



OAM on Preamble Baseline Proposal

Presented by

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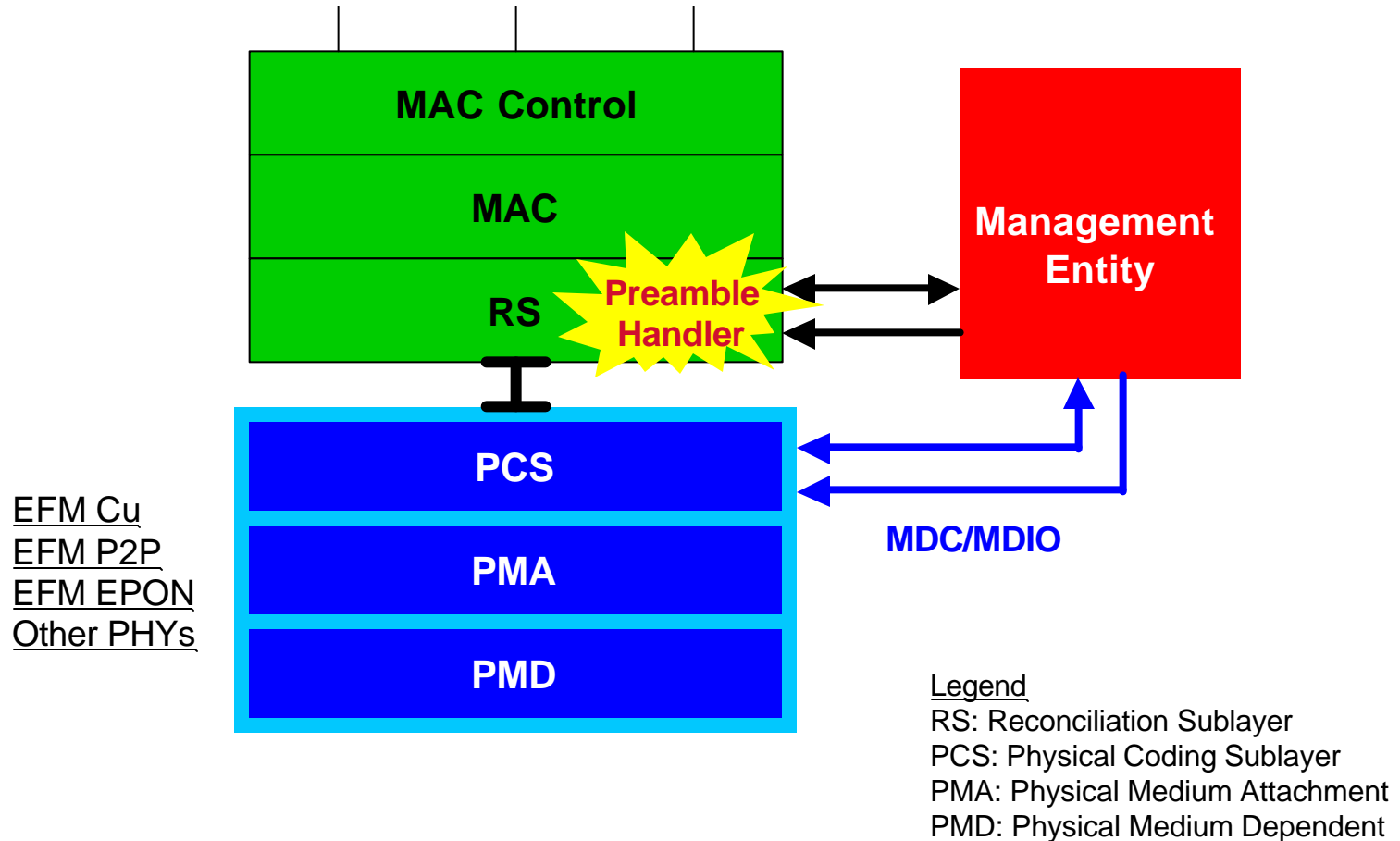
OAM on Preamble

- **OAM Requirements and applications**
- **Architecture and definitions**
- **Effects – bandwidth and compatibility**
- **Implementation Examples**
- **Conclusion**

OAM Functions

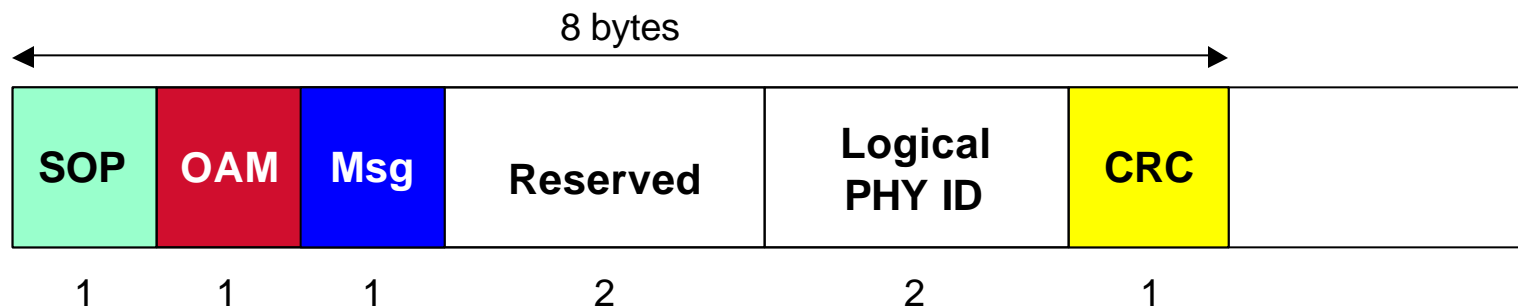
- **Loopback (Ping)**
- **End System Event Alarm (Dying Gasp)**
- **Remote Link Fault Indication**
- **Remote Read/Write Link Monitor Registers**
- **Possible Future Extensions**

Preamble Handler



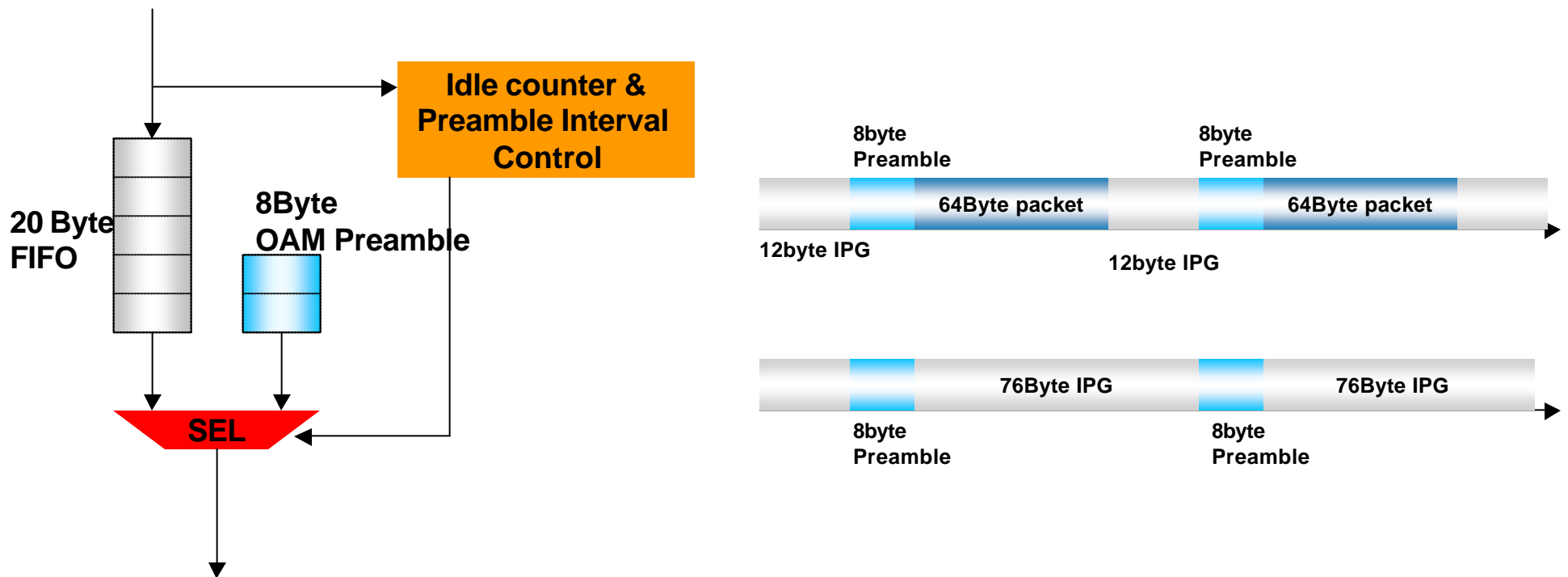
Preamble Format

- **8 byte Preamble includes:**
 - 1 byte: **SOP (Start of Packet)**
 - 2 bytes: **OAM, Message,**
 - 2 bytes: **Application specific OAM extension (Reserved)**
 - 2 bytes: **Logical PHY ID (Reserved)**
 - 1 byte: **CRC**
- **When no data frame exists, generate a “dummy frame”.**
- **When passing a frame to MAC, convert to standard Preamble.**

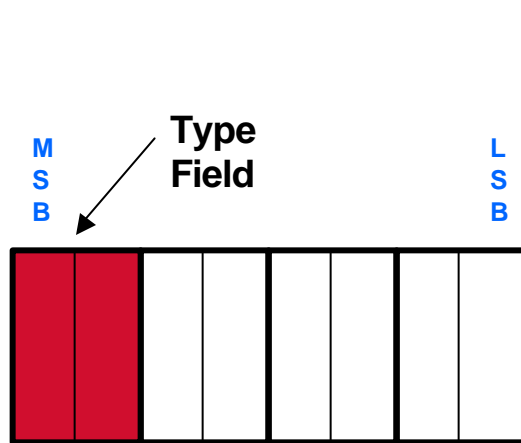


Dummy Frame: How it works

- 20Byte from IPG replaced with 8byteDummy-frame + 12byte IPG
- Make sure IPG rule for Dummy-frame as well as for Legal Frame
- Example of min Dummy-frame Inter-gap = 76 Byte
- **No impact on real traffic at all.**



OAM Type Field



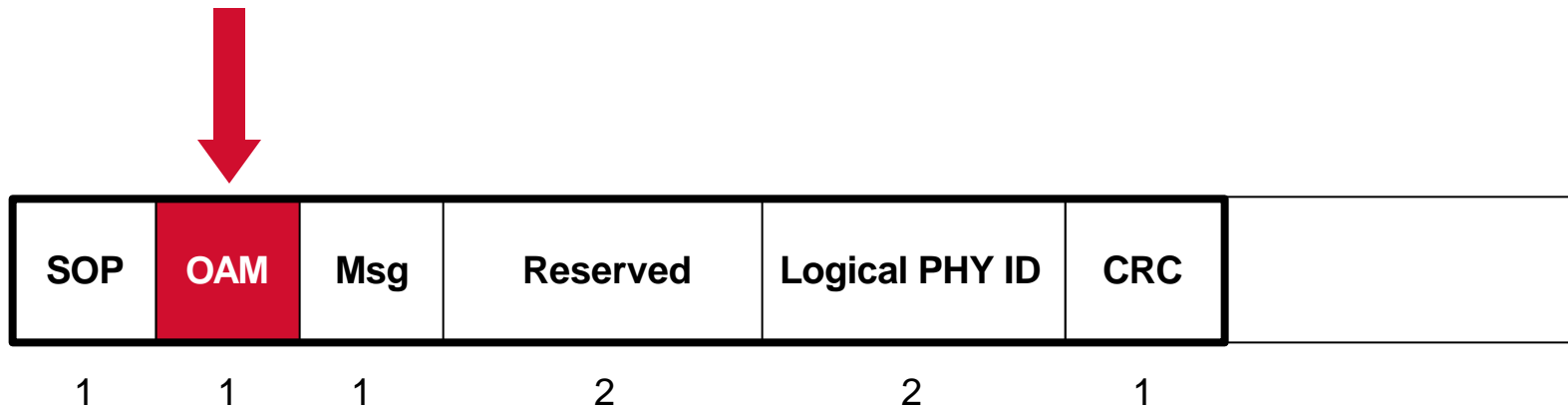
M L
S S
B B

0 0: OAM Preamble with Data

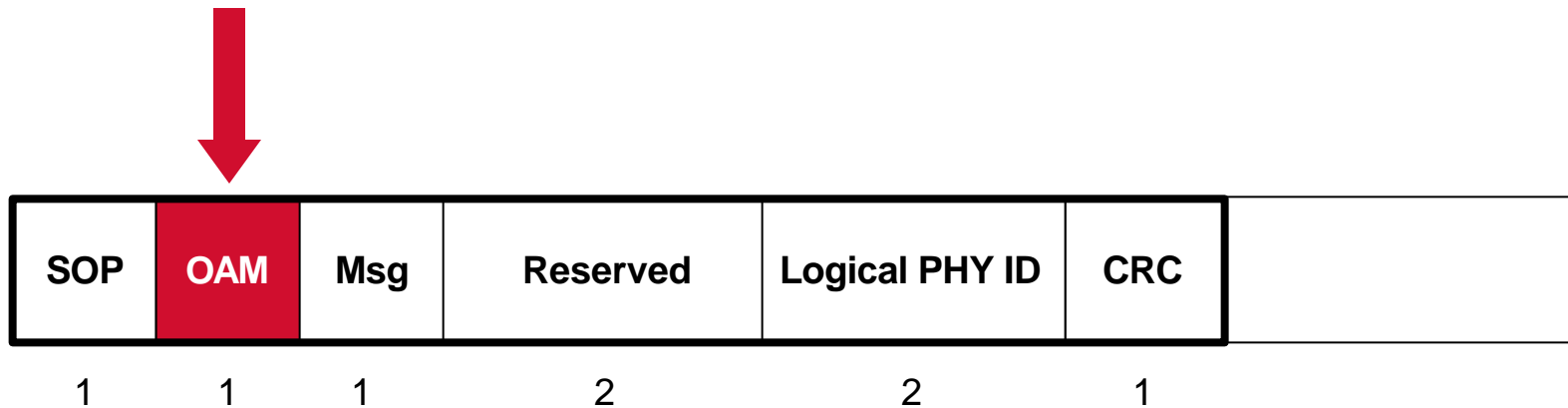
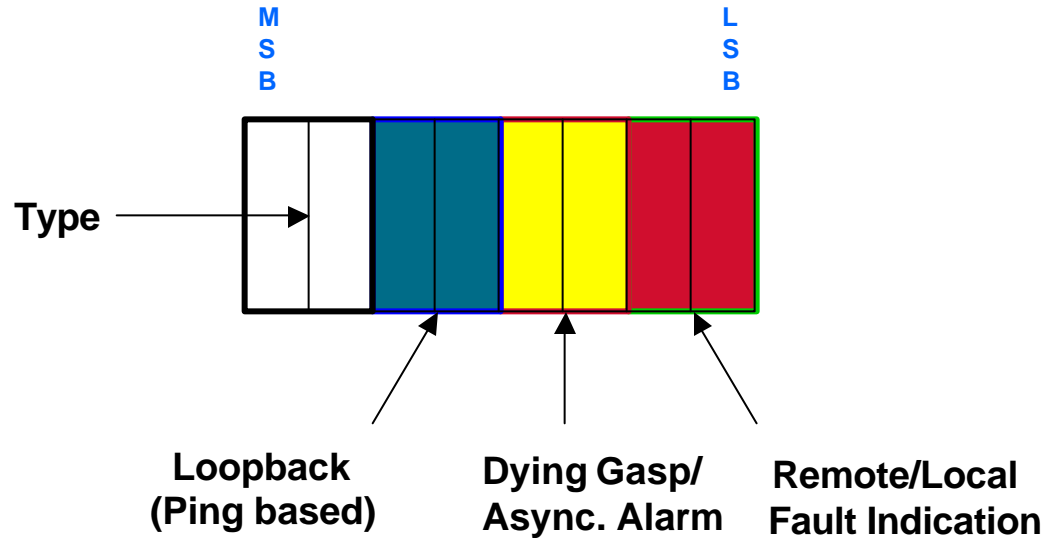
0 1: Standard Preamble

1 0: Dummy Frame without Data

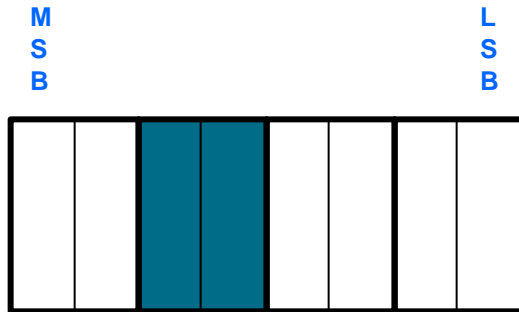
1 1: Reserved



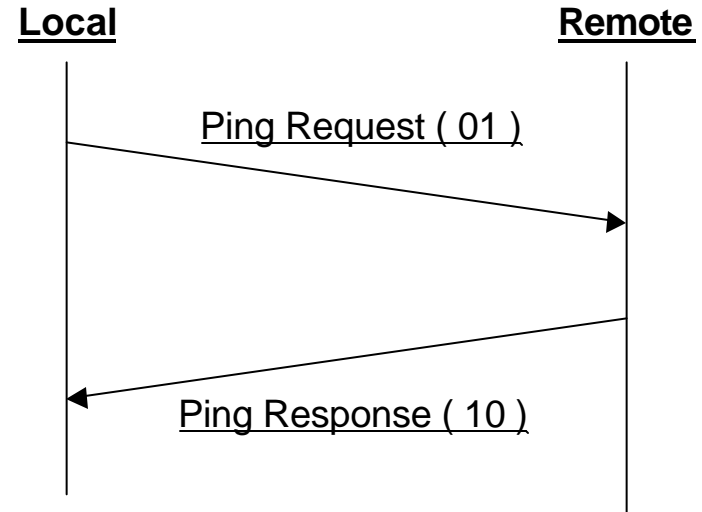
OAM Code Points



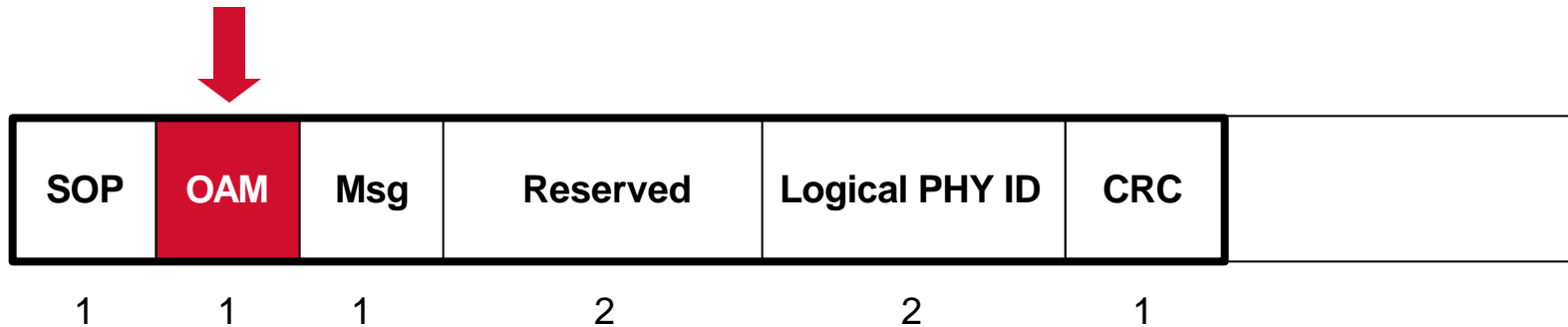
Loopback (Ping)



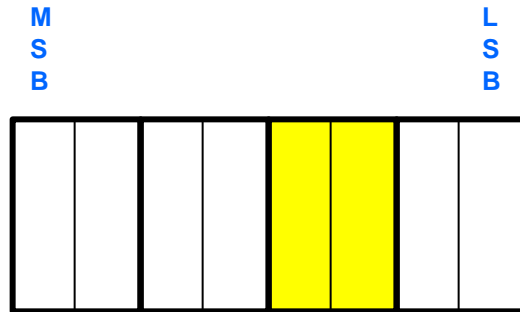
Loopback (Ping)
 00: No operation
 01: Ping Request
 10: Ping Response
 11: Reserved



Local) Sends Ping Request, awaits Response/timeout
Remote) Sends Ping Response to Request



General Asynchronous Event Alarm



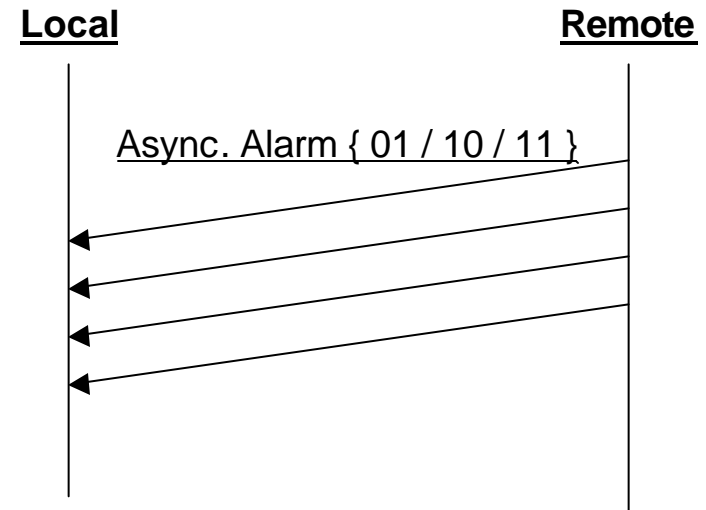
Asynchronous Event Alarm

00: Normal Operation

01: Going Failure due to power off

10: Going Failure due to node fail

11: Going Failure due to other reasons



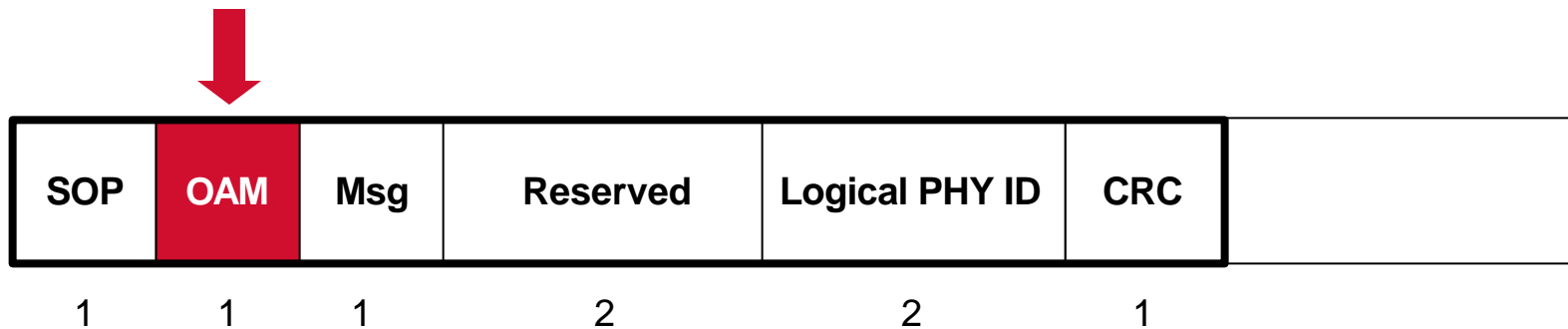
This Event alarm is triggered by the remote “node” (CPE / CO) failure.

Fault Indication



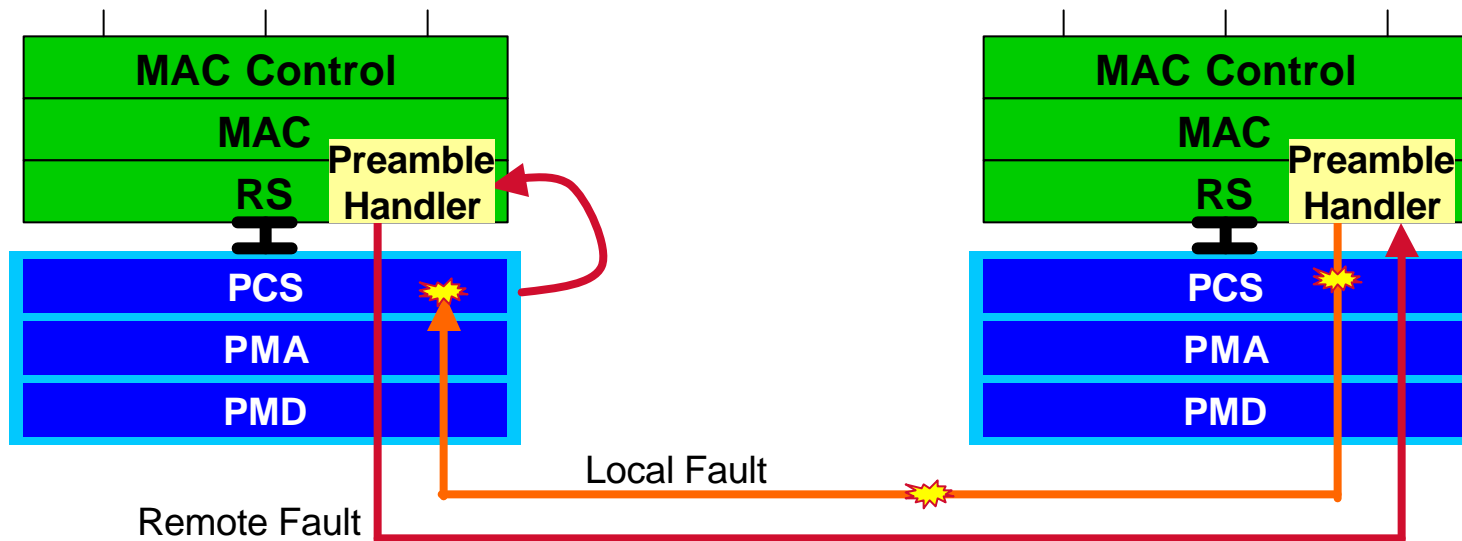
Remote Fault Indication bit
0: Normal Operation
1: Remote Fault

Local Fault Indication bit
0: Normal Operation
1: Local Fault



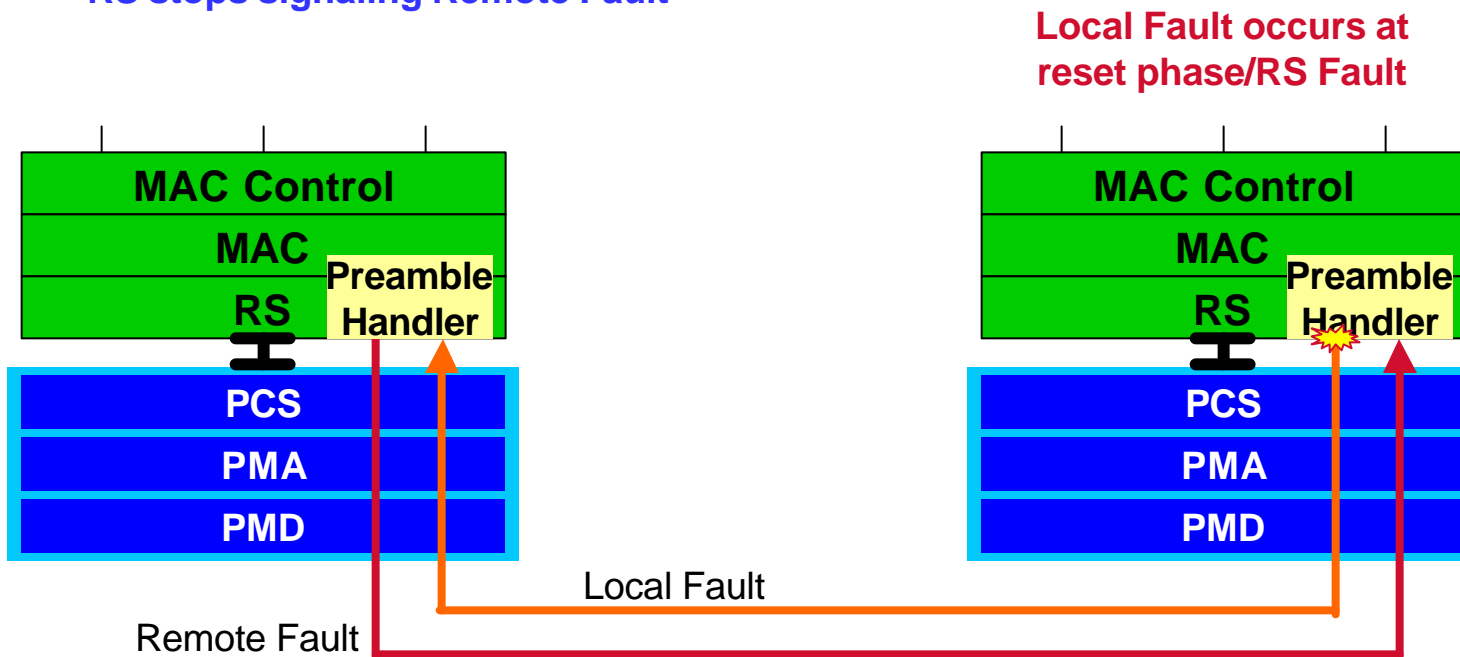
PHY Rx Fault Detect

- 1) When PHY Rx detects a Fault:
 - Set PHY Local Fault register and signals Local Fault to RS
 - RS signals Remote Fault in Tx direction
- 2) When the Fault is no longer detected by the PHY Rx:
 - Clear Local Fault indication in PHY and RS
 - RS stops signaling Remote Fault



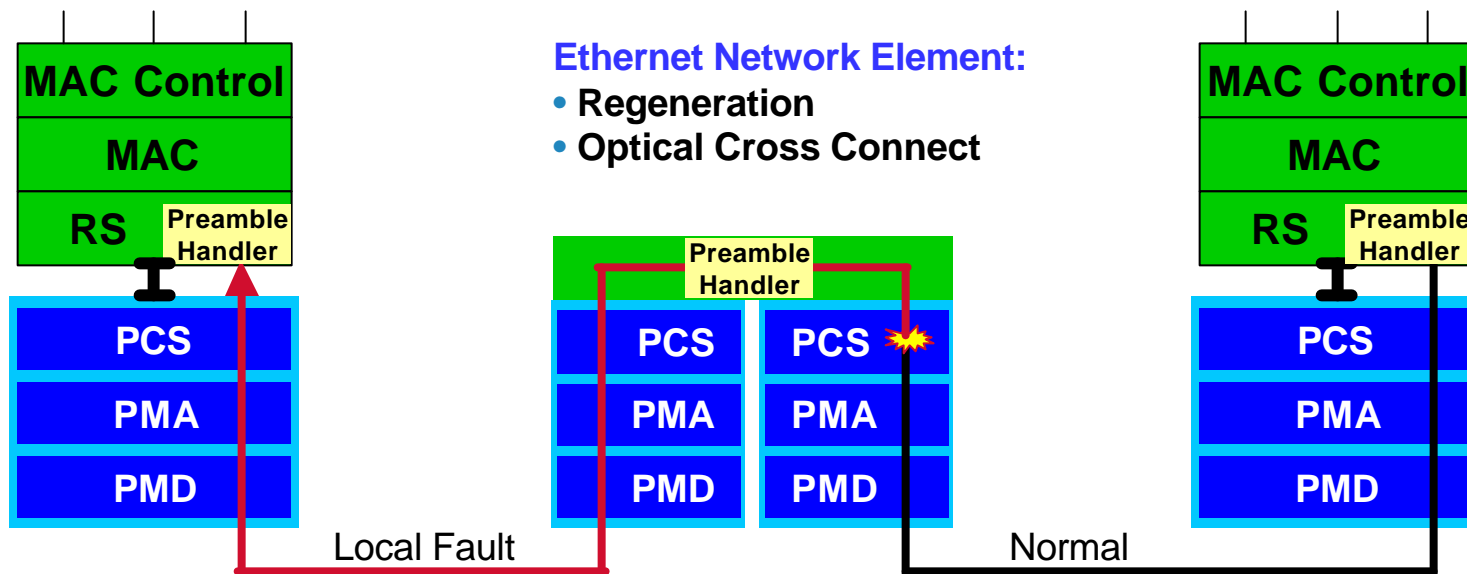
RS Fault Detect

- 1) When RS detects a Fault:
 - Set Local Fault indication RS
 - RS signals Remote Fault in Tx direction
- 2) When the Fault is no longer detected by the RS
 - Clear Local Fault indication in RS
 - RS stops signaling Remote Fault



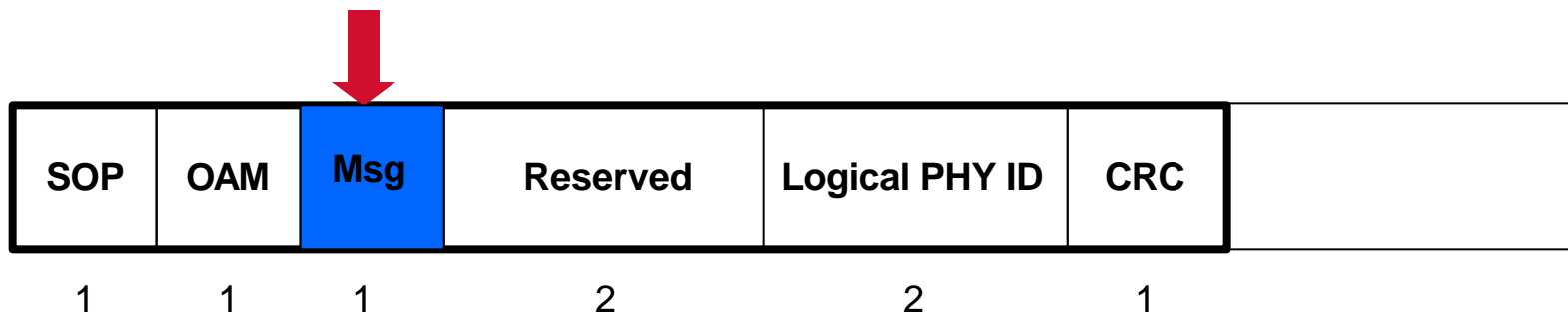
Optional Features of OAM Fault Indication

- “Ethernet Network Element (ENE)” includes OAM Preamble Handler
- RS generates and terminates Local and Remote Fault
- ENE OAM Preamble Handler reflects link-based Fault to RS across multiple link segments



Read/Write Message Passing

- “Message byte” used as a serial link
 - Higher Layer to define message handling
- Both send and receive
 - Local device may always send when frame is present
- Can be used to access remote MIB parameters
- Ethernet MIB passes “Message” byte with each frame
 - 2 objects – message_byte and message_byte_flag

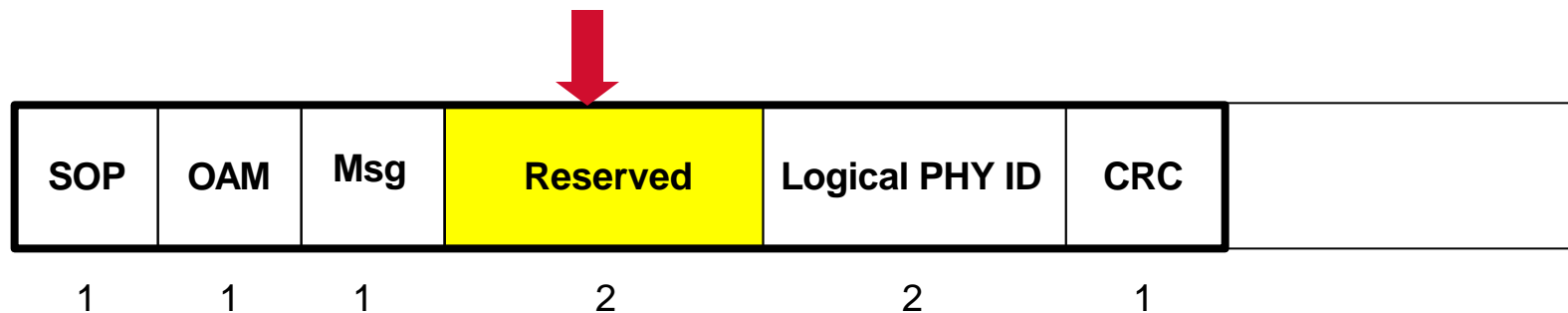


OAM on Preamble can read/write remote registers for:

- MAC level:
 - Tx/ Rx Pkts
 - CRC errors
- PCS/ PMA level:
 - Cu : SNR, Corrected Error
 - P2P: 8B10B symbol errors
 - P2MP: 8B10B symbol errors, upstream access control monitor
- PMD level:
 - Cu: Tx Power, AGC gain
 - P2P: Loss of Signal (Rx power)
 - P2MP: Loss of Signal (Tx/ Rx) power
- Plus, OAM Preamble CRC8 error counter

2byte Future Extension OAM

- End-end application specific OAM, such as
 - EPON specific additional OAM
 - End-End OAM, combined with Logical PHY Tag (like “SONET Path” OAM)
 - Other future usage
- EFM may not need specify those byte



OAM Bandwidth

- **Max: when we have min frame**

$$2\text{byte per } 8\text{byte}(\text{preamble}) + 64\text{byte}(\text{Frame}) + 12\text{byte}(\text{IPG}) = 2\text{byte} / 84\text{byte} = 2.4\%$$

- **Min: when we have longest frame**

$$2\text{byte per } 8\text{byte}(\text{preamble}) + 1522\text{ byte}(\text{Frame}) + 12\text{byte}(\text{IPG}) = 2\text{byte} / 1542 = 0.13\%$$

- **Reserved 2byte field can be used, if we need more BW.**

Preamble Transparency Table

Media (Full Duplex)	Current Spec scope	Action to PHY	Action to RS
802.3ah P2P Copper	New PHY (10M ~ 100M)	New PHY specs make sure Preamble to be carried transparently to RS	New RS layer or PCS layer Spec to Handle OAM on Preamble
802.3ah EPON	New PHY (1GE)	New PHY specs make sure Preamble to be carried transparently to RS	
802.3ah P2P Fiber	New PHY (1GE, PMD only ?) <u>Existing PCS/RS may have 1byte preamble shrinkage.</u>	Have to add amendment on PCS	
100Base TX 100base FX	Existing 4B5B PCS preserves 7Byte preamble + SFD to RS	No	
1000Base X (802.3z)	<u>Existing 8B10B PHY/RS may have 1byte preamble shrinkage.</u>	Have to add amendment on PCS	
10Gbase (802.3ae)	Existing preserves 7Byte preamble + SFD to RS	No	

802.3z PCS - Maintain 2 Idle Byte Alignment and 8 Byte Preamble

- Minimum transmit IPG of 12 byte times (MAC specification)
- RS does not modify the minimum transmit IPG of 12 byte times of MAC
- Allow variation in minimum IPG at the Transmit PCS
 - Hold packet until 2 byte alignment is achieved and make it up by shrinking following IPG
 - This would cause minimum IPG variation between 11 and 13 bytes, but it would always be average 12
 - No Preamble Compression
 - No significant change in PCS except do not chop one byte of preamble

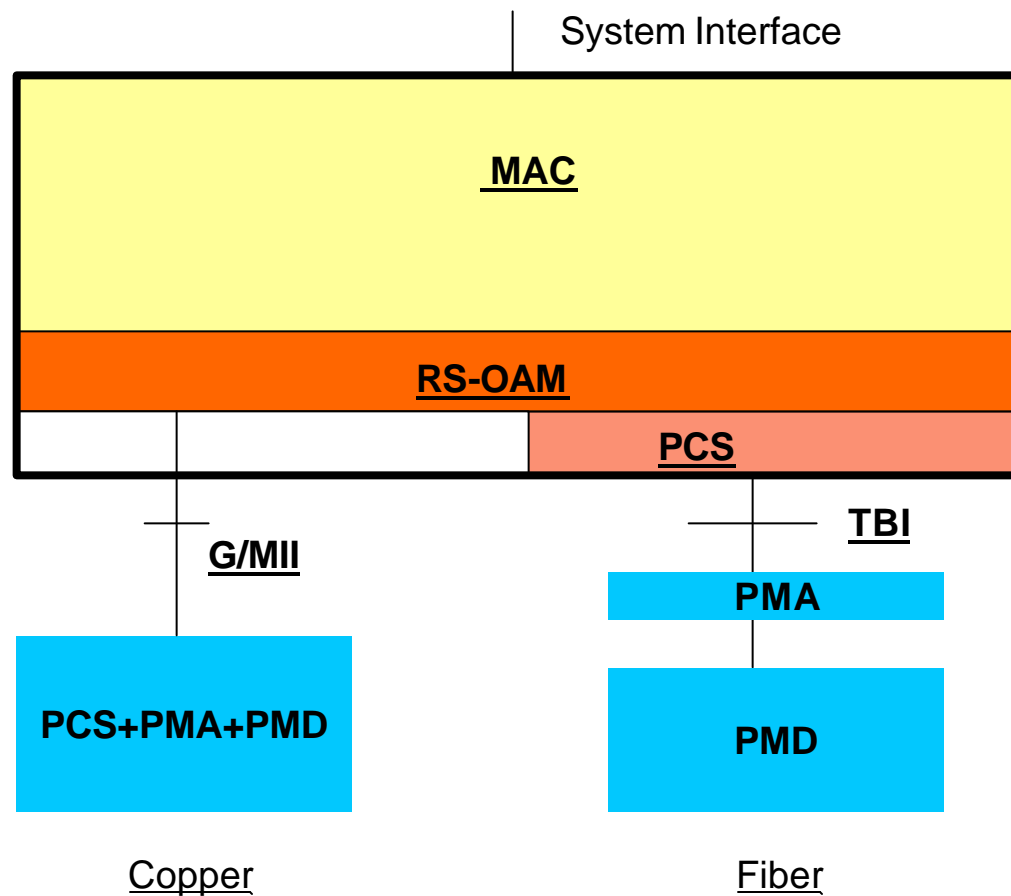
What sub-layer affected to support preamble transparency ?

- **RS sub-layer: for all Full duplex Ethernet**
 - A new Clause on RS-OAM sub layer
- **PCS sub-layer to make sure Preamble to be transparent for EFM-OAM**
 - EFM New PCS Clauses (P2P Cu, P2P Fiber, EPON)
 - Add Clause 36 (802.3z PCS) or annex: Transmit PCS does not shrink MAC Preamble and at transmit PCS minimum allowed IPG is 11 byte times

Detecting Start of Frame at RS

- We can rely on “DataEnable” on GMII to detect start of frame, once Preamble length is preserved.
 - Step 1: Detect DataEnable from GMII
 - Step 2: Convert first 7 bytes to (55) to MAC
 - Step 3: Convert 8th byte to SFD (D5) to MAC
 - Step 4: it is the start of MAC Frame (DA + SA +)

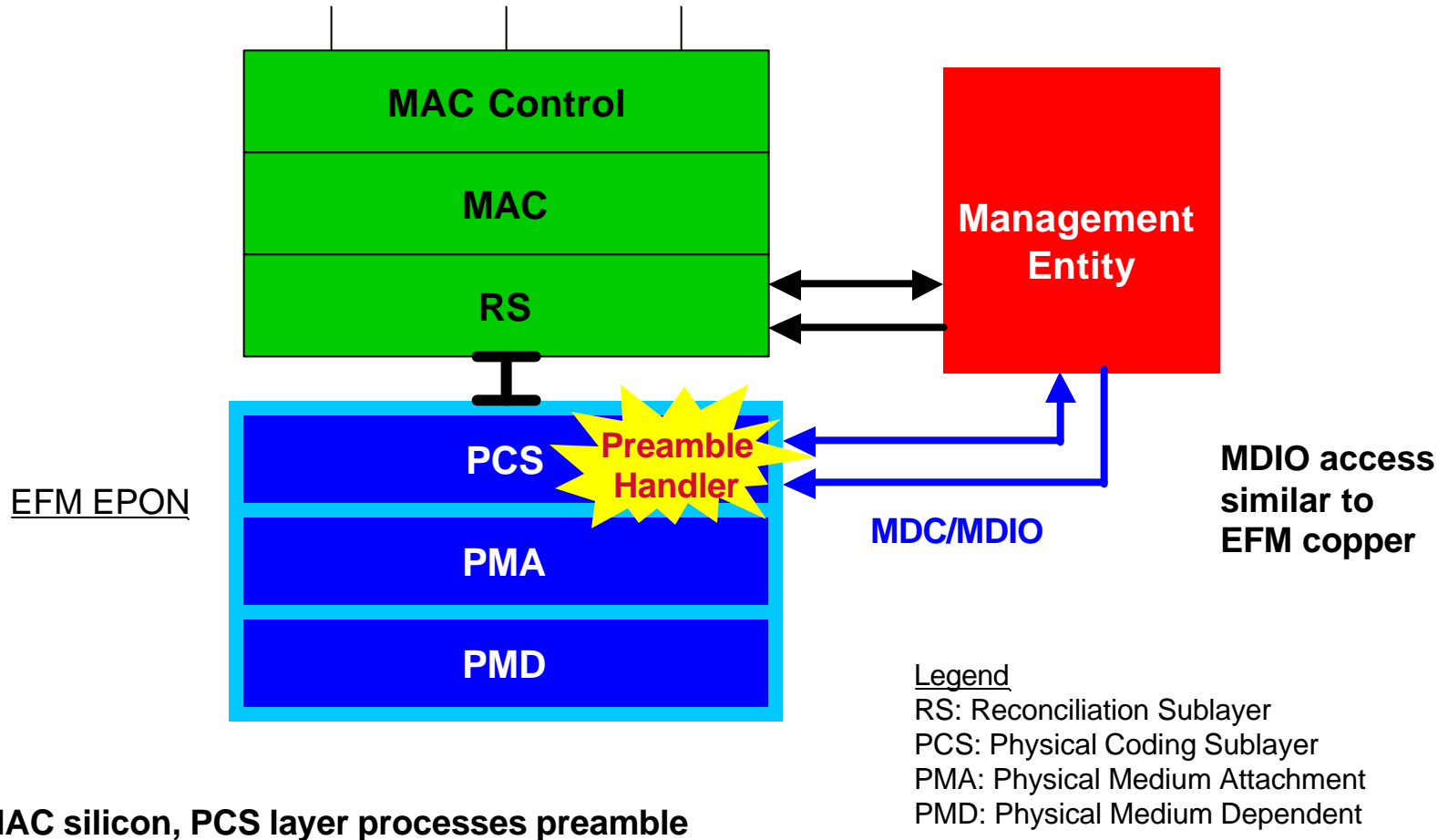
Typical EFM-OAM Implementation



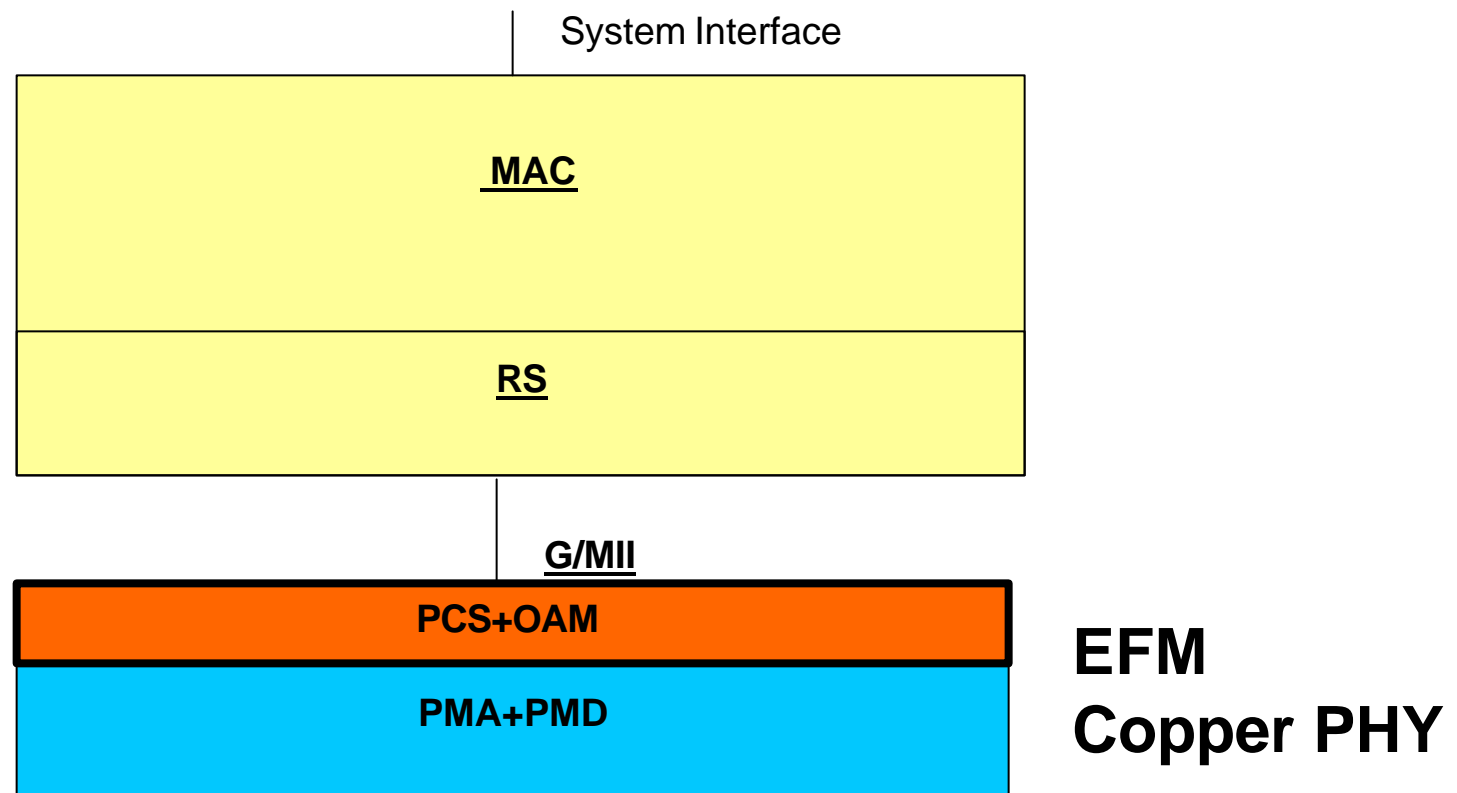
Preamble Handler Implementation

- Preamble handler may be implemented in either RS or PCS sublayers
 - **RS layer** for new MAC silicon
 - e.g. EPON / P2P Fiber, Cu Head-End
 - May use legacy PHYs
 - No bandwidth restriction across MDIO
 - **PCS layer option** for legacy MAC
 - e.g. Cu CPE
 - Optical Node Implementation
 - PHY Protection Implementation
- PCS Implementation examples shown next pages
- Only difference – one side or other of GMII

Preamble Handler Option

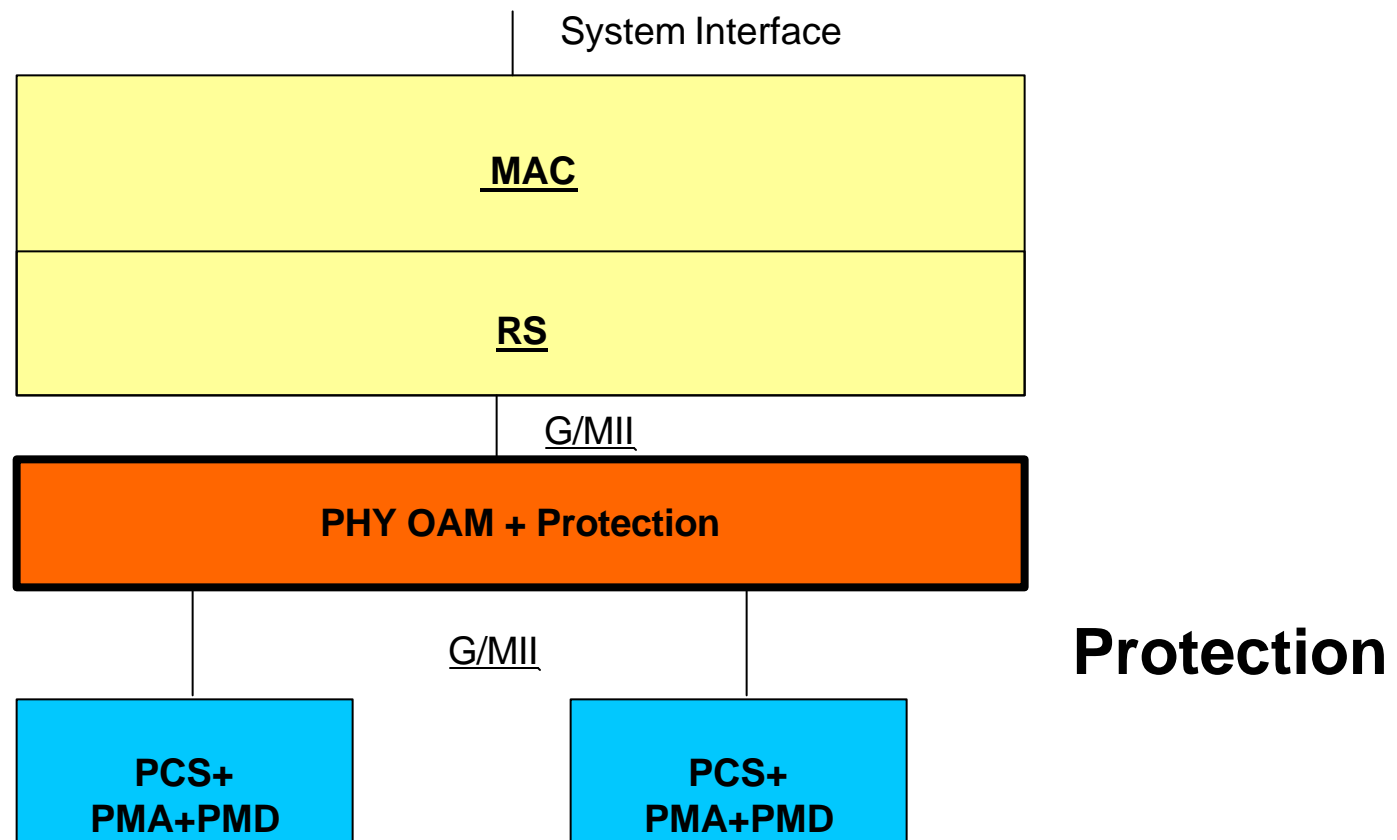


PCS OAM Implementation Option



Can Reuse the existing MAC chips

OAM + Protection PHY Implementation Option



Can Reuse the existing MAC & PHY chips

Conclusion

- **Preamble OAM enables Ethernet Carrier Class Link Management**
 - **Secure at Layer 1**
 - **Fast, multi-segment Link Fault Indication**
 - **Bandwidth transparency**
 - **Higher layer protocol transparency**
 - **Flexibility for future features**
 - **Can be applied to**
EFM, Metro Ethernet (CO to CO) and Ethernet over DWDM