance or cost penalties are accrued when isolation of overhead & payload traffic is unnecessary

Today – 802.3 is Peer to Peer

802.3ah (EFM) is NOT Peer to Peer

- Full duplex point to point is a peer-to-peer environment at PHY signal level...
- Symmetrical bandwidth uplink (OLT to ONU) and downlink (ONU to OLT)
- EFM Point to Point can not be peer to peer for OAM functionality (Master/Slave) (Cu or Optical)
- EFM Point to Multi-point cannot be peer to peer (Master/Slave or Client/Server)

P802.3ah P-2-P Has To Be Master/Slave

- Head end system (OLT) controls performance monitoring and administration of all tail end systems (ONT) regardless of topology
- OLT functions to link service provider OAM functionality to customer premise equipment
- OLT functions to link all CPE remote functionality to service provider Operations Services Systems (OSS)
- Applies to copper media as well as optical media

P-2-MP Option 1: Master/Slave

- Master (OLT) directly controls the uplink bandwidth from slave (ONU)
- Grant signal propagation delay in OAM signal from master to slave – may consume a significant portion of the time available for uplink traffic (guard band)
- Inexpensive – does not require complex timing and synchronization functionality
- Dynamic reallocation of uplink bandwidth between multiple slaves (round-robin or poll-mode)
- Work well in Fiber to the Home service environments where required uplink bandwidth is much lower than downlink services bandwidth and cost is a major factor

P-2-MP Option 2: Client/Server

- Server (OLT) assigns time slot to clients
- Each client (ONT) uses assigned time slot as needed
- Fixed assignable bandwidth (functions similar to existing TDM Private Line)
- Stranded bandwidth when not used by individual clients
- Expensive – requires complex ranging and timing synchronization functionality
- Would work well in a Multi-Tenant Business services environment where uplink and downlink bandwidth is symmetrical and ONT cost is less of a factor

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Common Requirements for Diverse Services

- Duplicate or enhance existing service provider management capability
- Most stringent services management requirements can support less stringent services – Less stringent service requirements can not support the most stringent services
- Use existing 802.3 technology where possible, borrow where can, add to as needed