

EFM OAM

Baseline Transport Proposal

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EFM OAM Objectives

- Support far-end OAM for subscriber access networks:
 - Remote Failure Indication
 - Remote Loopback
 - Link Monitoring

OAM Transport Recap

- Functionality and requirements agreed and mostly non-controversial
- Some historical controversy over method of OAM bit transfer
 - “Let’s use Ethernet frames to carry OAM...”
 - “Let’s carry OAM in the preamble...”
- Many recognized positive aspects in both
 - OAM a multi-faceted complex problem
 - Each network layer generally has own OAM functions
 - Different methods of bit transport can be used to address different requirements *without overlap*
- Should develop a single OAM strategy that addresses the entire market
 - Not partial coverage
 - Not two different solutions

OAM Transport Precursors

Proposed Ethernet OAM Baseline

- Current proposal drew from multiple previous proposals
 - gentry_1_0302.pdf
 - suzuki_2_0302.pdf
- Additional details provided
- Some significant changes

5Kft View

Proposed Ethernet OAM Baseline

- Certain Ethernet OAM capabilities mandatory and universally applicable to any and all Ethernet technologies
 - Detailed failure indication
 - MAC layer Ping
 - Loopback control
 - Link monitoring (peer 802.3 MIB variable read access)
- Mandatory features implemented via frame based transport
 - Fixed size 128B frames
 - Minimal and maximal periodicity
- Some situations require additional OAM capabilities
 - PHY availability test, immediate signaling of failure
- Ability to support additional capabilities is PHY dependent
 - Targeted at new P2P and P2MP fiber technologies
- Enhanced capabilities performed via preamble bit signaling
 - Single octet of preamble
 - Use negotiated via frame-based initialization procedures

Functional Partitioning

Proposed Ethernet OAM Baseline

Feature	Data transported in frame	State signaled in preamble
Event indication with diagnostics	✓	
Immediate non-intrusive signaling of PHY faults		✓
MAC layer ping/loopback	✓	
Lower layer ping/loopback		✓
Link monitoring	✓	

Different functions may be handled by different transport.

No functional overlap!

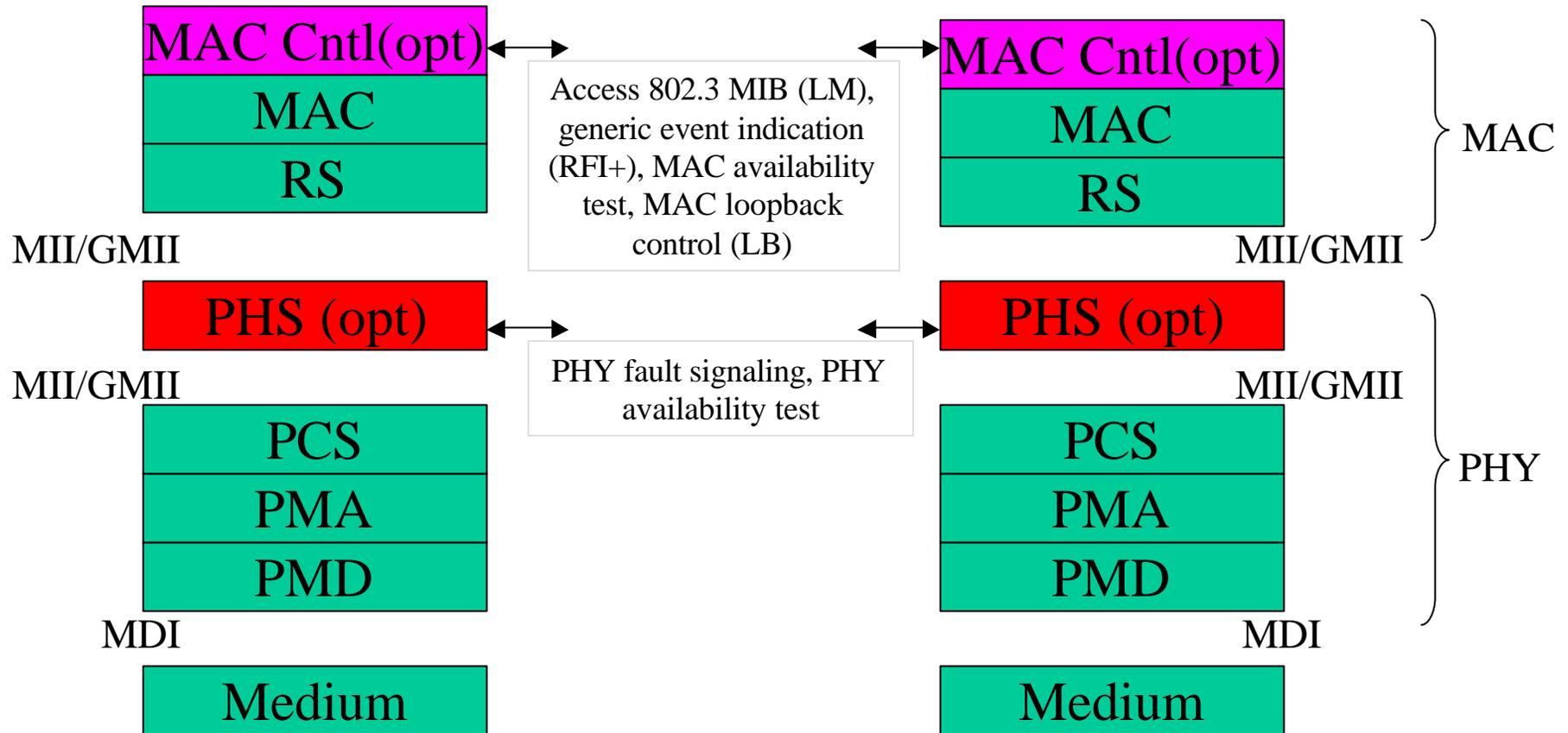
How does it apply to various media?

Proposed Ethernet OAM Baseline

- Consistent and mandatory OAM for all EFM
 - Applicable to all media, even Ethernet over copper
 - Functions:
 - Generic event indications
 - MAC connectivity and loopback
 - Link Monitoring
- Certain Ethernet PHYs may provide additional OAM capabilities
 - Ethernet over copper: IB/VOC/eoc
 - 10GE: WIS
 - P2P & P2MP EFM optical: enhanced preamble signaling
- Hierarchical network design
 - Each layer can provide its own OAM

Implementation Overview

Proposed Ethernet OAM Baseline



PHS = Preamble Handler Clause (new)

Ethernet MAC OAM

Proposed Ethernet OAM Baseline

- Initialization procedure
 - Negotiate OAM capabilities, including use of preamble signaling
 - Determine set of statistics and variables for status reports, periodicity, and minimal/maximal OAM bandwidth (frames per second)
- Periodic status reports
 - Includes set of Ethernet statistics and state variables
- Status queries
 - Query for specific 802.3 variable
- Event Notification
 - May include diagnostic data
 - Limited by allowable bandwidth of Ethernet OAM
- MAC layer ping
 - For availability testing, could be periodic or on-demand
- MAC layer loopback control
 - Frame turnaround implemented in MAC layer controlled by timer
- OAM frames can be transmitted even if link in a unidirectional state (ie no receive path)

MAC Control Frame Format

Proposed Ethernet OAM Baseline

MAC DA	MAC SA	Length/type	Sub type	OAM code	OAM data	CRC
6	6	2	1	1	108	4

Field	Description	Value
MAC DA	Slow_Protocols_Multicast Address	01-80-c1-00-00-02
MAC SA	Station's MAC Address	48-bit individual address of the station (egress port) sending the frame
Length/type	Slow_Protocols_Type	88-09
Subtype	Protocol Subtype value for EFM OAM	03 is next available
OAM Code	01 = Ping Request 02 = Ping Response 03 = Link Monitor etc	
OAM Data	Up to 108 octets	Data/Pad
FCS	Frame Check Sequence	32-bit CRC

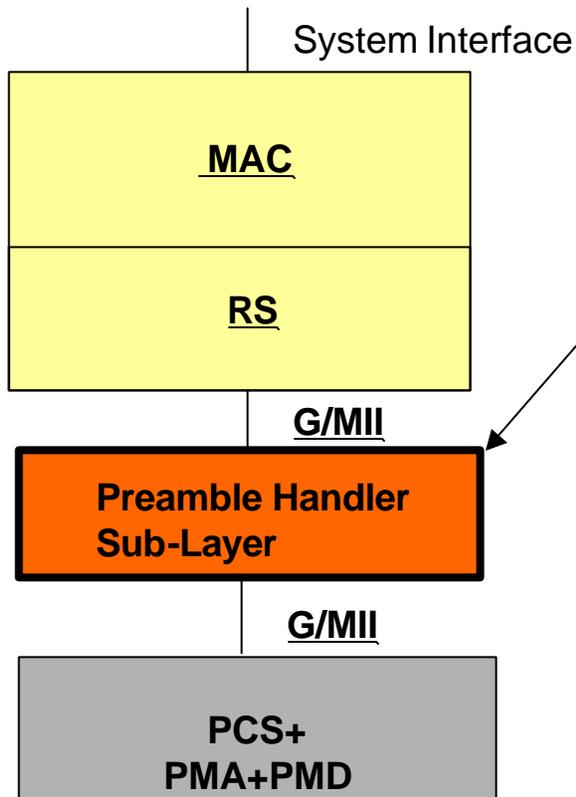
Ethernet PHY OAM

Proposed Ethernet OAM Baseline

- Optional implementation for P2P and P2MP
- Not applicable to all Ethernets
 - EFM Ethernet over xDSL
 - 10/100 BaseT
 - Etc.
- Use of Ethernet PHY OAM negotiated via OAM initialization procedure in frames
- One octet of preamble to provide *fast signaling* of small number of *PHY layer* state variables
 - PHY Layer Ping and Loopback Control
 - Alarm Indications
 - Local/Remote Fault Indications
- No access to MAC or higher layer information
- Limited access to PHY states required by MAC and above
 - MDIO speed does not impose any problematic restrictions

Where is PHY OAM Implemented?

Proposed Ethernet OAM Baseline



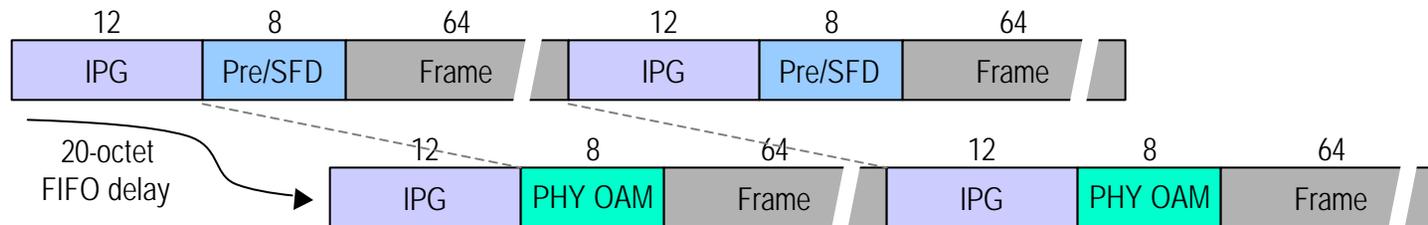
Preamble Handler Sub-layer

- Define “Preamble Handler Sub-layer”
- It is located below RS layer and above PCS across GMII/MII
- Specify a **NEW CLAUSE**
- More flexibility in implementations
- Minimal impacts on existing clauses
(No change to RS nor PCS for 100M, 10G PCS)

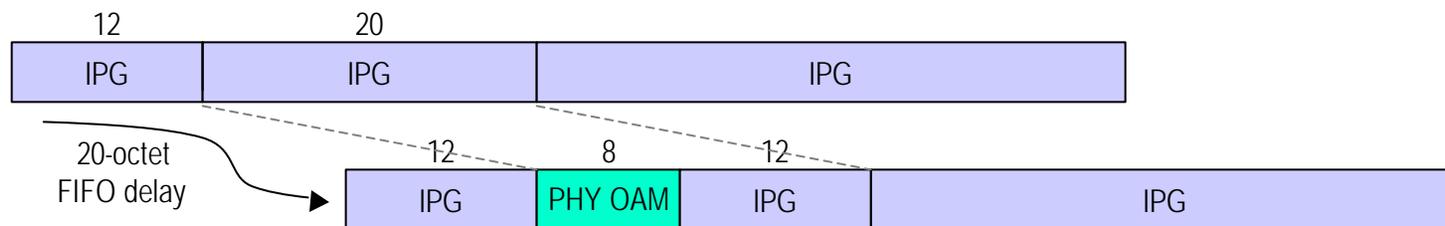
How is PHY OAM Implemented?

Proposed Ethernet OAM Baseline

- PHS implements 20B FIFO Queue
- Normal Preamble/SFD substituted with OAM Preamble



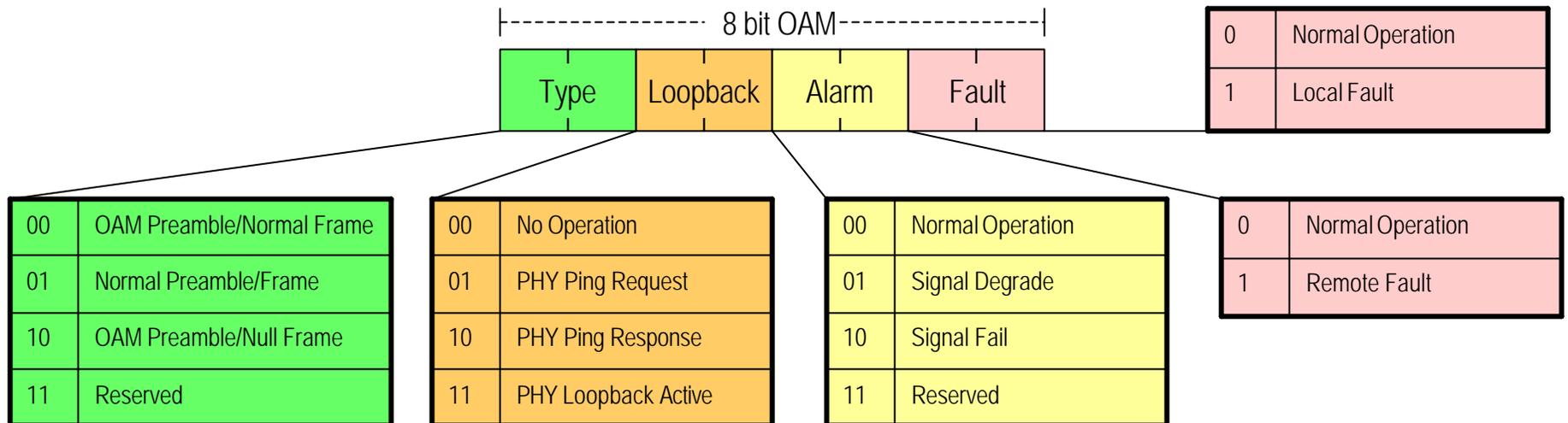
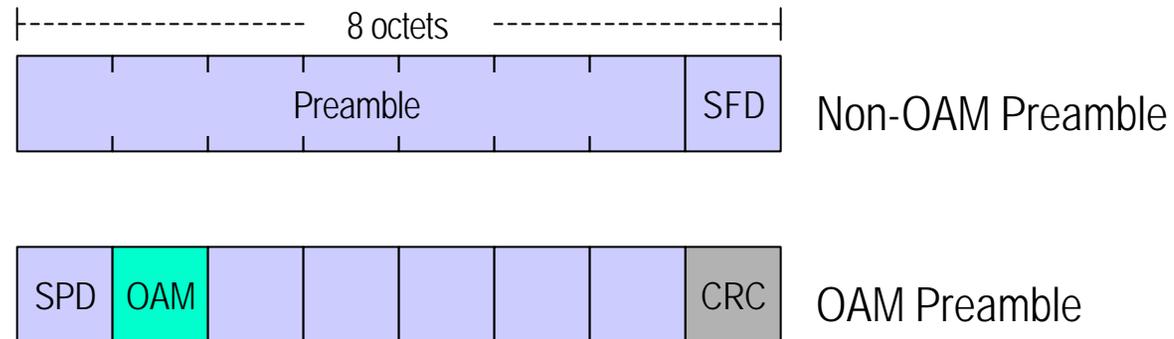
- PHS *may* replace IPG octets with PHY OAM octets
- IPG (idles) substituted with OAM Preamble



- PHY OAM octets ARE NOT FRAMES, do NOT PASS THE PHS, and have NO IMPACT ON MAC FUNCTION

Ethernet PHY OAM Format

Proposed Ethernet OAM Baseline



PHY OAM Impacts to Existing PHYs

Proposed Ethernet OAM Baseline

Media (Full Duplex)	Current Spec scope	Action to PHY	Action to Preamble OAM Sub-Layer
802.3ah EPON	New PHY (1GE)	New PHY specs make sure Preamble to be carried transparently to RS	Add new Clause: Preamble OAM Handler Sub-layer to specify
802.3ah P2P GE Fiber	New PHY (1GE, PMD only ?) <u>Existing PCS/RS may have 1byte preamble shrinkage.</u>	Add amendment on PCS TX to send 8 byte preamble	1) Handling of OAM byte in Preamble
100Base TX 100base FX	Existing 4B5B PCS preserves 7Byte preamble + SFD to RS	None	2) Generation of OAM Preamble to replace IPG
1000Base X (802.3z)	<u>Existing 8B10B PHY/RS may have 1byte preamble shrinkage.</u>	Add amendment on PCS TX to send 8 byte preamble	
10Gbase (802.3ae)	Existing preserves 7Byte preamble + SFD to RS	None	

PHY OAM and 1000BaseX

Proposed Ethernet OAM Baseline

- Previous chart shows *only* incompatibility is with 802.3z PHYs
 - May shrink preamble from 8B to 7B
- Options for new EFM GbE PHY:
 - Amendment on PCS TX to always send 8B preamble
 - Modify the MII/GMII interface to the PCS to support a signal from the PHS to the PCS that enables/disables preamble shrinking.

PHY OAM and EoCu

Proposed Ethernet OAM Baseline

- Details for integration of existing PHY DSL OAM and Ethernet need to be worked out
 - DSLs provide with VOC/eoc/IB
 - PHY OAM function of EoCu already defined by ITU, ANSI, etc.
- Ethernet MAC OAM operates over EoCu
 - Consistent Ethernet OAM capabilities across all PHYs

Scope of Standardization

Proposed Ethernet OAM Baseline

- Clause 55(?) (New OAM clause).
 - OAM overview, description, formats, etc.
- Clause 56 (?) (PHS layer).
 - Description, interfaces, etc.
- Clause 30 (Management).
 - New MIB objects, enhanced locally and also enhanced to include peer info.
- Clause 31 (MAC Control).
 - Minor additions for OAM slow protocol and use, pointers to Clause 55.
- Annex 43B.
 - Add OAM types to slow protocols list, maybe change slow protocol definition, etc.
- Clauses 22 & 45.
 - New PHY monitoring registers for things like RX power, signal-to-noise ration, etc.
- Annex 30A & 30B.
 - New OIDs for managed objects.
- Clause XX.
 - 1000 Base X PCS change for 8B preamble.

Comprehensive Ethernet OAM

Proposed Ethernet OAM Baseline

- Hierarchical networks have hierarchical OAM
- Important to provide OAM function at each layer
- Do not want overlapping OAM functions on multiple layers
- Proposed Ethernet OAM Baseline capitalizes on layered networks and functional partitioning