

“Out Of Band” Ethernet OAM OAM in Bit Stream (Below PCS/Above PMD)

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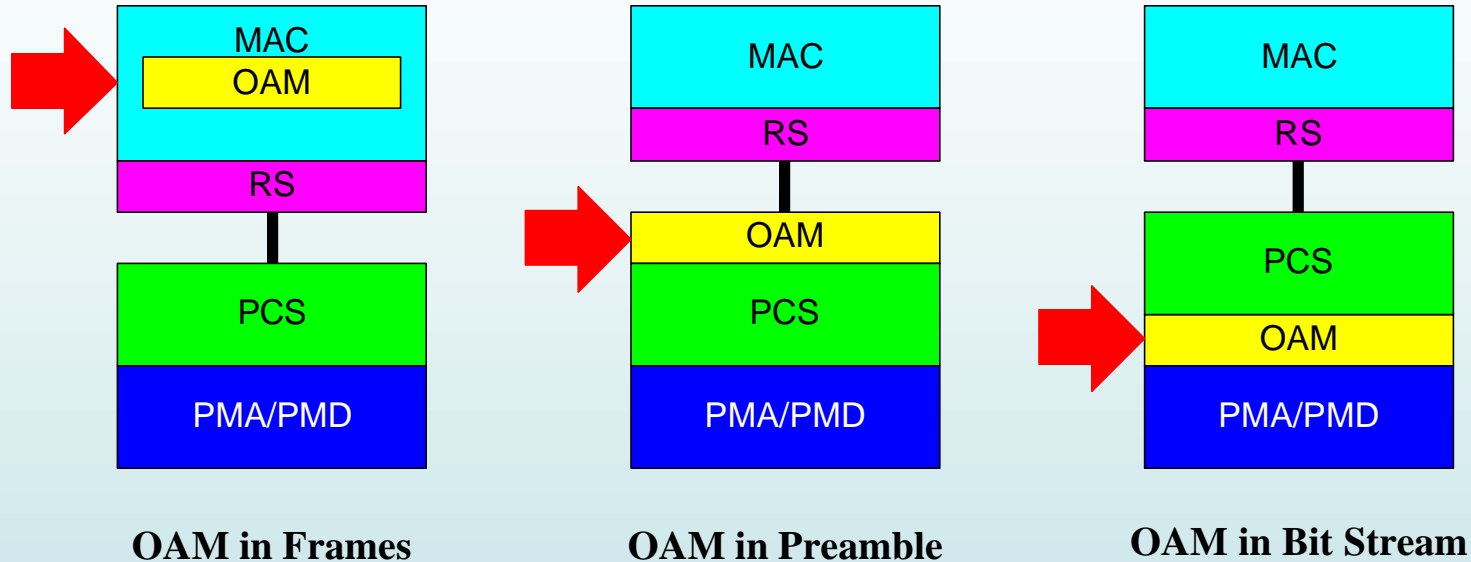
Bob Barrett - Fiberintheloop



Topics

- Location of OAM in MAC/PHY stack
- Existing SP OAM is “Out of Band”
- Ethernet “Out of Band” OAM
- Few Amendments to Existing Clauses
- Support for P2P and P2MP
- Support for P2MP over P2P PMD
- Support for ALL forms of Loop Back testing
- Support for Control Plane Signaling
- OAM Header Frame Format
- Command and Control
- Management Control Channel
- Comparisons
- Difference Between “In Band” and “Out of Band”
- Reasons for “Out of Band” OAM
- No New MAC/RS/PCS
- Support for 100Mb and 1000Mb
- Support for MP2MP over P2P
- Support for Media Conversion
- Support for Multiple forms of BERT test
- Ethernet Service Frame
- Physical Layer Addressing for P2MP
- Payload Bit Error Detection
- Header Frame Error Detection/Correction

Location of OAM in MAC/PHY stack



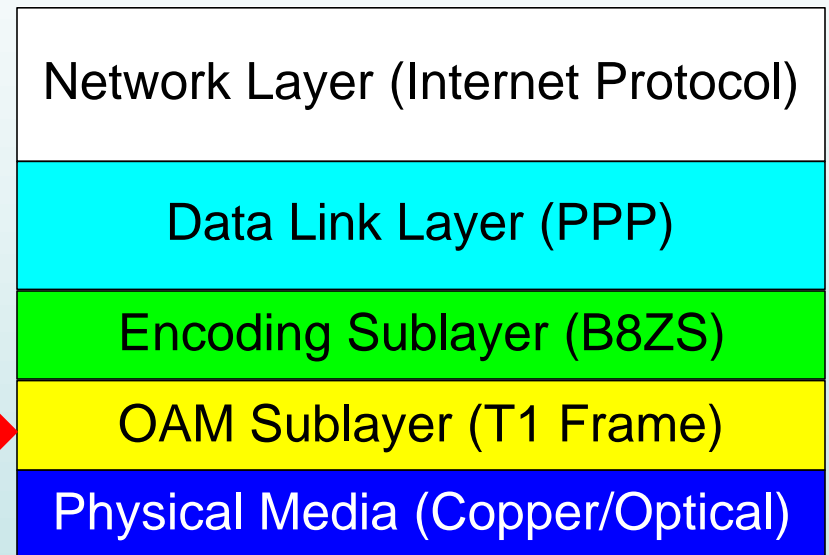
OAM in the bit stream is a sublayer between the existing PCS and the New PMA/PMDs

Difference Between “In Band” and “Out of Band”

- “In Band”
 - Above the Data Encoding Sublayer
 - Is Effected by the Data Traffic
 - Effects the Data Traffic
 - Data Channel Insecurity (data has to be decoded)
- “Out of Band”
 - Below the Data Encoding Sublayer
 - Is NOT Effected by the Data Traffic
 - Does NOT Effect the Data Traffic
 - Data Channel Secure (data stream not decoded)

Existing SP OAM is “Out of Band”

Existing Service Provider Operations, Administration, and Management functionality is in the bit stream between the data encoding sublayer and the physical media



Reasons for “Out of Band” OAM

- Functions Outside of Data Stream Bandwidth
- Secure From The Data Traffic
- OAM Bandwidth Fixed
- OAM Message Delivery/Response Latency is Always Strictly Predictable/Fixed
- OAM Functions Regardless of Data Traffic Problems or Failures
- Last Sublayer Operational Before Bit Signal Failure

Ethernet “Out of Band” OAM

- Added to Bit Stream After PCS encoding
- Data Transfer Rate Unaffected
 - (P2MP MACs Will Require Rate Adaptation)
- Minimum Fixed Functionality
 - (Implementation Specific Enhancements Possible)
- Bit Oriented to Output Of PCS
 - Post Encode 10 bit/Dectet (Pre Encode 8 bit/Octet)
- Separate Management Registers and Control Plane

No New MAC/RS/PCS

- Functions Below MAC/RS/PCS
- Unaffected By PCS Coding (8b/10b or 4b/5b)
- Does Not Require Additional Queues In MAC (OAM in Frames Does)
- Does Not Require Additional Queues In PCS (OAM in Preamble Does)
- Rate Adaptation for P2MP Can Use Open Loop Rate Control (Shimon Muller – 802.3ae)

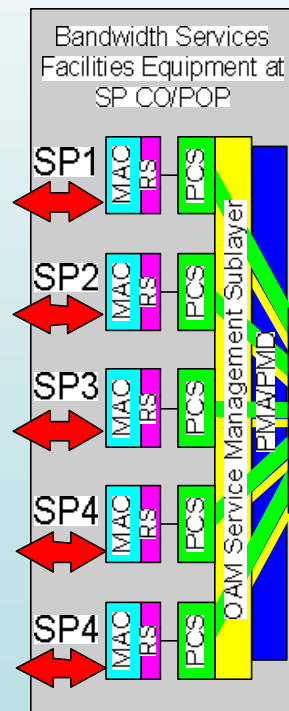
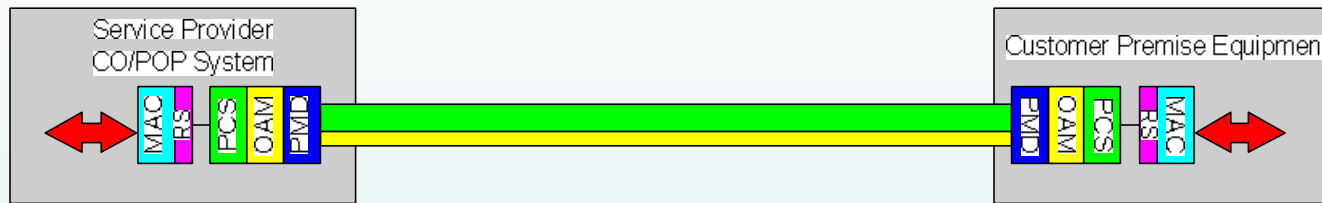
Few Amendments to Existing Clauses

- Clause 1 – New Speeds, Topology, Abbreviations
- Clause 30 – New Objects
- No Change to MAC or MAC Control
- No Change To Reconciliation Sublayer
 - (P2P and P2MP function the same)
- No Change To PCS (100Mb or 1000Mb)
 - (Except for Rate Adaptation)

Support for 100Mb and 1000Mb

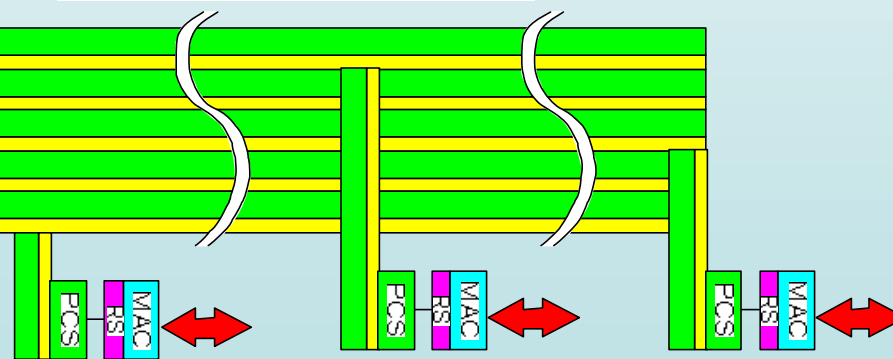
- OAM in Bit Stream Functions Outside Of Data Encoding
 - Sublayer Between PCS and PMA/PMD
- Dectet Oriented (10 bit)
- Supports 4b/5b (Code Symbol Duplets)
- Supports 8b/10b (Single Code Symbols)

Support for P2P and P2MP



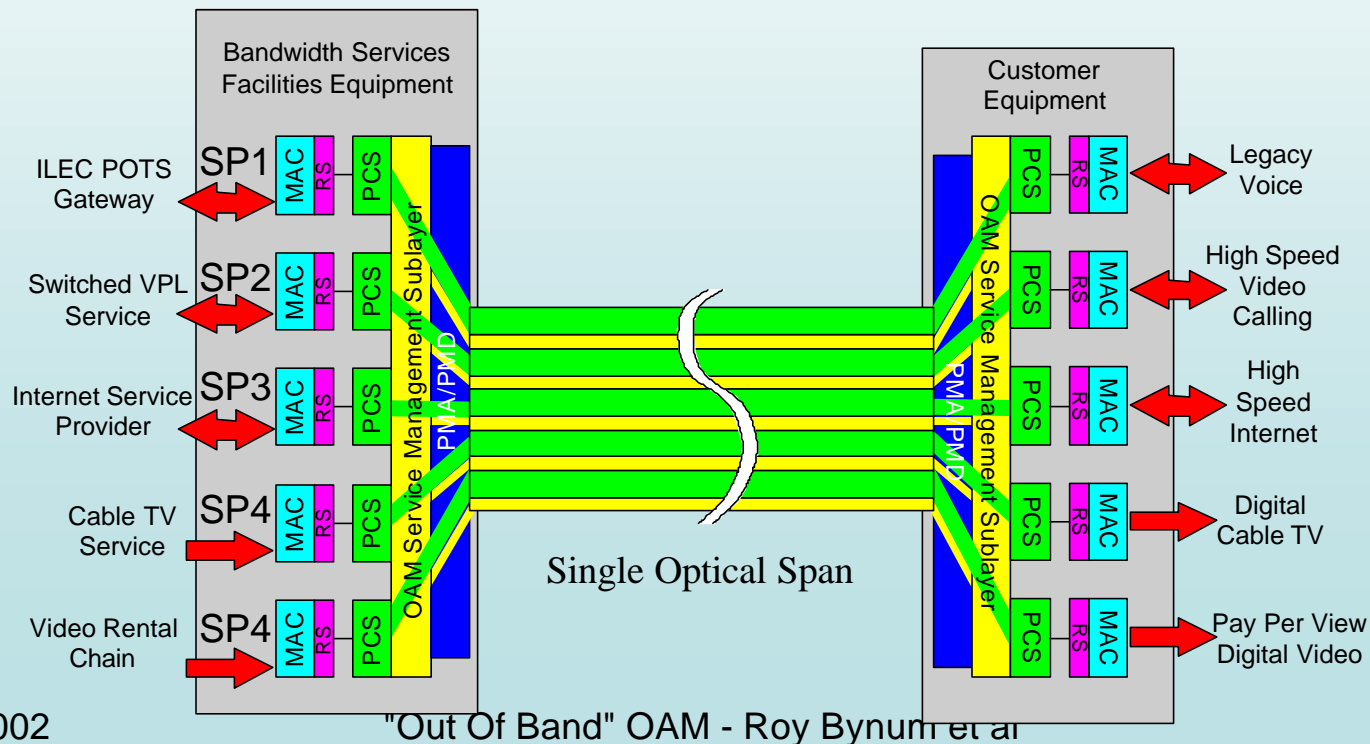
Using Discrete MAC/PCS Allows Scaling to Large Numbers of Discrete Encoded Ethernet Data Streams Over P2MP Topology

Point to MultiPoint Optical Span



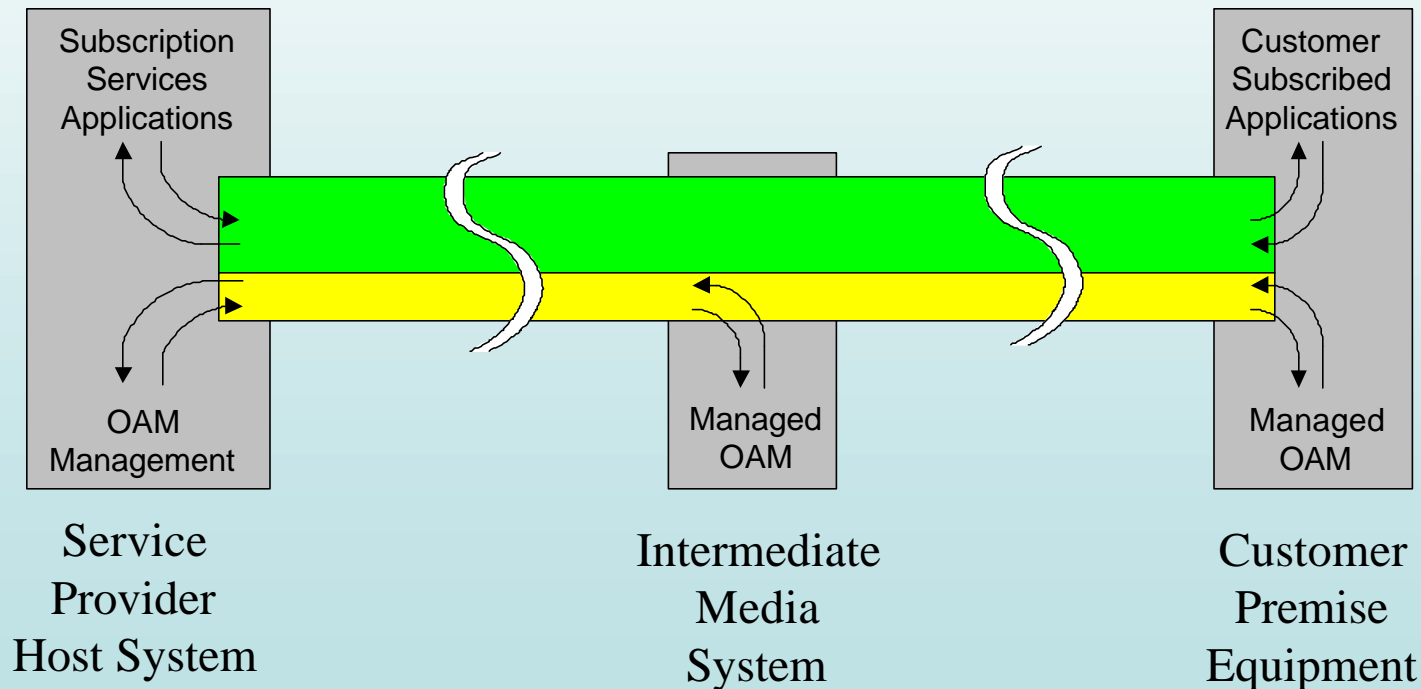
MP2MP over P2P

- Designed To Support Secure Unbundled Services
 - Major Market Requirement
- Each Channel Has Its Own OAM Overhead and Management Channel
- Variable Provisionable Fixed Bandwidth For Each Channel
 - Predictable QoS
- Each Channel Can Support Separate VLAN Mapping
 - Full 802.1D Support



Support for P2MP over P2P PMD

“Out of Band” OAM Allows
Secure Management of Intermediate Media System
Without Decoding The Services Ethernet Data Stream

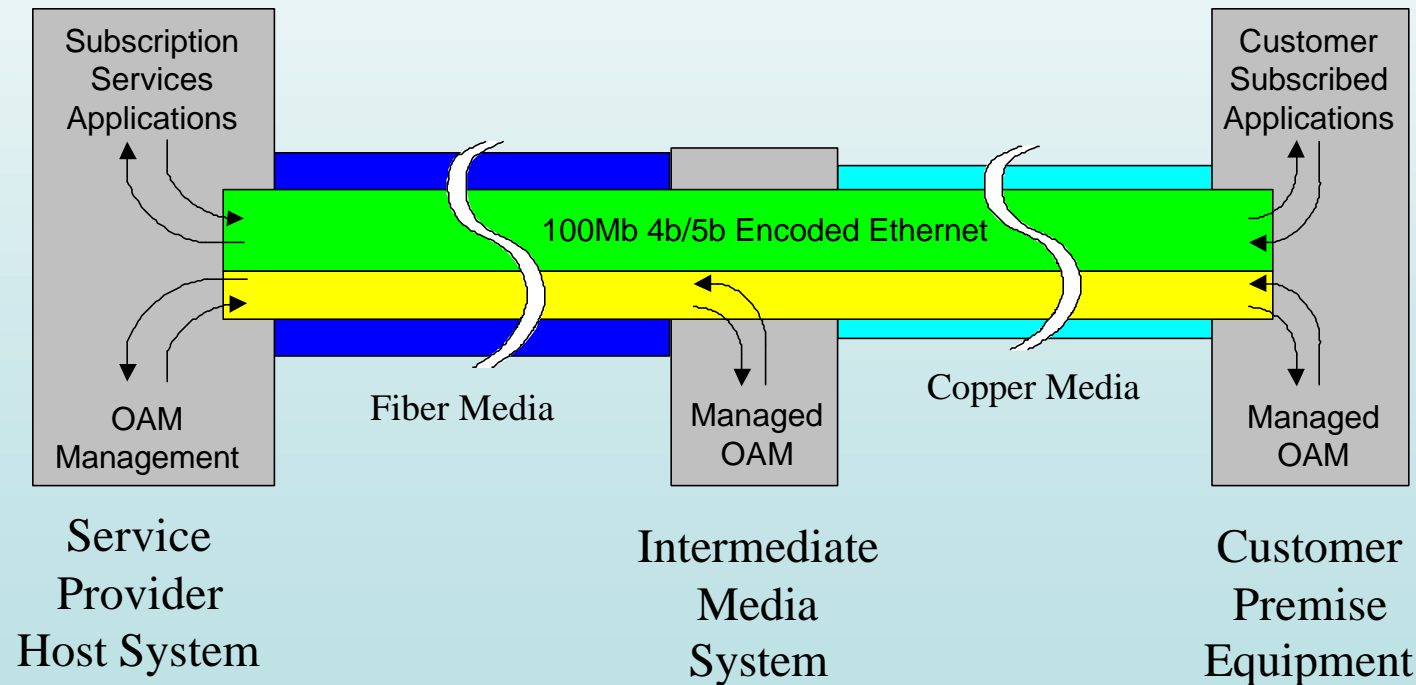


Support for Media Conversion

Secure OAM Management and Media Conversion

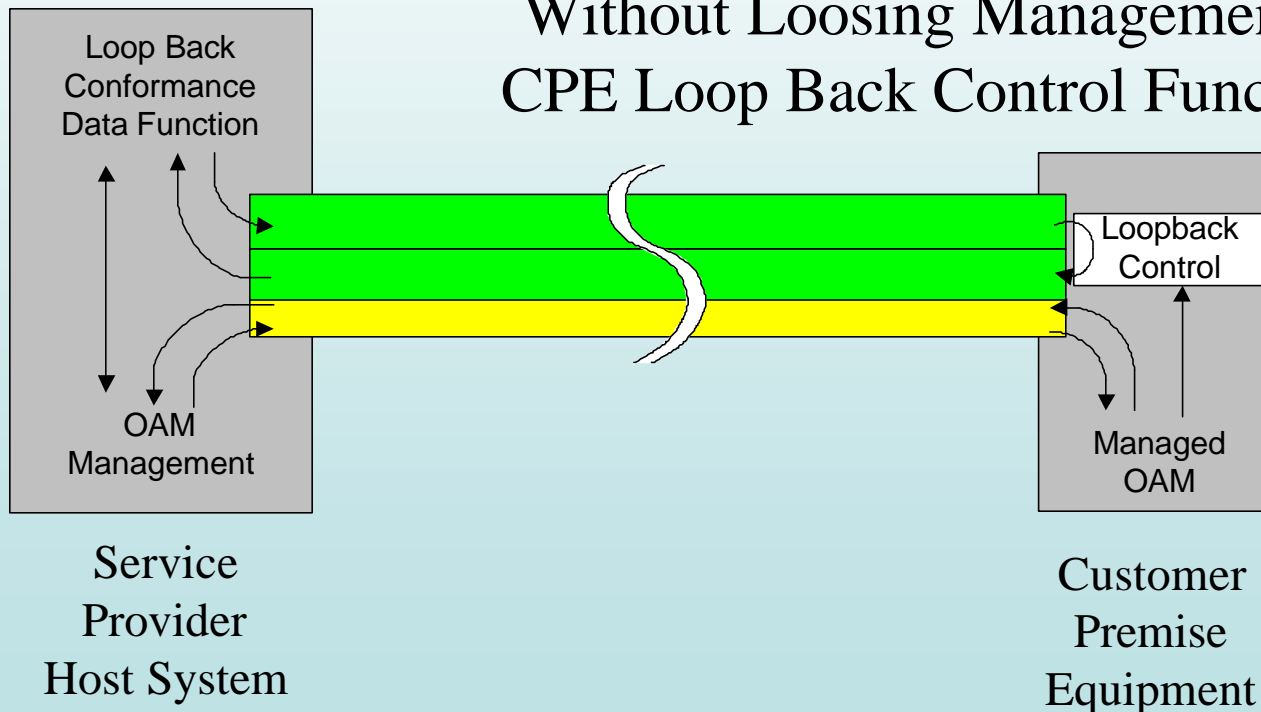
Be Done Without Decoding

The PCS Encoded Ethernet Data Stream



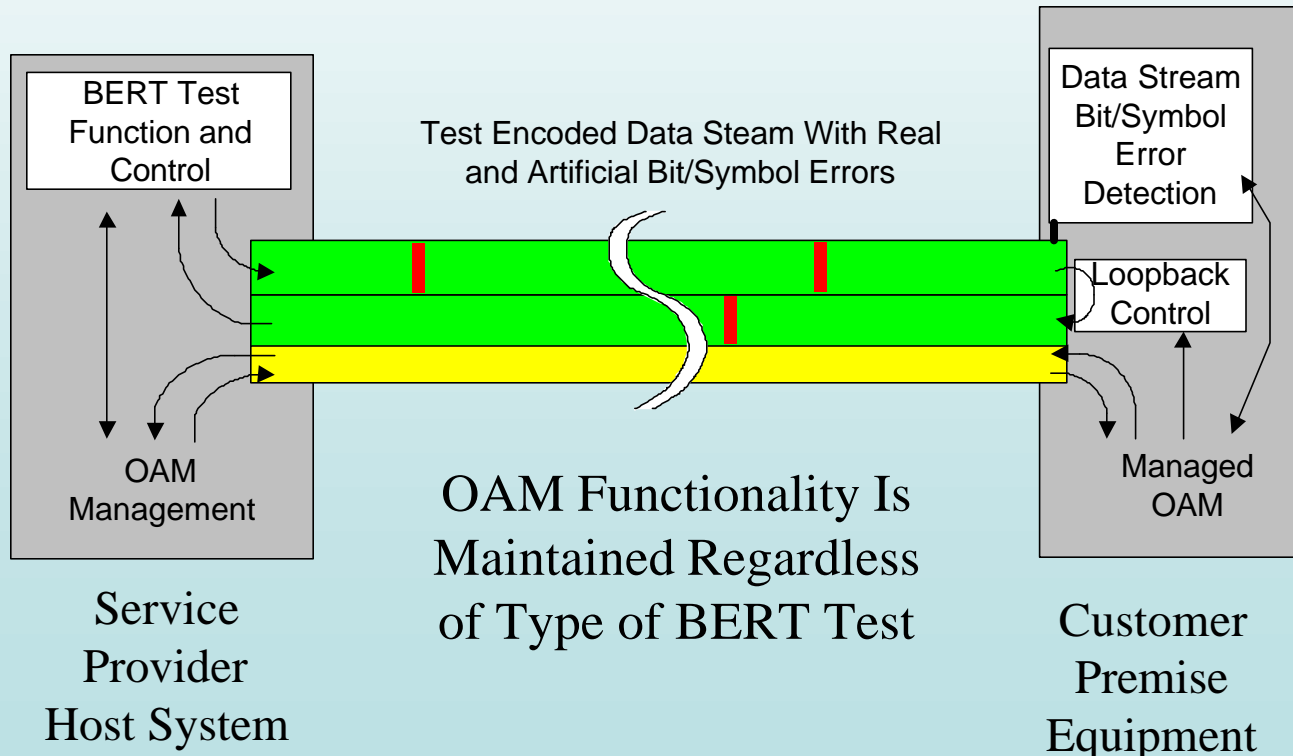
Support for ALL forms of Loop Back testing

“Out of Band” OAM Allows Any Form Of Loop Back Testing Of Encoded Data Stream Without Loosing Management of CPE Loop Back Control Functions



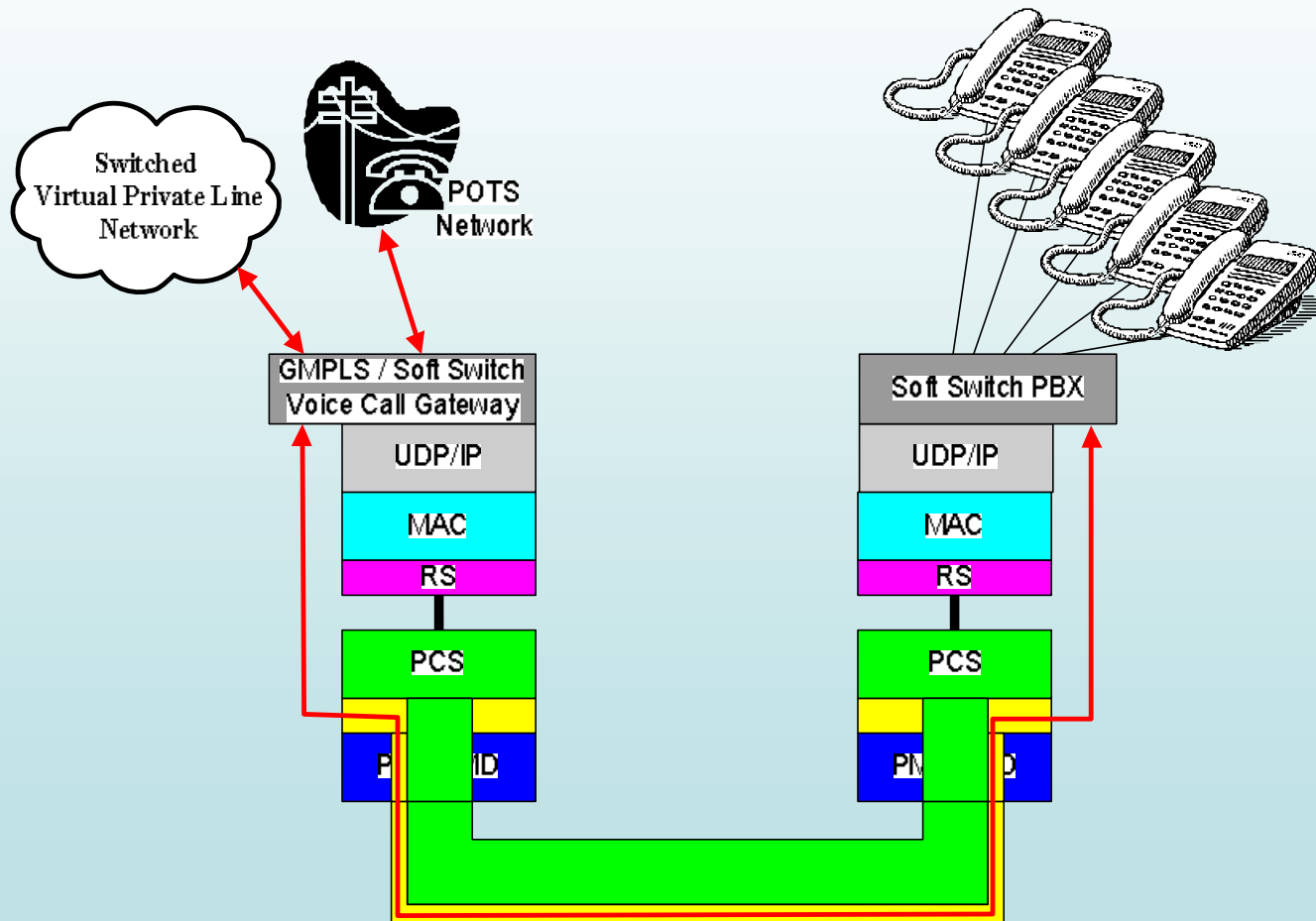
Support for Multiple forms of BERT test

Bit Error Rate Testing of the Encoded Data Stream Facility Can Be With Or Without Loop Back; Can Be Done With Symbol Error Insertion, Or By Random Bit Error Insertion



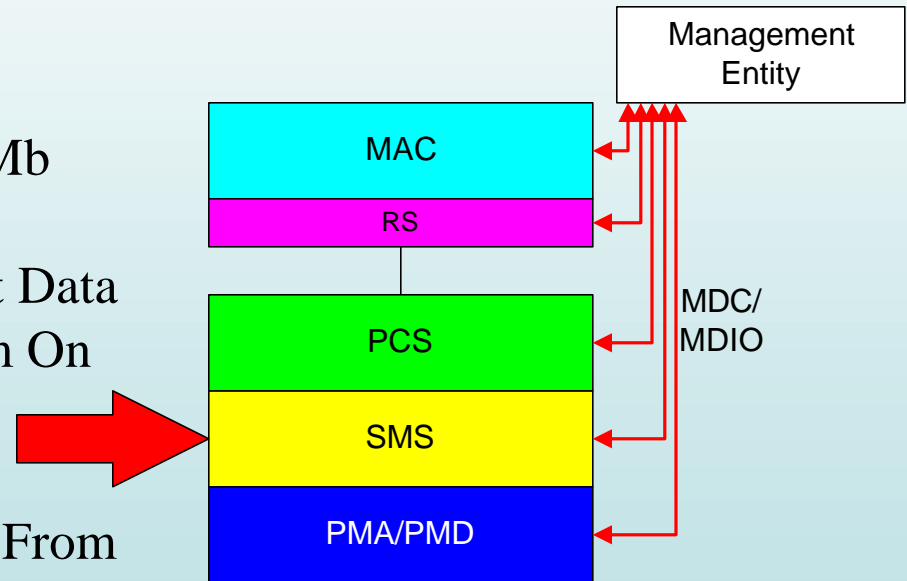
Support for Control Plane Signaling

Out of Band OAM Provides Deterministic (No Min/Max) Signal Path For Call Setup And Control (GMPLS)

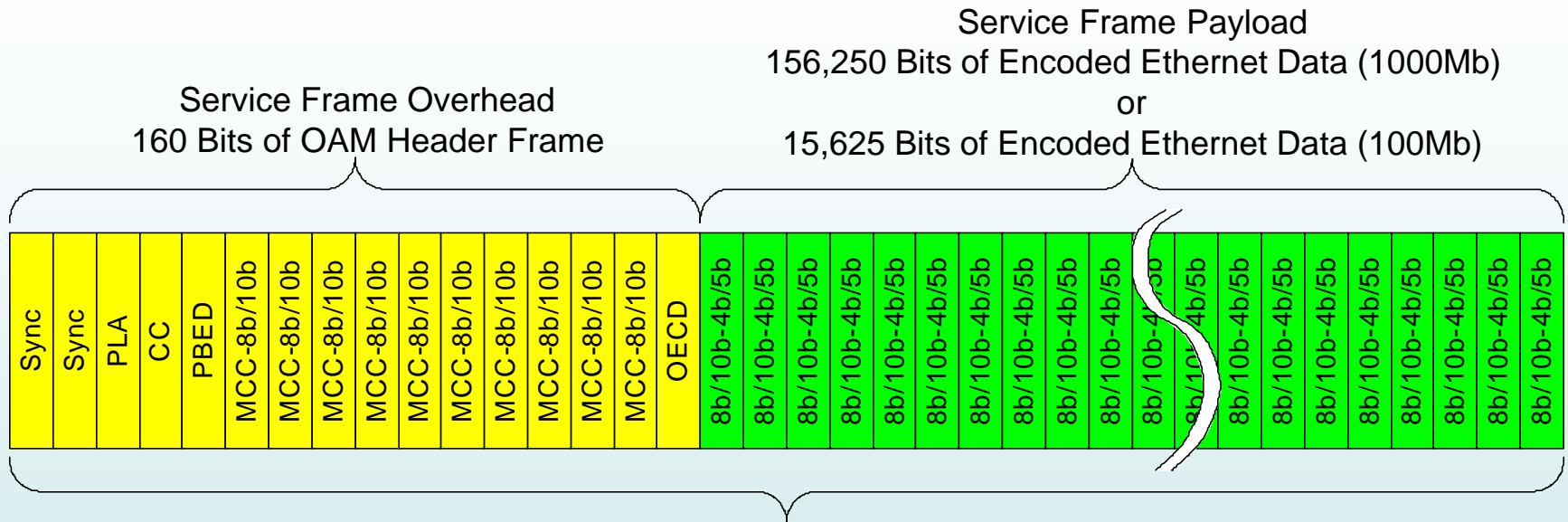


OAM Service Management Sublayer (SMS)

- Service Management Sublayer (SMS) Is Located The Same As The 10GbE WIS – Between the PCS and PMA/PMD
- MAC, RS, GMII, and PCS Functions Remain The Same For 100Mb or 1000Mb
- The SMS Takes The Encoded Ethernet Data And Adds The OAM To The Bit Stream On A Fixed Time Domain
- The Management Information To And From The SMS Is Through The MDC/MDIO



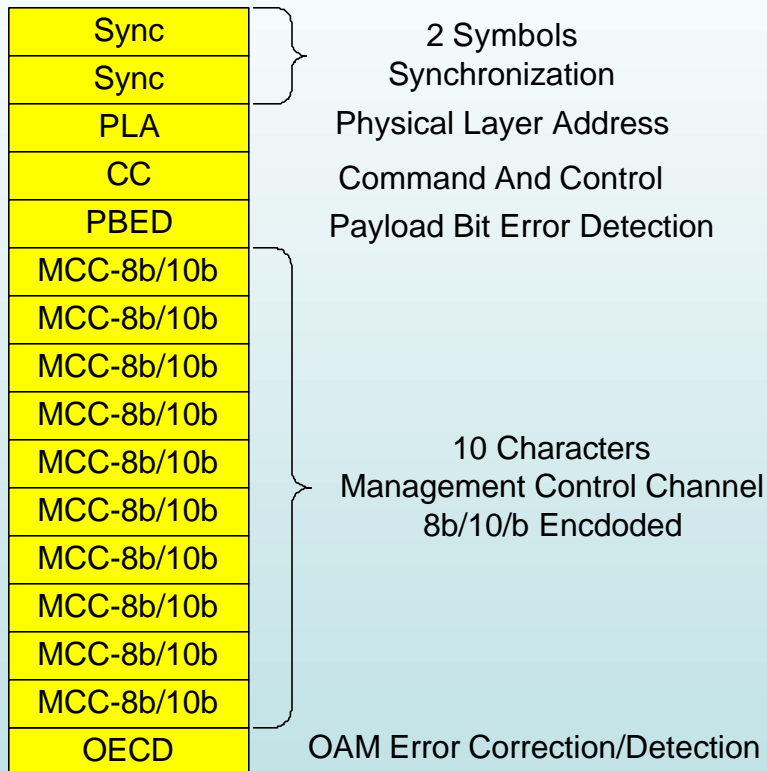
Ethernet Service Frame



125us (8000 Per Second) Service Frame

- “Out Of Band” OAM Is Inserted Into The Transmission Bit Stream Using An Ethernet Service Frame
 - The Service Frame Repeats Every 125us or 62.5us Depending On Implementation
- The Service Frame Has a Payload That Is The Encoded Ethernet Data Stream
 - The Service Frame Payload Comes Directly, Unmodified, From The PCS
- The Service Frame Has an Overhead That Is The OAM Header Frame
 - The OAM Frame Contains The “Out Of Band” OAM

OAM Header Frame Format



Each OAM Header Frame (OAMF) Contains

- 2 Reserved 8b/10b Symbols That Act As Sync Symbols,
- A Physical Layer Address (PLA),
- A Command and Control (CC) Field,
- A Payload Bit Error Detection (PBED) Field,
- An Implementation Specific Number of Management Control Channel Characters,
- An Overhead Error Correction/Detection Field

Physical Layer Addressing for MP

- 10 Bit, Un-encoded Field
- Physical Layer Addressing Is Used To Segregate Data Streams In Multipoint Deployments.
- Physical Layer Addresses Are Always For The “Remote” Systems
- The Head End (OLT) System Is The Default Send and Receive System
- All Ones Reserved For Broadcast – All Zeros Reserved For Control
- Other Addresses Reserved For Unicast or Broadcast
 - Address Reservation Negotiated Between Systems Of Different Vendors

Command and Control

- 10 Bit, Un-encoded Field
- Only For A Specific Encoded Data Stream Link Channel
- Used For Command and Control Messages From Head End To Remote Systems
- Used For Status Messages From The Remote Systems To The Head End
- The CC Field Contains
 - The Data Steam Link Status/Faults,
 - The Loop Back and BERT Test Commands,
 - During Initialization The Some Bits Can be Used For Format Negotiation
 - Facilities Status Queries And Alarms,
 - MCC Contents (MDIO commands or Control Plane Data)

Encoded Data Stream Payload Bit Error Detection

- 10 Bit, Un-encoded Field
- Only For A Specific Data Stream Channel
- Bit Interleaved Parity
- Dectet Oriented to Support Bit Structure of Encoded Data Field
- Contains The BIP Information Of The Previous Payload Of The Data Channel Over P2P Topology

Management Control Channel

- 8b/10b Encoded Data
- Up to 10 Data Characters
- Number Of Characters Is Implementation and Data Link Speed Specific
- The Character Count Will Be the Same For All Channels Within Any One Deployment
- Contains MDIO Requests And Responses
- Alternatively Contains Management Control Plane Data Stream
- Priority of MDIO to Control Plane Data Is Implementation Specific
- Size and Priority Negotiated Between Systems of Different Vendors

Header Frame Error Correction/Detection

- 10 Bit, Un-encoded Field
- For The Specific Local Header Frame
- Error Correction or Detection Is Undecided
- Reed/Solomon Error Correction
- 10 Bit Cyclic Redundancy Character
- Possibly Implementation Specific

Comparisons Of Current Proposals

Functional Characteristic	Channelized Ethernet OAM	Ethernet OAM in Preamble	Ethernet OAM in Frames
OAM "Out of Band"	Yes	No	No
Data Traffic Unaffected By OAM	Yes	Yes	No
OAM Unaffected by Data Traffic	Yes – BW Fixed – No Min/Max	No - (BW not Fixed Min/Max Known Avg. Unpredictable)	No - (BW not Fixed Min/Max Known Avg. Unpredictable)
Supports Secure Unbundled Services	Yes	No	No
Supports All Forms Of Loop Back Testing	Yes	No	No
Supports Discrete Loop Back Test Per Channel	Yes	No	No
Supports All Forms Of BERT Test Discrete Per Channel	Yes	No	No
Separate VLAN Mapping Discrete to Each Channel	Yes	Unknown	No
Modifications To Existing Clauses	Very Low	Moderate	High

Summary

“Out Of Band” OAM – “Channelized” Ethernet

- Functions At The Same Layer As Existing Service Provider OAM
- Supports All Operations Management Functions Required By Service Providers
- Supports Unbundled Services For Future Deployment Markets
- Minimal Change To Existing Clauses
- Supports 802.1D Bridging By Default
- Concentrates Work On New Clauses And New Sublayer Devices