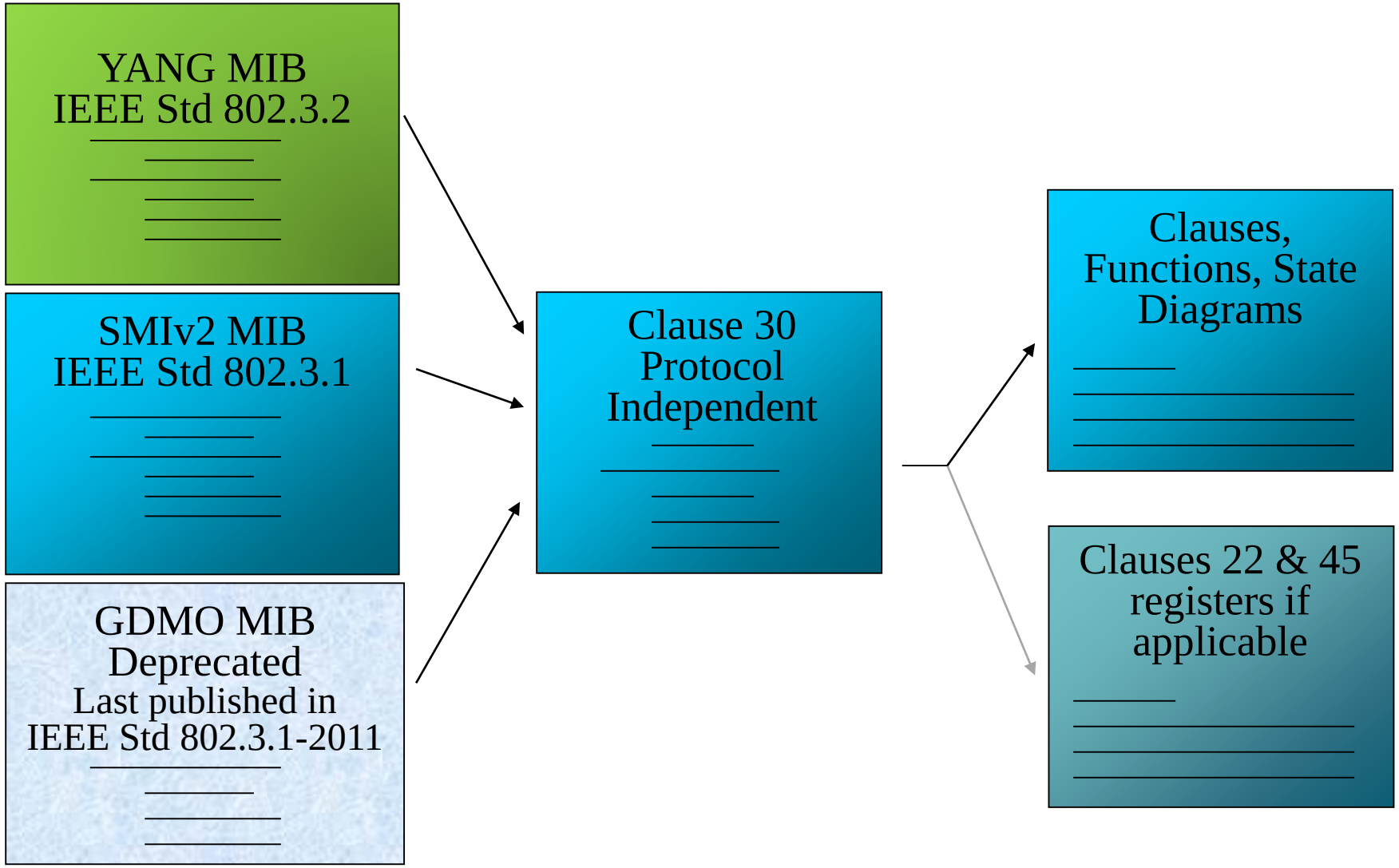
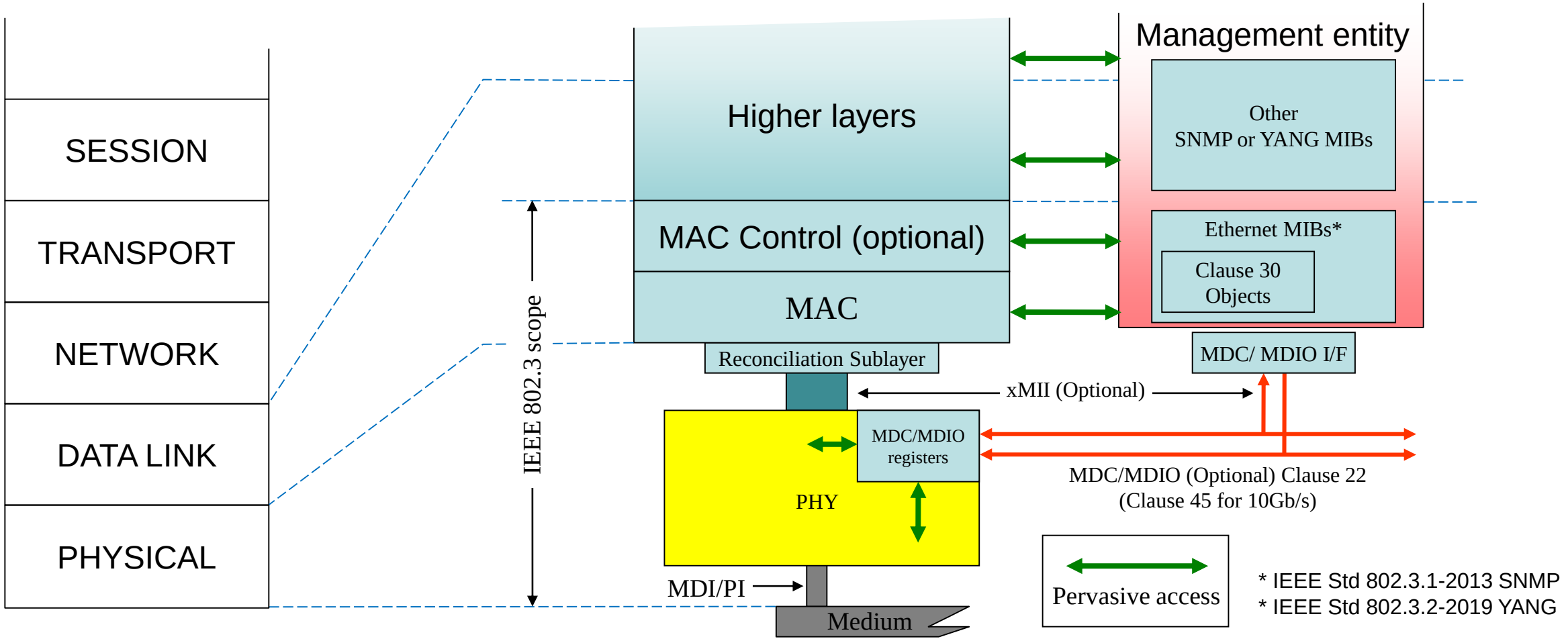
IEEE P802.3ct Management

David Law
dlaw@hpe.com

IEEE 802.3 Management Information Base (MIB) approach



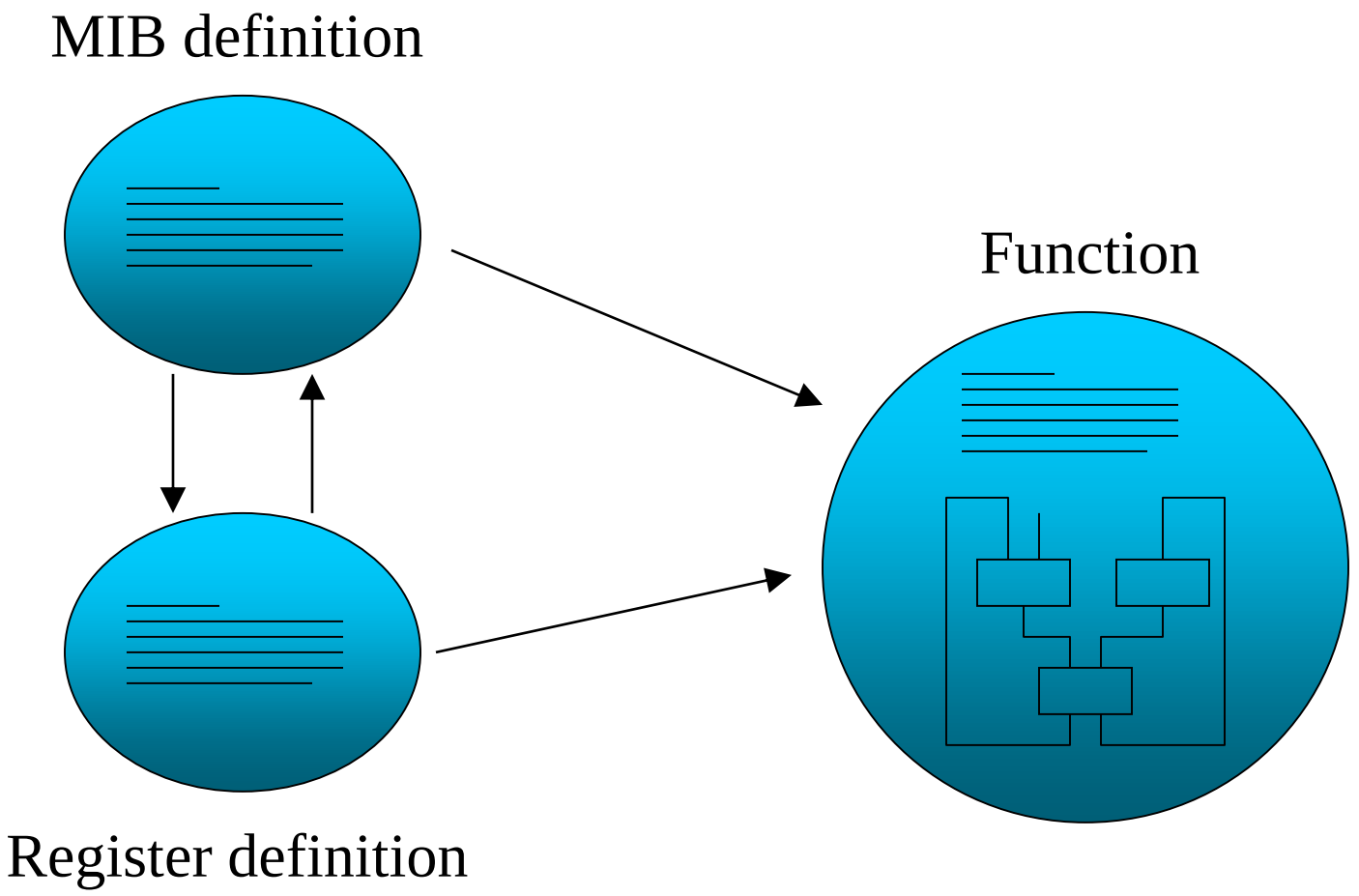
Management model



Reference: IEEE P802.3at DTE Power Enhancements management ad hoc, David Law, IEEE 802 July 2007 plenary week
URL: <http://www.ieee802.org/3/at/public/2007/07/law_2_0707.pdf>

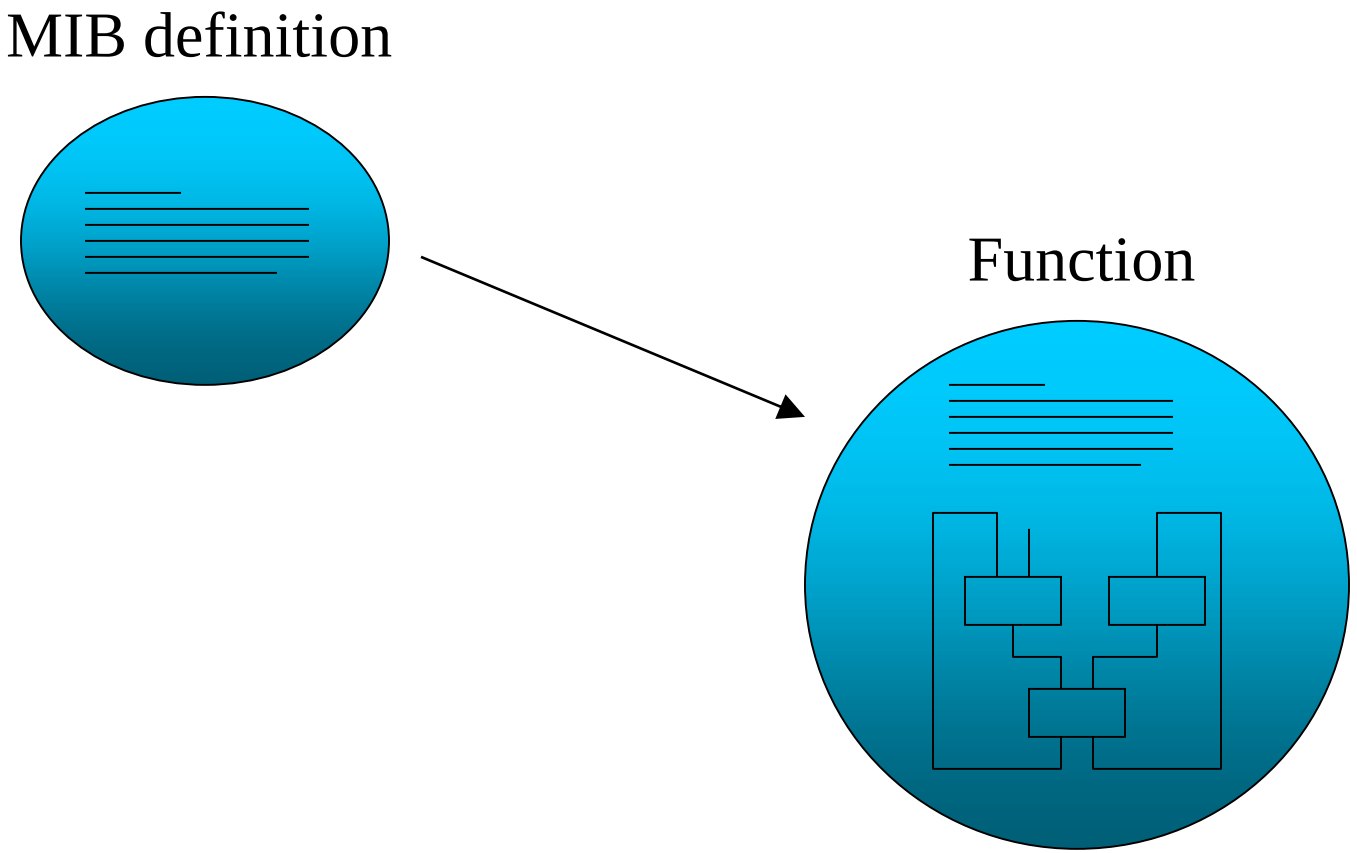
MIB, Registers and Function

Function in PHY needs register access to make it manageable across xMII



MIB, Registers and Function

Can have a MIB attribute but no register. Example: MAC packet counters



Examples

30.4.3.1.6 aFrameCheckSequenceErrors

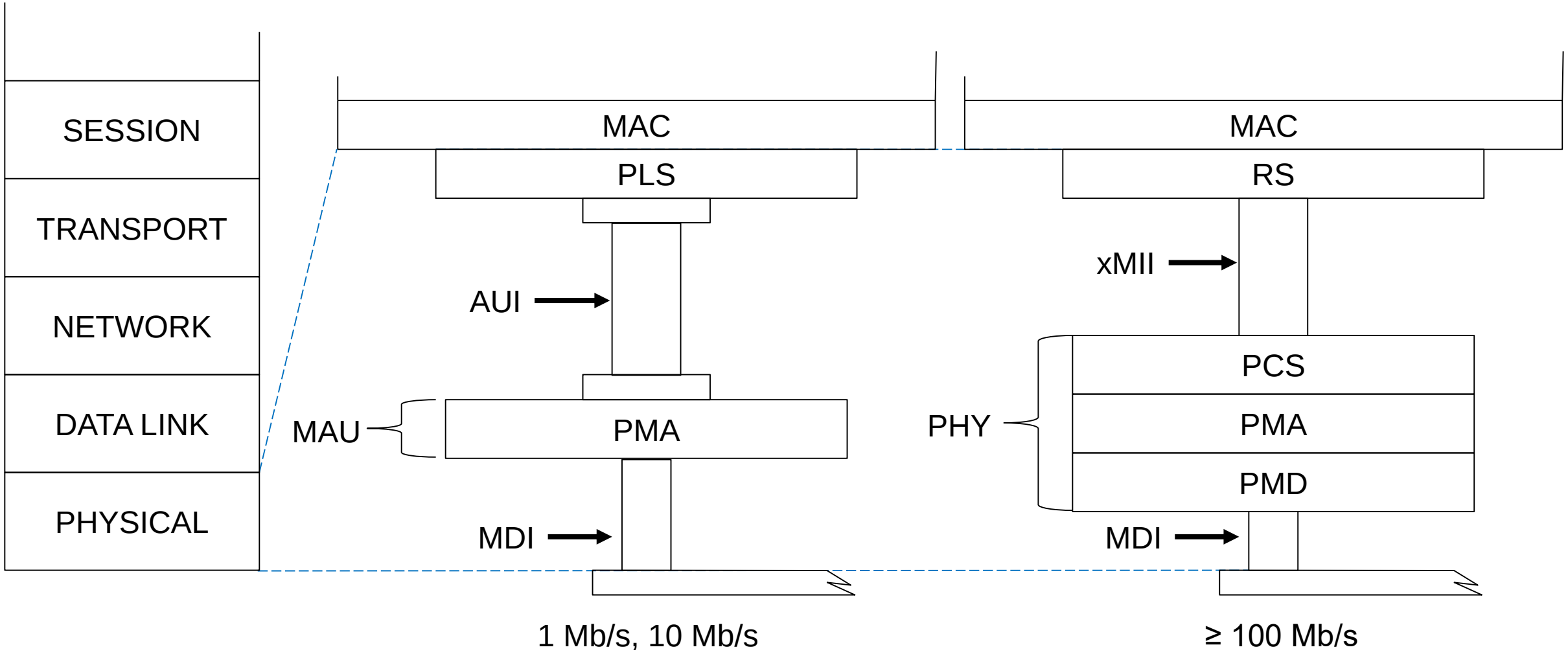
BEHAVIOUR DEFINED AS:
Increment counter by one for each frame with the FCSError signal asserted and the FramingError and CollisionEvent signals deasserted and whose OctetCount is greater than or equal to minFrameSize and for which the attribute aFramesTooLong has not been incremented.;

30.5.1.1.12 aLaneMapping

BEHAVIOUR DEFINED AS:
For 40/100/200/400GBASE-R PHYs and 100GBASE-P PHYs, an array of PCS lane identifiers. The indices of this array (0 to n – 1) denote the service interface lane number where n is the number of PCS lanes in use. Each element of this array contains the PCS lane number for the PCS lane that has been detected in the corresponding service interface lane.

If a Clause 45 MDIO Interface to the PCS is present, then this attribute will map to the Lane mapping registers (see 45.2.3.48 and 45.2.3.49).;

IEEE 802.3 MAU and PHY



MAU managed object class

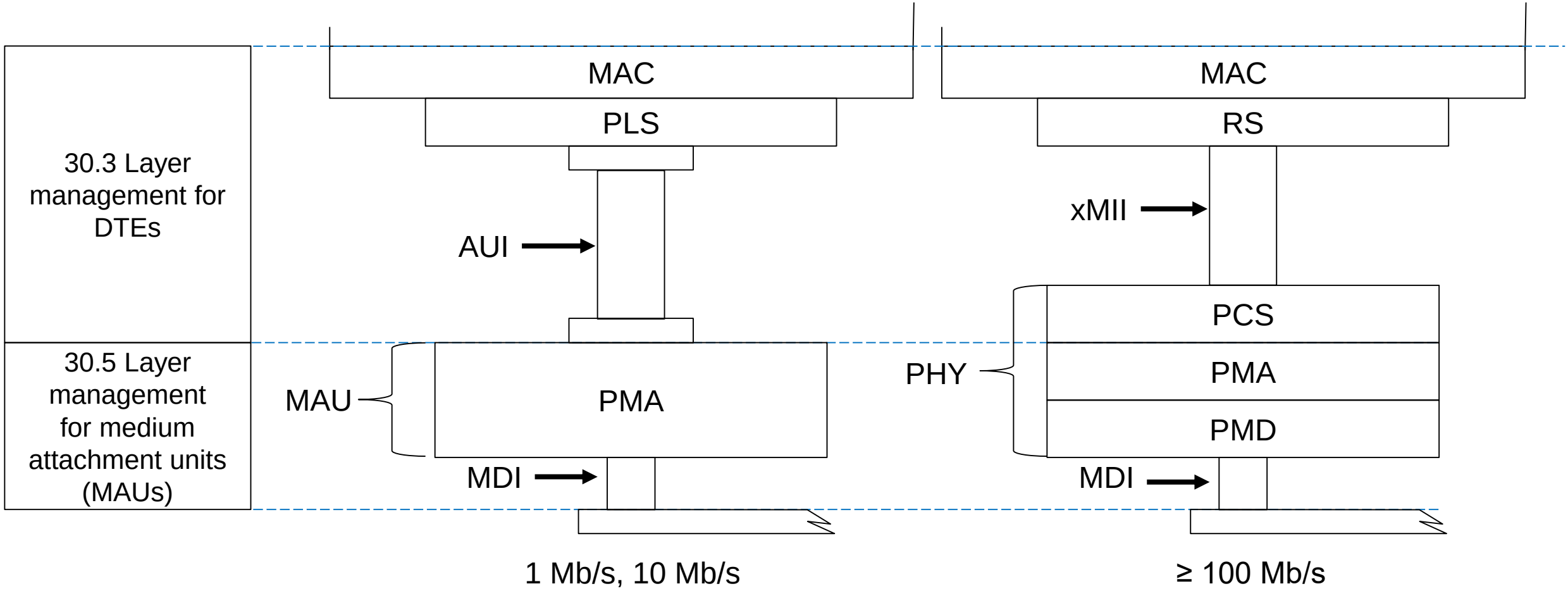
30.5 Layer management for medium attachment units (MAUs)

30.5.1 MAU managed object class

This subclause formally defines the behaviours for the oMAU managed object class, attributes, actions, and notifications.

The sublayer that connects directly to the media is called MAU for 10 Mb/s operation and its equivalent is the combined PMA and PMD sublayers at higher operating speeds. Because this clause defines management for use at many speeds, it needs to be able to refer to MAUs and the PMA and PMD sublayers as a group. Therefore in this clause, the term MAU will include PMA and PMD sublayers, as well as MAUs, except in those instances where it is explicitly restricted to 10 Mb/s.

IEEE 802.3 Managed Objects



30.3 DTE

Basic Package (mandatory)
Mandatory Package (mandatory)
Recommended Package (optional)
Optional Package (optional)
Array Package (optional)
Excessive Deferral Package (optional)
Multiple PHY Package (optional)
PHY Error Monitor Capability (optional)

30.4 Repeater

Basic Control Capability (mandatory)
Performance Monitor Capability (optional)
Address Tracking Capability (optional)
100/1000 Mb/s Monitor Capability (optional)
1000 Mb/s Burst Monitor Capability (optional)

30.5 MAU

Basic Package (mandatory)
MAU Control Package (optional)
Media Loss Tracking Package (conditional)
Broadband DTE MAU Package (conditional)
MII Capability (conditional)
PHY Error Monitor Capability (optional)
MultiGBASE-T Operating Margin package (conditional)
Forward Error Correction Package (conditional)
Energy-Efficient Ethernet (optional)

DTE	Repeater	MAU
Basic Package (mandatory)	Basic Control Capability (mandatory)	Basic Package (mandatory)
Mandatory Package (mandatory)	Performance Monitor Capability (optional)	MAU Control Package (optional)
Recommended Package (optional)	Address Tracking Capability (optional)	Media Loss Tracking Package (conditional)
Optional Package (optional)	100/1000 Mb/s Monitor Capability (optional)	Broadband DTE MAU Package (conditional)
Array Package (optional)	1000 Mb/s Burst Monitor Capability (optional)	MII Capability (conditional)
Excessive Deferral Package (optional)		PHY Error Monitor Capability (optional)
Multiple PHY Package (optional)		MultiGBASE-T Operating Margin package (conditional)
PHY Error Monitor Capability (optional)		Forward Error Correction Package (conditional)
Energy-Efficient Ethernet (optional)		Energy-Efficient Ethernet (optional)

DTE

Basic Package (mandatory)
Mandatory Package (mandatory)
Recommended Package (optional)
Optional Package (optional)
Array Package (optional)
Excessive Deferral Package (optional)
Multiple PHY Package (optional)
PHY Error Monitor Capability (optional)
Energy-Efficient Ethernet (optional)

Basic Package (mandatory)
aResourceTypeID
aResourceInfo
oMACEntity

PHY Error Monitor Capability (optional)
aSymbolErrorDuringCarrier

Energy-Efficient Ethernet (optional)
aTransmitLPIMicroseconds
aReceiveLPIMicroseconds
aTransmitLPITransitions
aReceiveLPITransitions

30.3.2.1.5 aSymbolErrorDuringCarrier

For operation at 10 Gb/s, 25 Gb/s, 40 Gb/s, 100 Gb/s, 200 Gb/s, and 400 Gb/s, it is a count of the number of times the receiving media is non-idle (the time between the Start of Packet Delimiter and the End of Packet Delimiter as defined by 46.2.5 and 81.2.5) for a period of time equal to or greater than minFrameSize, and during which there was at least one occurrence of an event that causes the PHY to indicate “Receive Error” on the media independent interface (see Table 46–4 and Table 81–4).

At all speeds this counter shall be incremented only once per valid CarrierEvent and if a collision is present this counter shall not increment.

30.3.2.1.8 aTransmitLPIMicroseconds

A count reflecting the amount of time that the LPI_REQUEST parameter has the value ASSERT.

30.3.2.1.9 aReceiveLPIMicroseconds

A count reflecting the amount of time that the LPI_INDICATION parameter has the value ASSERT.

30.3.2.1.10 aTransmitLPITransitions

A count of occurrences of the transition from state LPI_DEASSERTED to state LPI_ASSERTED of the LPI transmit state diagram is the RS.

30.3.2.1.11 aReceiveLPITransitions

A count of occurrences of the transition from DEASSERT to ASSERT of the LPI_INDICATE parameter.

IEEE P802.3ct:

30.5.1.1.2 aMAUType

Insert 100GBASE-ZR PHY type into the “APPROPRIATE SYNTAX” section of 30.5.1.1.2 after 100GBASE-ER4 as follows:

APPROPRIATE SYNTAX:

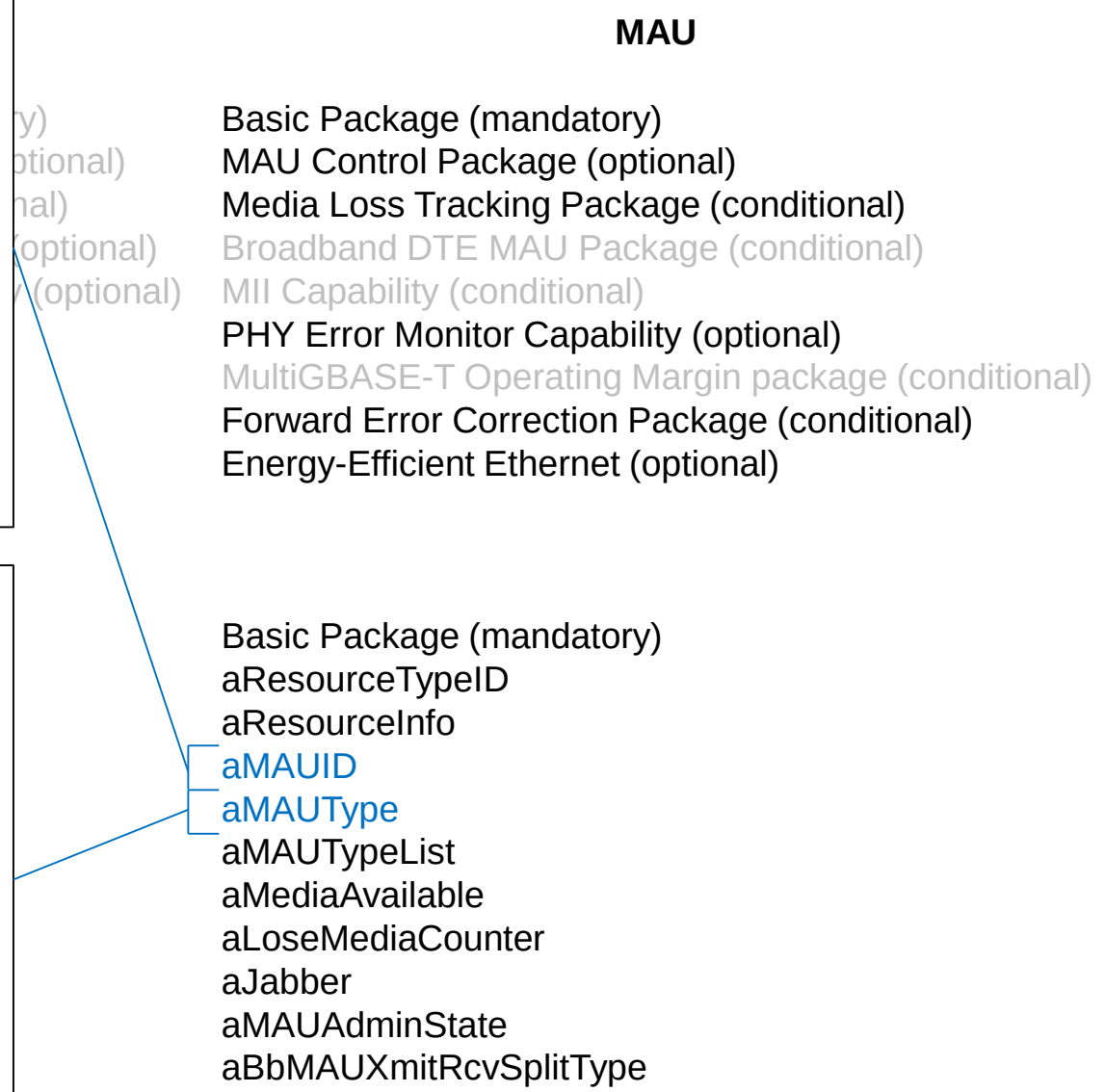
100GBASE-ZR	100GBASE-R PCS/100GBASE-ZR PMA over a DWDM system PMD with reach up to at least 80 km as specified in Clause 154

30.3.2.1.2 aPhyType

APPROPRIATE SYNTAX:

40GBASE-T	Clause 113 40 Gb/s DSQ128
100GBASE-R	Clause 82 100 Gb/s multi-PCS lane using 2-level PAM
100GBASE-P	Clause 82 100 Gb/s multi-PCS lane using >2-level PAM
200GBASE-R	Clause 119 200 Gb/s multi-PCS lane 64B/66B

Comment: Perhaps 100GBASE-R should be updated to ‘Clause 82 100 Gb/s multi-PCS lane 64B/66B’ since (1) the title of Clause 82 is ‘Physical Coding Sublayer (PCS) for 64B/66B, type 40GBASE-R and 100GBASE-R’ and (2) it is a PCS that doesn’t specify the signaling.



30.5.1.1.3 aMAUTypeList

BEHAVIOUR DEFINED AS: … returns the possible types that the MAU could be, identifying the ability of the MAU.

30.5.1.1.4 aMediaAvailable

Last updated by IEEE Std 802.3cd-2018

BEHAVIOUR DEFINED AS: For 40 Gb/s, 50 Gb/s, 100 Gb/s, 200 Gb/s, and 400 Gb/s, the enumerations map to value of the link_fault variable (see 81.3.4) within the Link Fault Signaling state diagram (see 81.3.4.1 and Figure 46–11) as follows: the values OK and Link Interruption map to the enumeration “available”, the value Local Fault maps to the enumeration “not available” and the value Remote Fault maps to the enumeration “remote fault”.

30.5.1.1.5 aLoseMediaCounter

BEHAVIOUR DEFINED AS: Counts the number of times that the MediaAvailable attribute changes from the enumeration “available” to any other enumeration. Mandatory for MAU type “AUI”, optional for all others.;

30.5.1.1.6 aJabber

BEHAVIOUR DEFINED AS: … this counter will increment for a 10 Mb/s baseband and broadband MAUs only.

MAU

Basic Package (mandatory)
MAU Control Package (optional)
Media Loss Tracking Package (conditional)
Broadband DTE MAU Package (conditional)
MII Capability (conditional)
PHY Error Monitor Capability (optional)
MultiGBASE-T Operating Margin package (conditional)
Forward Error Correction Package (conditional)
Energy-Efficient Ethernet (optional)

Basic Package (mandatory)
aResourceTypeID
aResourceInfo
aMAUID
aMAUType
aMAUTypeList
aMediaAvailable
aLoseMediaCounter
aJabber
aMAUAdminState
aBbMAUXmitRcvSplitType

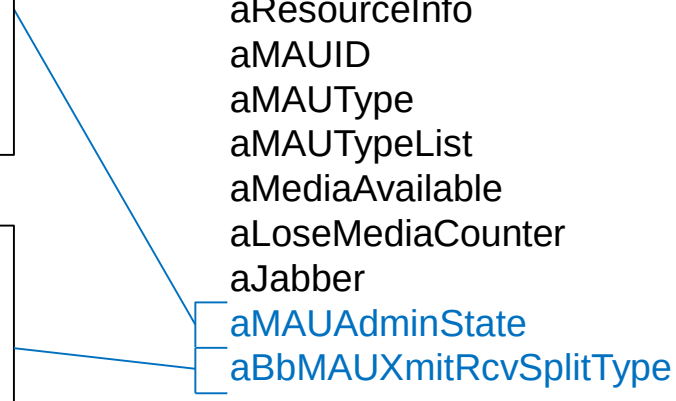
DTE	Repeater	MAU
Basic Package (mandatory)	Basic Control Capability (mandatory)	Basic Package (mandatory)
Mandatory Package (mandatory)	Performance Monitor Capability (optional)	MAU Control Package (optional)
Recommended Package (optional)	Address Tracking Capability (optional)	Media Loss Tracking Package (conditional)
Optional Package (optional)	100/1000 Mb/s Monitor Capability (optional)	Broadband DTE MAU Package (conditional)
Array Package (optional)	1000 Mb/s Burst Monitor Capability (optional)	MII Capability (conditional)
Excessive Deferral Package (optional)		PHY Error Monitor Capability (optional)
Multiple PHY Package (optional)		MultiGBASE-T Operating Margin package (conditional)
PHY Error Monitor Capability (optional)		Forward Error Correction Package (conditional)
Energy-Efficient Ethernet (optional)		Energy-Efficient Ethernet (optional)

30.5.1.1.7 aMAUAdminState

BEHAVIOUR DEFINED AS: A MAU in management state “standby” forces DI and CI to idle and the media transmitter to idle or fault, if supported. The management state “standby” only applies to link type MAUs. The state of MediaAvailable is unaffected. A MAU or AUI in …

30.5.1.1.8 aBbMAUXmitRcvSplitType

BEHAVIOUR DEFINED AS: Returns a value that indicates the type of frequency multiplexing/cabling system used to separate the transmit and receive paths for the.



Basic Package (mandatory)
aResourceTypeID
aResourceInfo
aMAUID
aMAUType
aMAUTypeList
aMediaAvailable
aLoseMediaCounter
aJabber
aMAUAdminState
aBbMAUXmitRcvSplitType

DTE	Repeater	MAU
Basic Package (mandatory)	Basic Control Capability (mandatory)	Basic Package (mandatory)
Mandatory Package (mandatory)	Performance Monitor Capability (optional)	MAU Control Package (optional)
Recommended Package (optional)	Address Tracking Capability (optional)	Media Loss Tracking Package (conditional)
Optional Package (optional)	100/1000 Mb/s Monitor Capability (optional)	Broadband DTE MAU Package (conditional)
Array Package (optional)	1000 Mb/s Burst Monitor Capability (optional)	MII Capability (conditional)
Excessive Deferral Package (optional)		PHY Error Monitor Capability (optional)
Multiple PHY Package (optional)		MultiGBASE-T Operating Margin package (conditional)
PHY Error Monitor Capability (optional)		Forward Error Correction Package (conditional)
		Energy-Efficient Ethernet (optional)

20.2.2.1.4 aLoseMediaCounter

BEHAVIOUR DEFINED AS: Counts the number of times that the MAU leaves MediaAvailState “available.” Mandatory for MAU type “AUI,” optional for all others.

Media Loss Tracking Package (conditional)
aLoseMediaCounter

30.5.1.1.24 aLDFastRetrainCount

BEHAVIOUR DEFINED AS: A count of the number of fast retrains initiated by the local device.

30.5.1.1.25 aLPFastRetrainCount

BEHAVIOUR DEFINED AS: count of the number of fast retrains initiated by the link partner.

Energy-Efficient Ethernet (optional)
aLDFastRetrainCount
aLPFastRetrainCount

30.5.1.1.10 aFalseCarriers

BEHAVIOUR DEFINED AS: A count of the number of false carrier events during IDLE in 100BASE-X and 1000BASE-X links.

Comment: No need for an IEEE P802.3ct change to this attribute, this only applies to 100BASE-X and 1000BASE-X links.

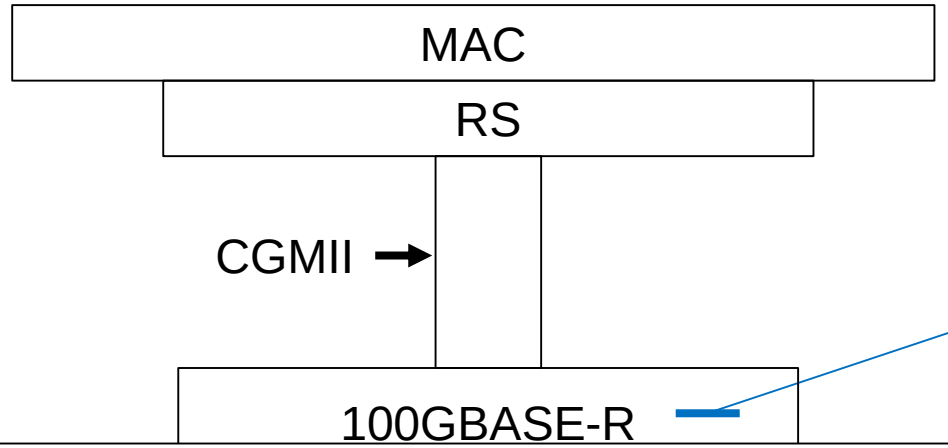
30.5.1.1.13 aIdleErrorCount

BEHAVIOUR DEFINED AS: This attribute takes the eight-bit value from the 100BASE-T2 Status register (MII management register 10) bits 7:0 “Idle Error Count” as described in 100BASE-T2, 32.5.3.2.6 and 40.5.

Comment: No need for an IEEE P802.3ct change to this attribute, this only applies to 100BASE-T2 links.

PHY Error Monitor Capability
aFalseCarriers
aBIPErrorCount
aLaneMapping
aRSFECBIPErrorCount
aRSFECLaneMapping
aIdleErrorCount

Forward Error Correction Package
aFECAbility
aFECmode
aFECCorrectedBlocks
aFECUncorrectableBlocks
aRSFECBypassAbility
aRSFECBypassIndicationAbility
aRSFECBypassEnable
aRSFECBypassIndicationEnable
aPCSFECBypassIndicationAbility
aPCSFECBypassIndicationEnable



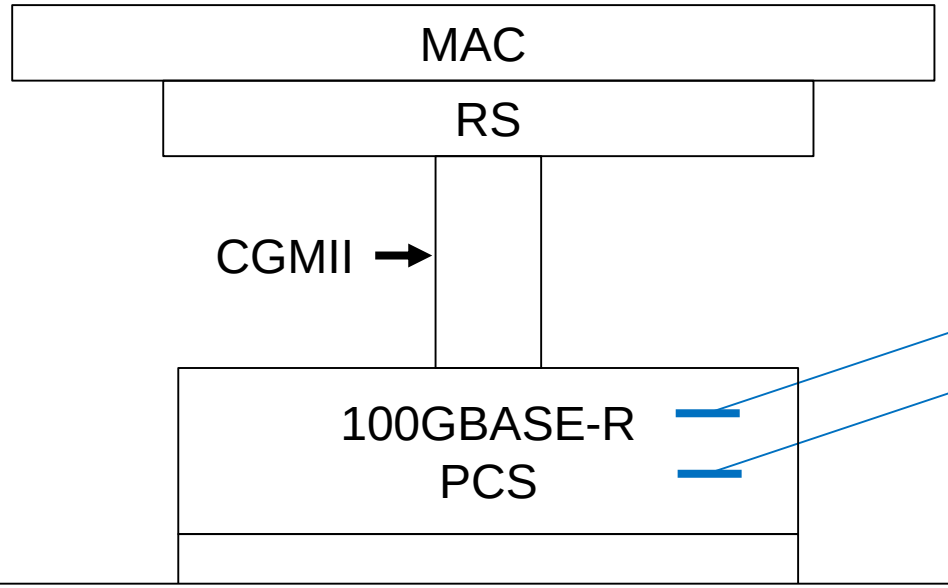
30.5.1.1.11 aBIPErrorCount

BEHAVIOUR DEFINED AS: For 40/100GBASE-R PHYs and 100GBASE-P PHYS, an array of BIP error counters. The counters do not increment for other PHY types. The indices of this array (0 to n – 1) denote the PCS lane number where n is the number of PCS lanes in use. Each element of this array contains a count of BIP errors for that PCS lane. Increment the counter by one for each BIP error detected during alignment marker removal in the PCS for the corresponding lane.

Comment: Subclause 82.2.8 'BIP calculations' defines how to update error counters. I don't see any change to this subclause in IEEE P802.3ct therefore I assume that there is no change in the operation of the BIP Error Counting for a 100GBASE-ZR PHY. Based on this there is no need for an IEEE P802.3ct change to this attribute.

PHY Error Monitor Capability
aFalseCarriers
aBIPErrorCount
aLaneMapping
aRSFECBIPErrorCount
aRSFECLaneMapping
aIdleErrorCount

Forward Error Correction Package
aFECAbility
aFECmode
aFECCorrectedBlocks
aFECUncorrectableBlocks
aRSFECBypassAbility
aRSFECBypassIndicationAbility
aRSFECBypassEnable
aRSFECBypassIndicationEnable
aPCSFECBypassIndicationAbility
aPCSFECBypassIndicationEnable



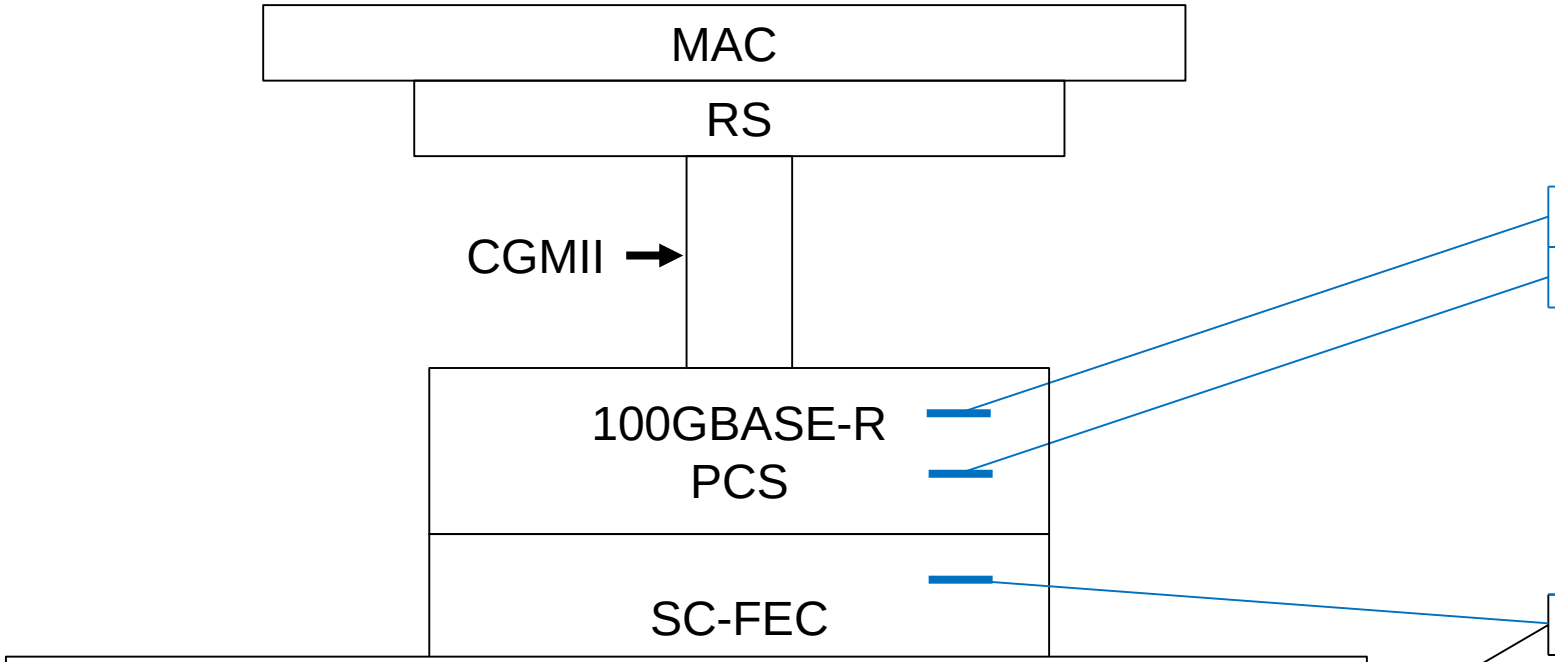
30.5.1.1.12 aLaneMapping

BEHAVIOUR DEFINED AS: For 40/100/200/400GBASE-R PHYs and 100GBASE-P PHYs, an array of PCS lane identifiers. The indices of this array (0 to n – 1) denote the service interface lane number where n is the number of PCS lanes in use. Each element of this array contains the PCS lane number for the PCS lane that has been detected in the corresponding service interface lane.

Comment: I don't see any changes in IEEE P802.3ct in relation to PCS lane mapping described in Clause 82 (for example subclause 82.2.19.3 'State diagrams'). Based on this there is no need for an IEEE P802.3ct change to this attribute.

PHY Error Monitor Capability
aFalseCarriers
aBIPErrorCount
aLaneMapping
aRSFECBIPErrorCount
aRSFECLaneMapping
aIdleErrorCount

Forward Error Correction Package
aFECAbility
aFECmode
aFECCorrectedBlocks
aFECUncorrectableBlocks
aRSFECBypassAbility
aRSFECBypassIndicationAbility
aRSFECBypassEnable
aRSFECBypassIndicationEnable
aPCSFECBypassIndicationAbility
aPCSFECBypassIndicationEnable



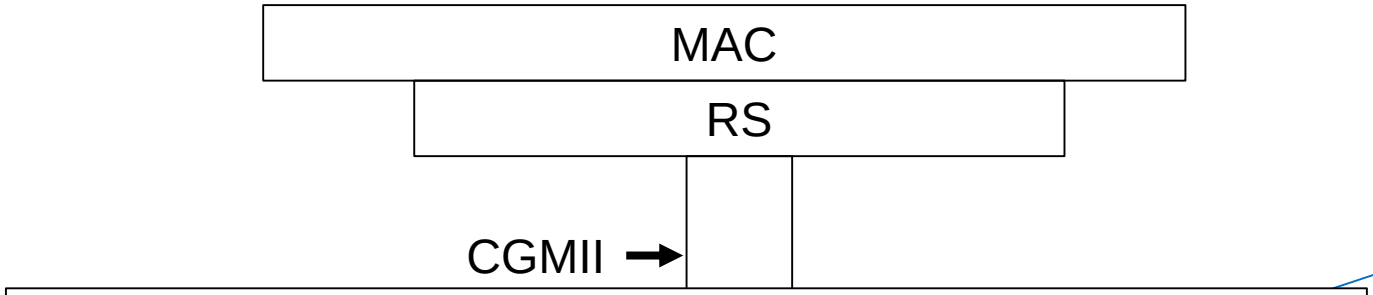
PHY Error Monitor Capability
aFalseCarriers
aBIPErrorCount
aLaneMapping
aRSFECBIPErrorCount
aRSFECLaneMapping
aIdleErrorCount

Forward Error Correction Package
aFECAbility
aFECmode
aFECCorrectedBlocks
aFECUncorrectableBlocks
aRSFECBypassAbility
aRSFECBypassIndicationAbility
aRSFECBypassEnable
aRSFECBypassIndicationEnable
aPCSFECBypassIndicationAbility
aPCSFECBypassIndicationEnable

30.5.1.1.15 aFECAbility

BEHAVIOUR DEFINED AS: A read-only value that indicates if the PHY supports an optional FEC sublayer for forward error correction (see 65.2, Clause 74, Clause 91, and Clause 108).

Comment: We need to add a reference to subclause 153.2 for SC-FEC in the parenthetical 'see' list. This attribute also needs to be updated for PHYs with mandatory FEC, correct me if I'm wrong, but I didn't think 100GBASE-ZR was the first FEC with mandatory FEC, so this attribute should probably have been updated before now.



30.5.1.1.16 aFECmode

BEHAVIOUR DEFINED AS: A read-write value that indicates the mode of operation of the FEC sublayer for forward error correction (see 65.2, Clause 74, Clause 91, and Clause 108). A GET operation returns the current mode of operation of the PHY. A SET operation changes the mode of operation of the PHY to the indicated value. The enumerations “BASE-R enabled” and “RS-FEC enabled” are only used for 25GBASE-CR, 25GBASE-CR-S, 25GBASE-KR, and 25GBASE-KR-S PHYs where operation in the no-FEC mode maps to the enumerations “disabled”, operation in the BASE-R FEC mode maps to the enumerations “BASE-R enabled”, and operation in the RS-FEC mode maps to the enumerations “RS-FEC enabled” (see 110.6 and 111.6).

Comment: Need to add a SC-FEC to the list. We also need to address mandatory FEC, for example a SET operation where FEC is mandatory will have no effect.

PHY Error Monitor Capability
aFalseCarriers
aBIPErrorCount
aLaneMapping
aRSFECBIPErrorCount
aRSFECLaneMapping
aIdleErrorCount

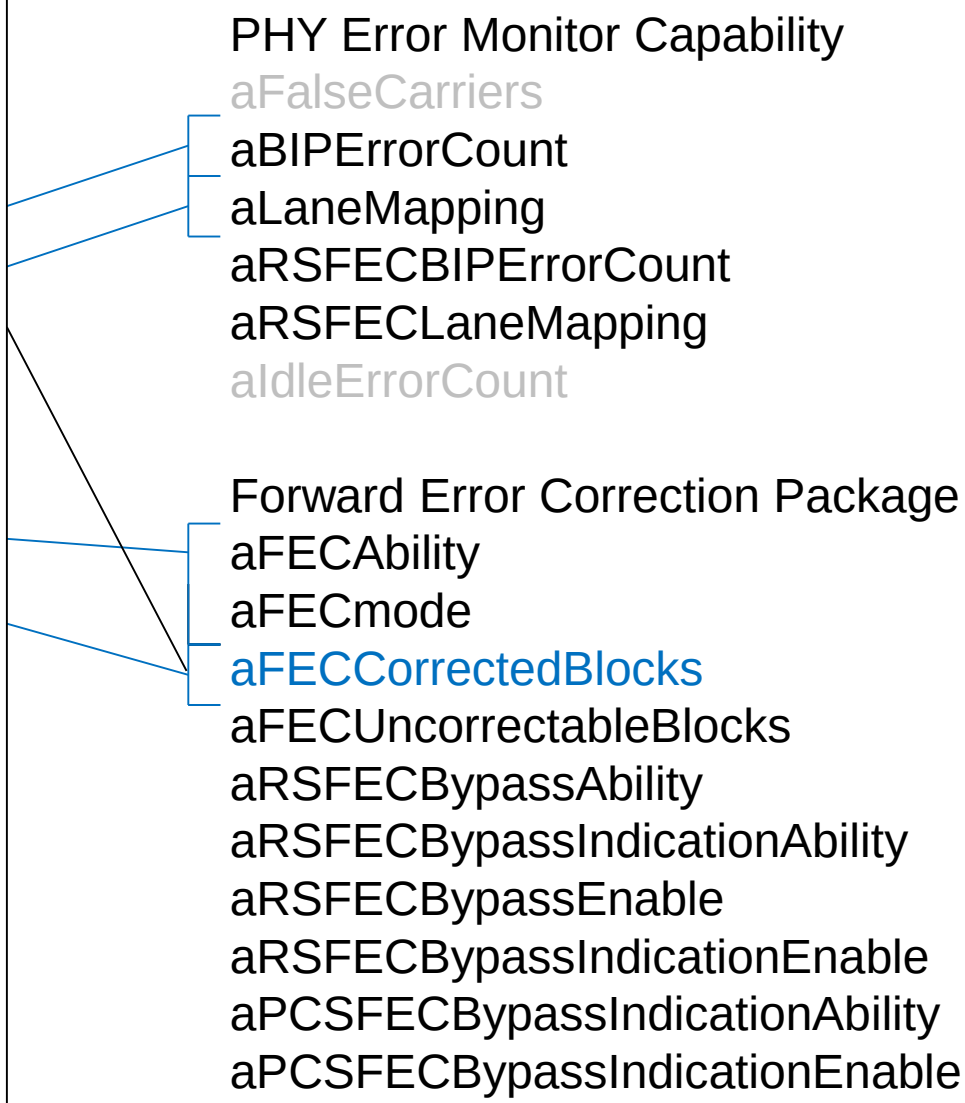
Forward Error Correction Package
aFECAbility
aFECmode
aFECCorrectedBlocks
aFECUncorrectableBlocks
aRSFECBypassAbility
aRSFECBypassIndicationAbility
aRSFECBypassEnable
aRSFECBypassIndicationEnable
aPCSFECBypassIndicationAbility
aPCSFECBypassIndicationEnable

30.5.1.1.17 aFECCorrectedBlocks

BEHAVIOUR DEFINED AS: For 1000BASE-PX, 10/25/40/50/100/200/400GBASE-R, 100GBASE-P, 10GBASE-PR, or 10/1GBASE-PRX PHYs, an array of corrected FEC block counters. The counters do not increment for other PHY types. The indices of this array (0 to N – 1) denote the FEC sublayer instance number where N is the number of FEC sublayer instances in use. The number of FEC sublayer instances in use is set to one for PHYs that do not use PCS lanes or use a single FEC instance for all lanes. Each element of this array contains a count of corrected FEC blocks for that FEC sublayer instance. Increment the counter by one for each received block that is corrected by the FEC function in the PHY for the corresponding lane or FEC sublayer instance. If a Clause 45 MDIO Interface is present, then this attribute maps to the FEC corrected blocks counter(s) (see 45.2.10.5 and 45.2.1.103 for 10GBASE-R, 45.2.3.41 for 10GBASE-PR and 10/1GBASE-PRX, 45.2.1.125 for BASE-R, 45.2.1.112 for RS-FEC, and 45.2.3.61 for PCS FEC).

Note: Last updated by IEEE Std 802.3cd-2018.

Comment: This behaviour mentions FEC sublayer instances, but this is in reference to the number of lanes and says '... set to one for PHYs that do not use PCS lanes or use a single FEC instance for all lanes.'. I believe the latter part of the quoted text covers SC-FEC which is a single instance for all lanes (Figure 153–2). Based on this I think the only update needed is to the Clause 45 list to add a reference to subclause 45.2.1.186al 'SC-FEC corrected codewords counter (Register 1.2276, 1.2277)' added by IEEE P802.3ct for 100GBASE-ZR. In addition I didn't think all 10/25/40/50/100/200/400GBASE-R PHYs support FEC, so perhaps this needs to be qualified with 'that support FEC'.

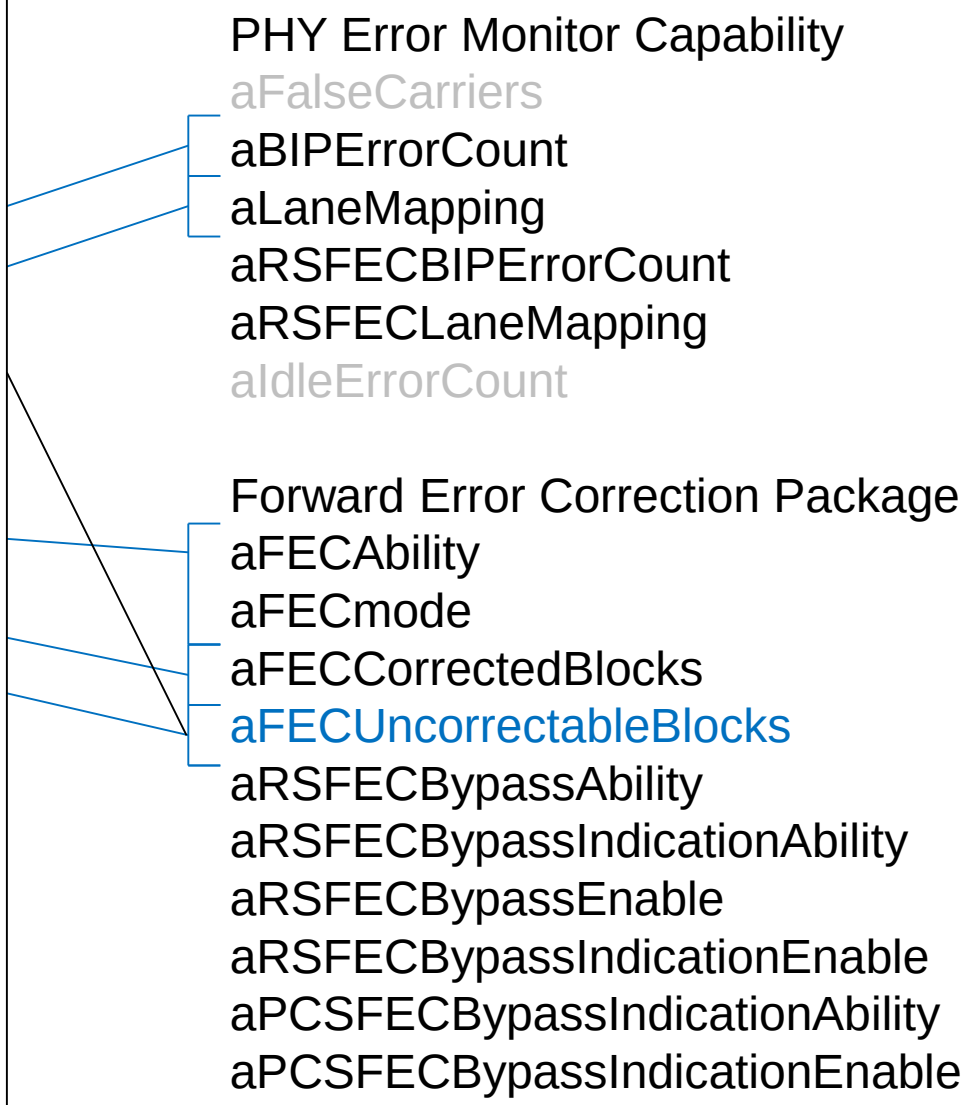


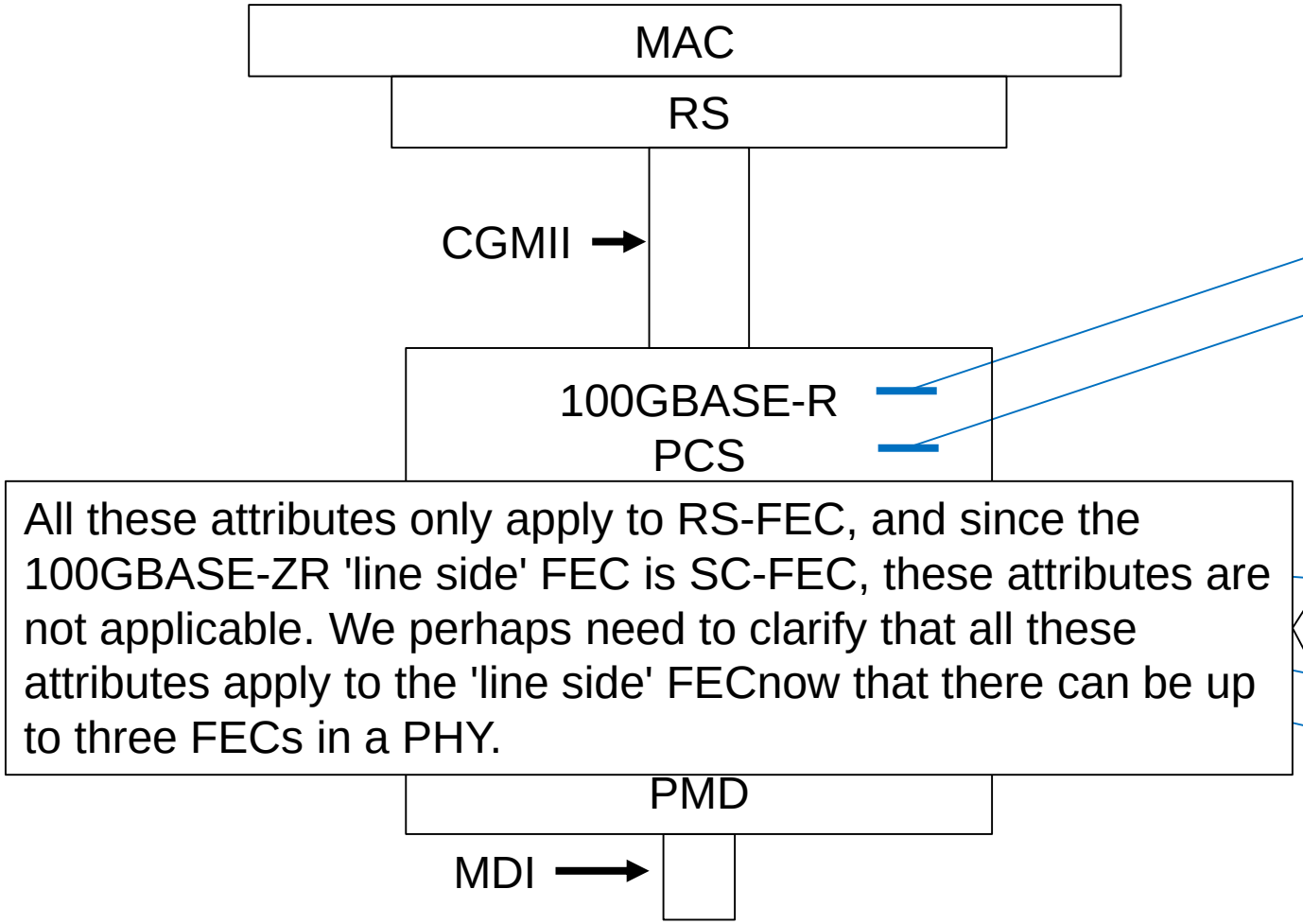
30.5.1.1.18 aFECUncorrectableBlocks

BEHAVIOUR DEFINED AS: For 1000BASE-PX, 10/25/40/50/100/200/400GBASE-R, 100GBASE-P, 10GBASE-PR, or 10/1GBASE-PRX PHYs, an array of uncorrectable FEC block counters. The counters do not increment for other PHY types. The indices of this array (0 to N – 1) denote the FEC sublayer instance number where N is the number of FEC sublayer instances in use. The number of FEC sublayer instances in use is set to one for PHYs that do not use PCS lanes or use a single FEC instance for all lanes. Each element of this array contains a count of uncorrectable FEC blocks for that FEC sublayer instance. Increment the counter by one for each FEC block that is determined to be uncorrectable by the FEC function in the PHY for the corresponding lane or FEC sublayer instance. If a Clause 45 MDIO Interface is present, then this attribute maps to the FEC uncorrectable blocks counter(s) (see 45.2.10.6 and 45.2.1.104 for 10GBASE-R, 45.2.3.42 for 10GBASE-PR and 10/ 1GBASE-PRX, 45.2.1.133 for BASE-R, 45.2.1.113 for RS-FEC, and 45.2.3.62 for PCS FEC).

Note: Last updated by IEEE Std 802.3cd-2018.

My comment: Same as aFECUncorrectableBlocks, but reference will be to subclause 45.2.1.186am 'SC-FEC uncorrected codewords counter (Register 1.2278, 1.2279)' added by IEEE P802.3ct for 100GBASE-ZR.
In addition I didn't think all 10/25/40/50/100/200/400GBASE-R PHYs support FEC, so perhaps this needs to be qualified with 'that support FEC'.





PHY Error Monitor Capability

aFalseCarriers

aBIPErrorCount

aLaneMapping

aRSFECBIPErrorCount

aRSFECLaneMapping

aIdleErrorCount

Forward Error Correction Package

aFECAbility

aFECmode

aFECCorrectedBlocks

aFECUncorrectableBlocks

aRSFECBypassAbility

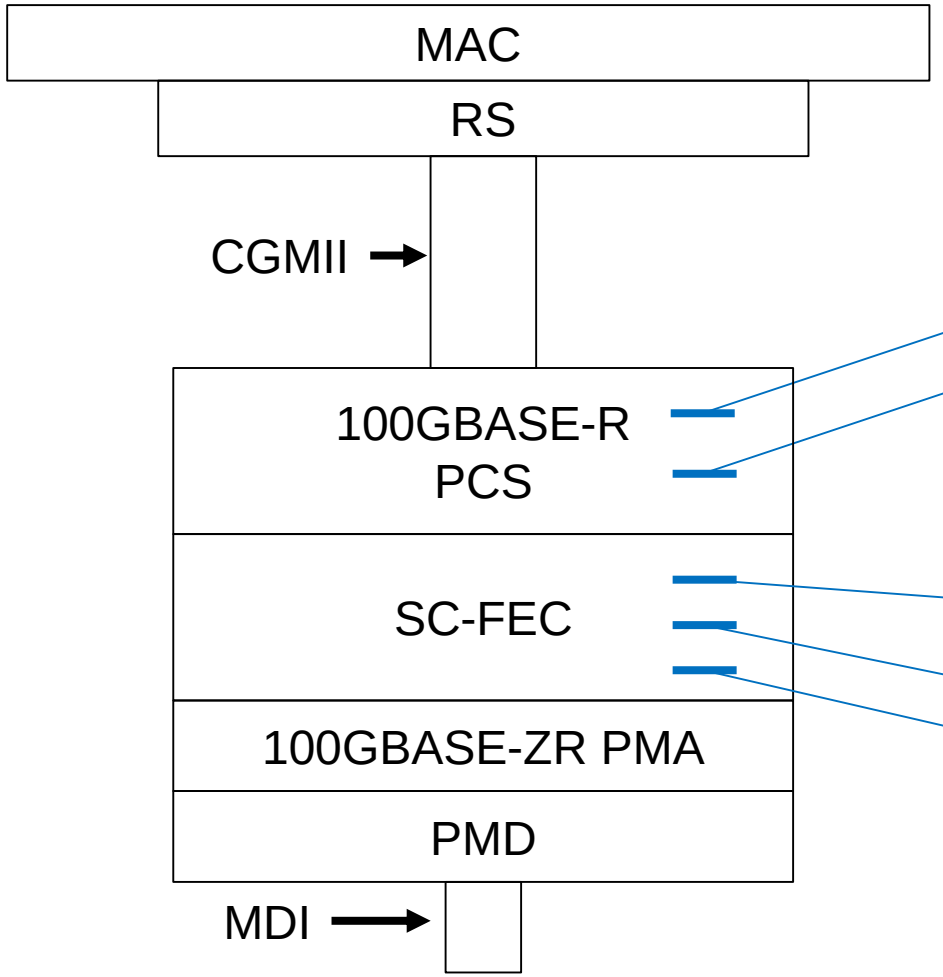
aRSFECBypassIndicationAbility

aRSFECBypassEnable

aRSFECBypassIndicationEnable

aPCSFECBypassIndicationAbility

aPCSFECBypassIndicationEnable



PHY Error Monitor Capability

aFalseCarriers

aBIPErrorCount

aLaneMapping

aRSFECBIPErrorCount

aRSFECLaneMapping

aIdleErrorCount

Forward Error Correction Package

aFECAbility

aFECmode

aFECCorrectedBlocks

aFECUncorrectableBlocks

aRSFECBypassAbility

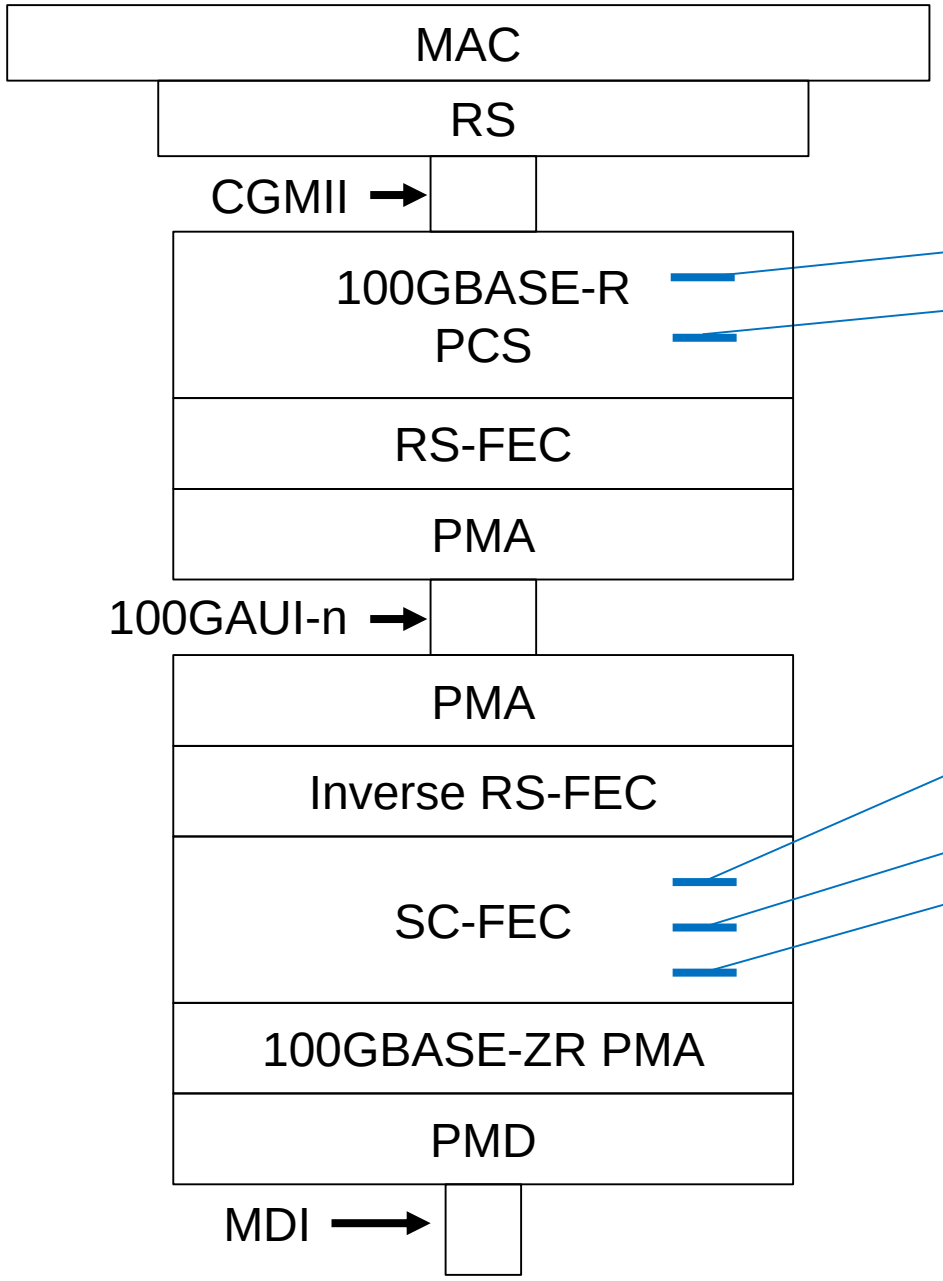
aRSFECBypassIndicationAbility

aRSFECBypassEnable

aRSFECBypassIndicationEnable

aPCSFECBypassIndicationAbility

aPCSFECBypassIndicationEnable



PHY Error Monitor Capability

aFalseCarriers

aBIPErrorCount

aLaneMapping

aRSFECBIPErrorCount

aRSFECLaneMapping

aIdleErrorCount

Forward Error Correction Package

aFECAbility

aFECmode

aFECCorrectedBlocks

aFECUncorrectableBlocks

aRSFECBypassAbility

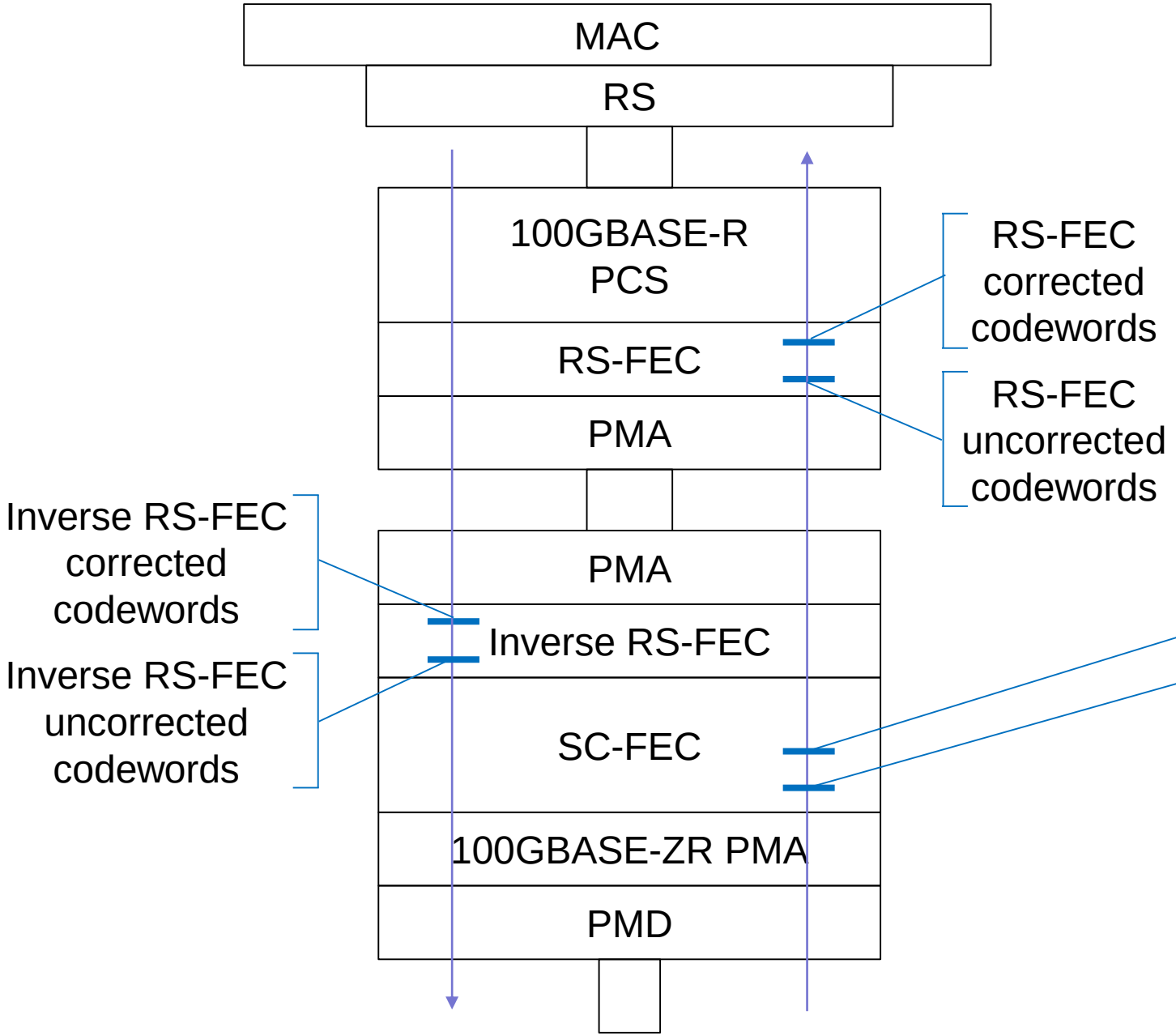
aRSFECBypassIndicationAbility

aRSFECBypassEnable

aRSFECBypassIndicationEnable

aPCSFECBypassIndicationAbility

aPCSFECBypassIndicationEnable



PHY Error Monitor Capability

aFalseCarriers

aBIPErrorCount

aLaneMapping

aRSFECBIPErrorCount

aRSFECLaneMapping

aIdleErrorCount

Forward Error Correction Package

aFECAbility

aFECmode

aFECCorrectedBlocks

aFECUncorrectableBlocks

aRSFECBypassAbility

aRSFECBypassIndicationAbility

aRSFECBypassEnable

aRSFECBypassIndicationEnable

aPCSFECBypassIndicationAbility

aPCSFECBypassIndicationEnable

Thank you