OAM for Copper, P-P GbE and EPON

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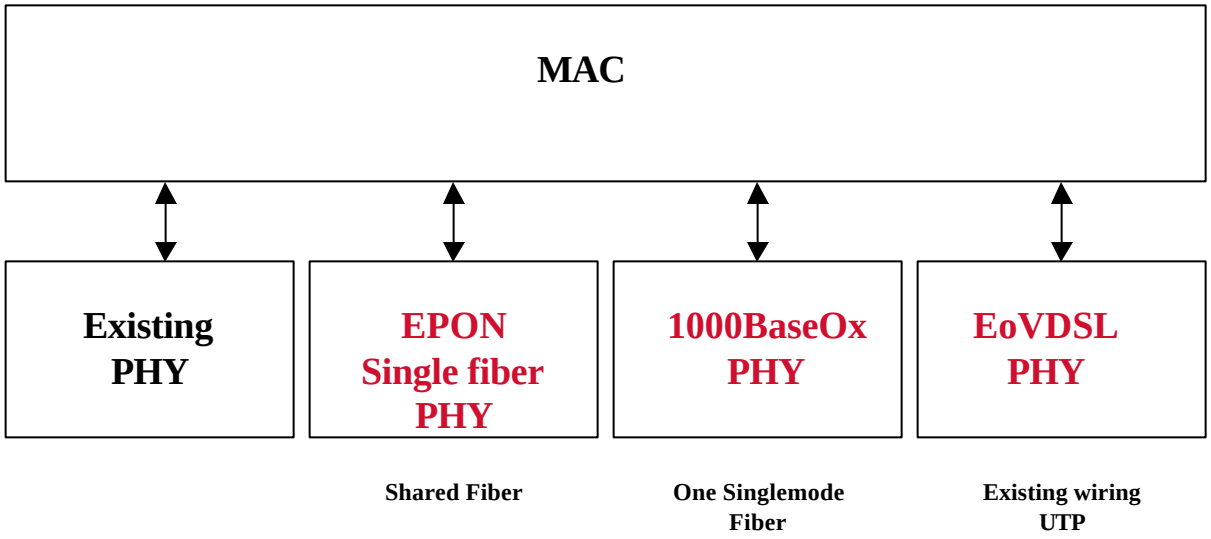
EFM OAM Objectives

- **Support Far-end OAM in EFM, which includes :**
  - **Link Monitoring**
  - **Remote Failure Indication**
  - **Remote Loop back**

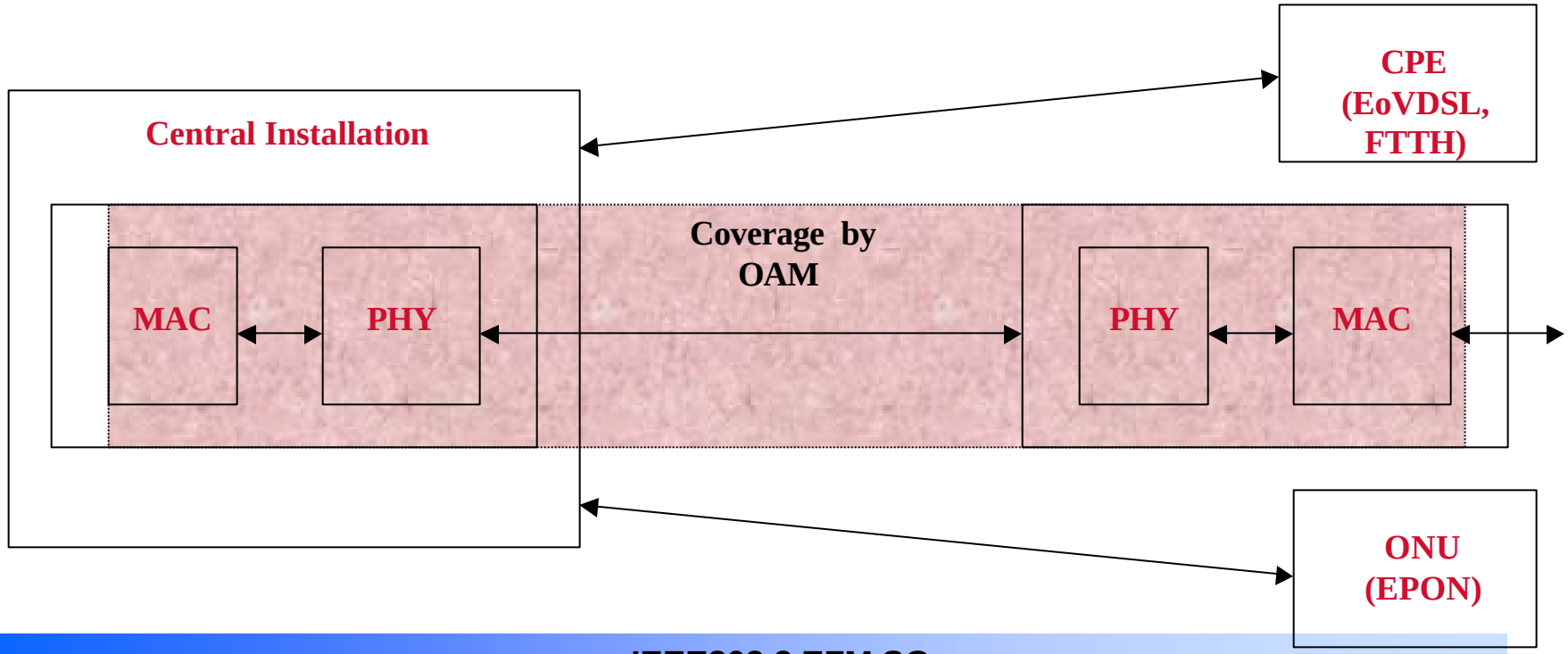
Common OAM for all PHYs

- What OAM (Link monitor, Failure Indication, Remote Loopback) means for each PHY ?
- Preferable to have a common OAM capability for all PHYs.
- Minimize PHY dependent OAM functions
- May recommend to extend it to existing PHY



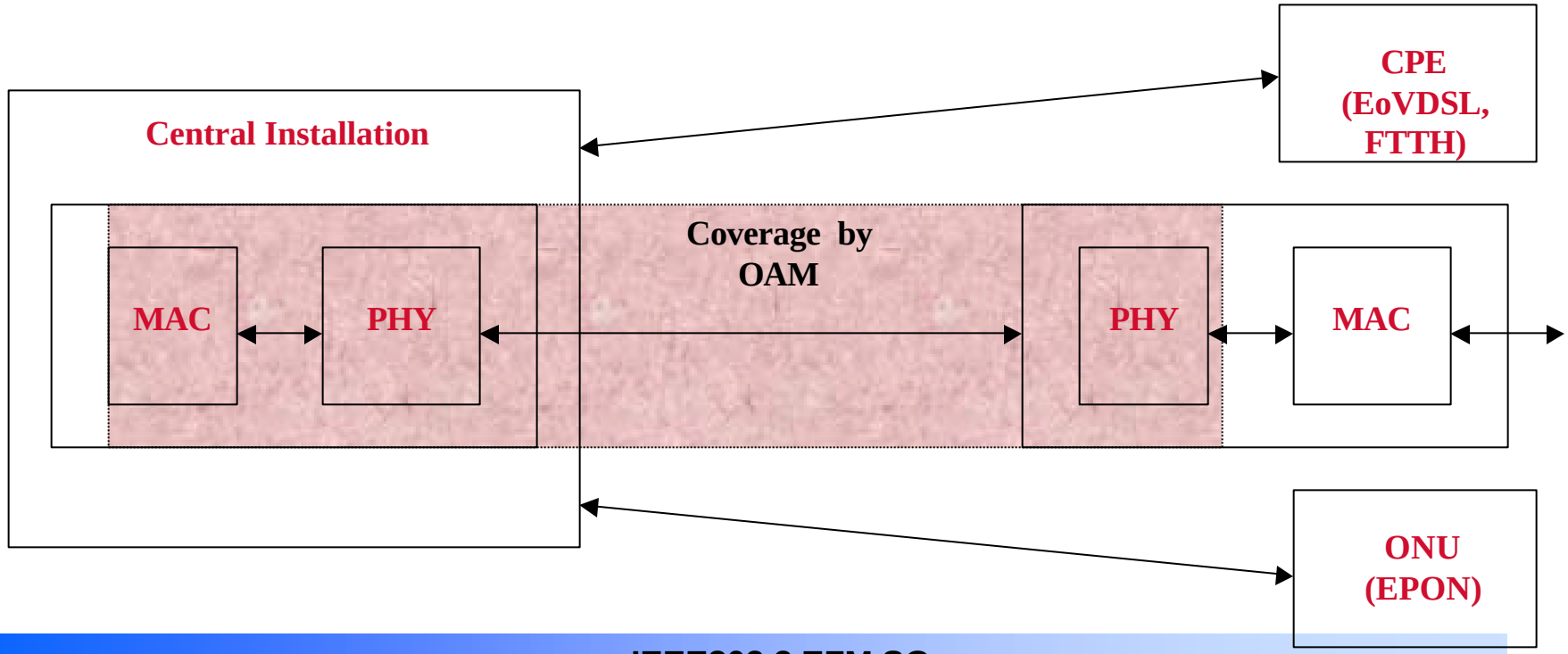
Demarcation Point - 1

- Both CPE MAC&PHY are owned by service providers.
- Not always have SNMP/IP stack on CPE box



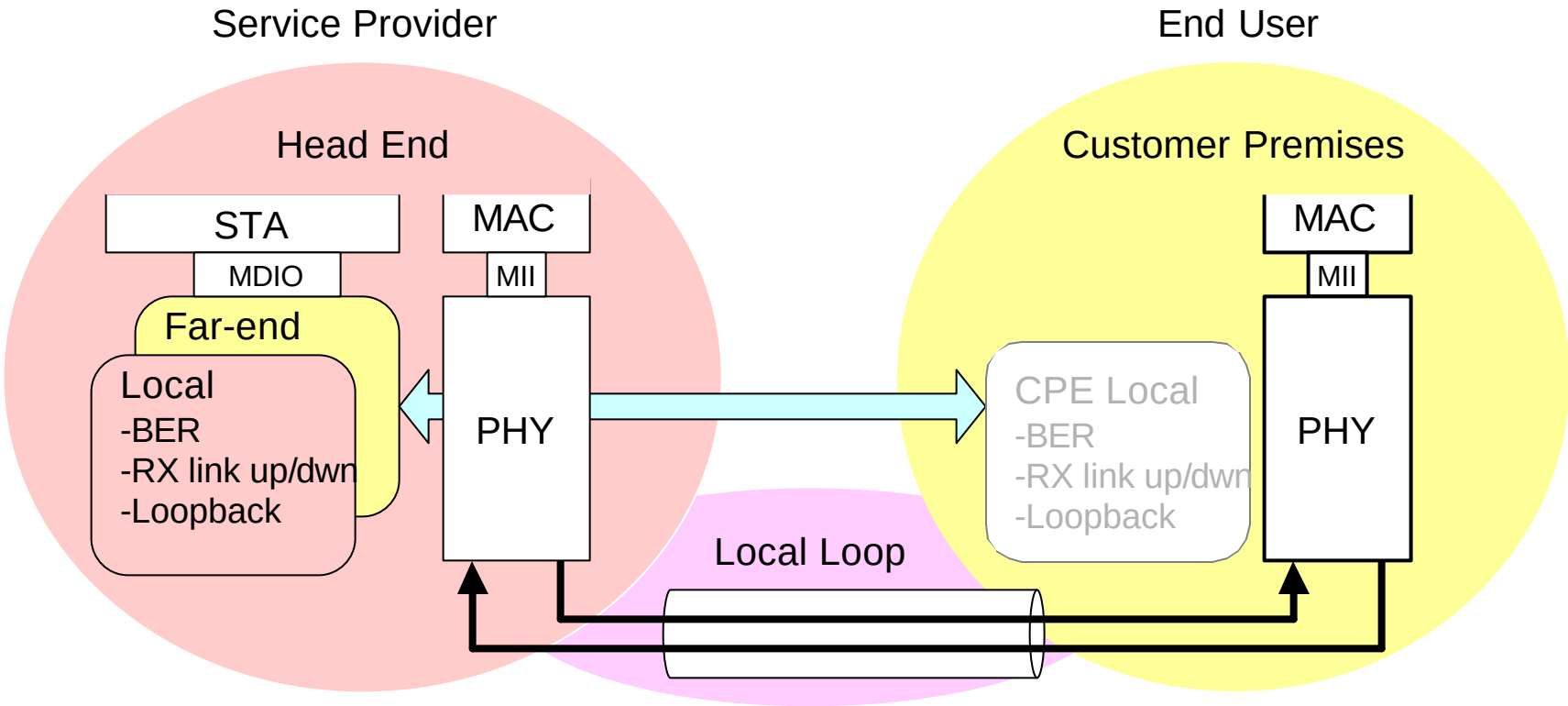
Demarcation Point-2

- Managed target at CPE side is PHY layer only.
- CPE MAC not owned by provider (eg. Media Converter model)



Operation Model: Head End to manage CPE

- **CPE local stats/status is read/written by Head End**



Ref: http://www.ieee802.org/3/efm/public/may01/ishida_1_0501.pdf

Link Monitoring
for each EFM-PHY

	P-P Copper	P-P GbE	EPON
MAC	Tx/Rx PKT CRC Error	Tx/Rx PKT CRC Error	Tx/Rx PKT CRC Error
PCS / PMA	SNR (Inter Symbol Error) Corrected Error	8B10B Code Violation	8B10B Code Violation TDMA Control Status Monitor (Loss of Time Slot)
PMD (Optical / Analog)	Tx Power AGC gain (Rx)	Loss of Signal (Rx Power)	Loss of Signal (Tx/RX Power)

-BER/Code Violation / CRC Error need to be counted at registers, then reported to Head-End
-LOS is instant failure detection.

How to report link monitoring from CPE to Head End

What kind of Complexity / Intelligence shall we assume to report ??

{ RX / Tx / Error PKT counter, Code Violation statistics, LOS…. }

- **1) Rely on higher layer (IP/SNMP) management channel ?**
  - **-Needs PHY, MAC and IP work properly**
  - **-Needs CPU at CPE**
- **2) Shall we generate MAC control packet ? (Detail: Denny Gentry presentation)**
  - **-Needs PHY and MAC work properly**
- **3) Shall we define <u>PHY level Register Read / Write Operation</u>.**
  - **-Needs PHY work properly**
  - **-Need Simple Embedded Management Channel at PHY layer (IPG / Preamble)**
- **If PHY not work properly (such as unidirectional failure)**
  - **- Need Failure Indication at PHY level (Next page)**

Remote Defect Indication for each EFM-PHY

	Copper	P-P GbE	EPON
MAC	(MAC Control PKT option)	(MAC Control PKT option)	MAC Control PKT per ONU
PCS / PMA	Local/Remote Fault Indication Dying Gasp	Local/Remote Fault Indication Dying Gasp	Local/Remote Fault Indication per ONU Dying Gasp
PMD (Optical / Analog)	n/a	n/a	n/a

-When PCS/PMD detects Failure (LOS) or Link Performance Degradation, it indicates to remote side.
-This includes Local Fault (AIS) and Remote Fault (RDI)
-MAC Control level Keep Alive Option can be combined, which needs PHY level to work properly.
-EPON needs per ONU Defect Indication

How to Indicate Failure ?

- **MAC Control PKT**
  - **Slow but Detail Failure Cause Report**
  - **Need to assume PHY to work properly**
- **PHY level Failure Indication**
  - **Fast, Continuous & On/Off indication**
  - **Need to define a new PHY coding**
  - **On IPG / Preamble (Optical), EOC/VOC (VDSL)**

Remote Loop Back
for each EFM-PHY

	Copper	P-P GbE	EPON
MAC	Control PKT Health Check	Control PKT Health Check	Control PKT Health Check Per ONU
PCS / PMA	no	(Note)	no
PMD (Optical / Analog)	no	no	no

NOTE: PHY loopback needed only for PHYonly devices / Media conversion.
EPON needs “per ONU” loopback.
Loopback at HE is needed ? (EPON will have a difficulty ?)

How to “Control” Loop back ?

- **Needs Remote Loopback Enable / Disable command capability**
- **Using Remote Register R/W capability**

How to Isolate Failures ?

- *HeadEnd / OLT needs to isolate failure of { Media, CPE PHY or MAC }*
- **Loopback**
  - **MAC control PKT-Loopback tells us MAC and PHY is OK**
  - **PHY-Loopback tells us PHY is OK**
- **Link Monitor (8B10B, CRC Error etc) tells us**
  - **Long-term service level degradation (BER).**
  - **Needs PHY to work properly to report it to remote side.**
- **PHY Failure Indication tells us**
  - **PHY has something wrong.**
- **Needs Combination of Loop back, failure Indication & Link Monitoring**
  - **-PHY level Indication for severe failure.**
  - **-Link Monitoring for Slow BER degradation**
  - **-Remote Loopback make sure health check at PHY / MAC layer**
  - **-EPON needs upstream access control status monitoring**

Summary

- **OAM operation**
  - Link monitor→ Failure Detection & Indication->Failure Isolation and Loopback
- **Link Monitoring at MAC/PHY/PMD**
  - Service Level (such as BER) Monitoring
  - Management Channel for register R/W at PHY Level needed for dumb CPEs
  - MAC /SNMP level reporting is also an option for intelligent CPEs
- **Failure Indication at PHY**
  - Instant Indication when PHY not work properly
- **Remote Loopback**
  - PHY/MAC level loop back for each layer health check
- **Failure Isolation needs combination of**
  - { Link monitor, Failure Indication and Loopback }
  - { EPON upstream access status monitoring }