

2.5G/5G PHY/MAC interface and Architecture in 802.3bz

George Zimmerman
CME Consulting
Chief Editor 802.3bz
2.5G/5GBASE-T

Overview

- 802.3bz has established Clause 125 for 2.5G/5G architecture overview
 - Currently Draft 1.2 is in Task Force review
 - Expected to go to WG Ballot in January
- 802.3bz chose NOT to specify an IEEE 802-standardized PHY/MAC extender or AUI
 - Extended XGMII to 2.5G/5Gbps rates as the logical PHY/MAC interface
 - Favored vendor differentiation and technology flexibility

Clause 125 – 2.5G/5G Ethernet

Draft Amendment to IEEE Std 802.3-2015
IEEE P802.3bz 2.5/5GBASE-T Task Force

IEEE Draft P802.3bz/D1.2
2nd December 2015

125. Introduction to 2.5 Gb/s and 5 Gb/s networks

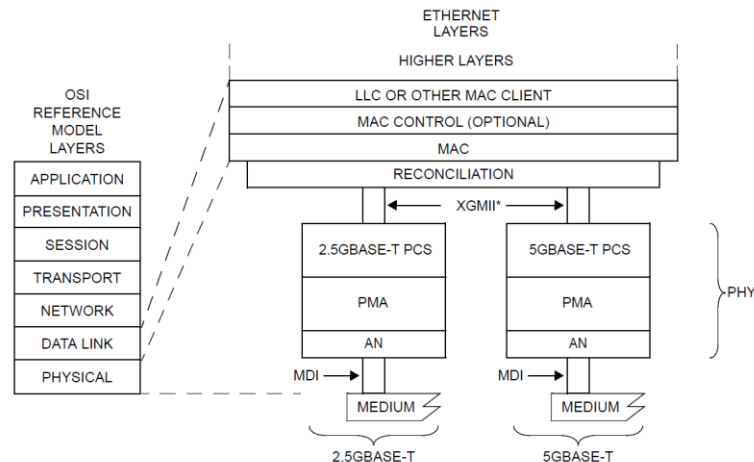
125.1 Overview

125.1.1 Scope

This clause describes the general requirements for 2.5 Gigabit and 5 Gigabit Ethernet. 2.5 Gigabit Ethernet uses the IEEE 802.3 MAC sublayer operating at a data rate of 2.5 Gb/s, coupled with any IEEE 802.3 2.5GBASE Physical Layer implementation. 5 Gigabit Ethernet uses the IEEE 802.3 MAC sublayer operating at a data rate of 5 Gb/s, coupled with any IEEE 802.3 5GBASE Physical Layer implementation. 2.5 Gb/s and 5 Gb/s Physical Layer entities, such as those specified in Table 125–1, provide a bit error ratio (BER) better than or equal to 10^{-12} at the MAC/PLS service interface.

2.5 Gigabit and 5 Gigabit Ethernet is defined for full duplex operation only.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15



AN = AUTO-NEGOTIATION
LLC = LOGICAL LINK CONTROL
MAC = MEDIA ACCESS CONTROL
MDI = MEDIUM DEPENDENT INTERFACE
PCS = PHYSICAL CODING SUBLAYER

PHY = PHYSICAL LAYER DEVICE
PMA = PHYSICAL MEDIUM ATTACHMENT
XGMII* = 10 GIGABIT MEDIA INDEPENDENT INTERFACE
* XGMII IS OPTIONAL

Figure 125–1—Architectural positioning of 2.5 Gigabit and 5 Gigabit Ethernet

Table 125–2—Nomenclature and clause correlation (2.5GBASE and 5GBASE)

Nomenclature	Clause ^a					
	28	46	78	126	126	
	Auto-Negotiation	RS	XGMII	EEE	2.5GBASE-T PCS/PMA	5GBASE-T PCS/PMA
2.5GBASE-T	M	M	O	O	M	
5GBASE-T	M	M	O	O		M

^aO = Optional, M = Mandatory.

125. Introduction to 2.5 Gb/s and 5 Gb/s networks	59
125.1 Overview	59
125.1.1 Scope	59
125.1.2 Relationship of 2.5 Gigabit and 5 Gigabit Ethernet to the ISO OSI reference model	59
125.1.3 Nomenclature	59
125.1.4 Physical Layer signalling systems	61
125.2 Summary of 2.5 Gigabit and 5 Gigabit Ethernet sublayers	61
125.2.1 Reconciliation Sublayer (RS) and Media Independent Interface	61
125.2.2 Physical coding sublayer (PCS)	62
125.2.3 Physical Medium Attachment sublayer (PMA)	62
125.2.4 Auto-Negotiation, type BASE-T	62
125.2.5 Management interface (MDIO/MDC)	62
125.2.6 Management	62
125.4 Delay Constraints	63

So far, all are defined only for BASE-T, ready for new PHY insertion

Clause 45 Management in bz

- Defines selection of new speeds
 - PMA/PMD
 - PCS (not shown)
- 2.5G/5G extended abilities register for PMA/PMD selection

Table 45-4—PMA/PMD control 1 register bit definitions

Bit	Name	Description	R/W
1.0.5:2	Speed selection	5 4 3 2 1 x x x = Reserved x 1 x x = Reserved 0 1 1 1 = 5Gb/s 0 1 1 0 = 2.5Gb/s 0 1 0 1 = 400Gb/s 0 1 0 0 = 25Gb/s 0 0 1 1 = 100Gb/s 0 0 1 0 = 40Gb/s 0 0 0 1 = 10PASS-TS/2BASE-TL 0 0 0 0 = 10Gb/s	R/W

45.2.1.4 PMA/PMD speed ability (Register 1.4)

Change Reserved row and

Insert rows below it in Table 45-6 to include speeds of 2.5Gb/s and 5Gb/s as shown (unchanged rows not shown):.

Table 45-6—PMA/PMD speed ability register bit definitions

Bit(s)	Name	Description	R/W ^a
1.4.15:13	Reserved for future speeds	Value always 0	RO
1.4.14	5G capable	1 = PMA/PMD is capable of operating at 5 Gb/s 0 = PMA/PMD is not capable of operating as 5 Gb/s	RO
1.4.13	2.5G capable	1 = PMA/PMD is capable of operating at 2.5 Gb/s 0 = PMA/PMD is not capable of operating as 2.5 Gb/s	RO

^aRO = Read only

Table 45-14—PMA/PMD Extended Ability register bit definitions

Bit(s)	Name	Description	R/W ^a
1.11.14	Reserved2.5/5G extended abilities	Value always 01 = PMA/PMD has 2.5/5G extended abilities listed in register 1.21 0 = PMA/PMD does not have 2.5/5G extended abilities	RO

^aRO = Read only

The MII

- 802.3bz amends Clause 46 to extend XGMII to include 2.5Gbps and 5Gbps operation
 - Several point edits, see examples

46.1.3 Rate of operation

Change Clause 46.1.3 as shown:

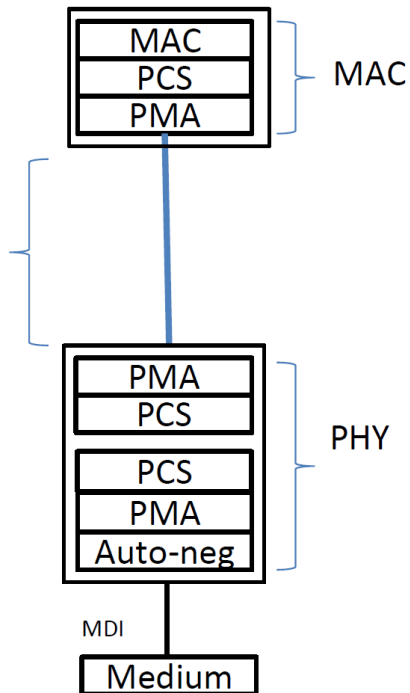
The XGMII supports ~~only the 10 Gb/s~~ MAC data rates of 10 Gb/s, 5 Gb/s, and 2.5 Gb/s as defined within this clause. A compliant device may implement any subset of these rates. Operation at 10 Mb/s and 100 Mb/s is supported by the MII defined in [Clause 22](#) and operation at 1000 Mb/s by the GMII defined in [Clause 35](#).

The TX_CLK frequency shall be ~~156.25 MHz ±0.01%~~, one-sixty-fourth of the MAC transmit data rate ±0.01%.

An Electrical Interface Extender?

- See http://www.ieee802.org/3/bz/public/may15/bains_3bz_01b_0515.pdf
- Current PHY/MAC extension interfaces are defined outside of IEEE 802.3
 - Allows multiport interfaces (IEEE 802.3 generally works on a per-port basis)
 - Allows technology evolution and vendor differentiation (MSAs handle this well)

MAC/PHY Interface – IEEE 802.3 and Technology Evolution



IEEE Specifications

- MII for 10 Mbps (clause 22) and 100 Mbps (Clause 35)
 - 4-bit TXD, TX_ER, TX_EN, TX_CLK
 - 4-bit RXD, RX_ER, COL, RX_CLK
- GMII for 1 Gbps
 - 8-bit TXD, TX_ER, TX_EN, TX_CLK
 - 8-bit RXD, RX_ER, COL, RX_CLK

Technology Status

- Parallel Physical interface defined by IEEE – SERDES Tech not available

1G SERDES Available

Third party Solution

- Single port of 10M/100M/1G over Single Tx/Rx SERDES (1.25Gbps)
- Four ports of 10M/100M/1G over Single Tx/Rx SERDES (5Gbps)

End Result – Specific to BASE-T PHYs?

Summary

- No consistency for IEEE defined MAC/PHY interface - IEEE can only define interface using available technology at time of standardization
- IEEE MAC/PHY specification is limited to one physical port per SERDES
- Third parties MAC/PHY interface will evolve as
 - Higher SERDES is available at lower cost/power
 - More than 1 port over single SERDES – For example with 64b/66b PCS
 - 8x 1G over 10.3125 Gbps
 - 4 x 2.5G over 10.3125G
 - 2 x 5G over 10.3125G
 - 2 x 10G over 20.6250 etc.

=> MAC/PHY Interface at IEEE should remain as a logical interface!

Thank You!