Unified LAN/WAN PHY Proposal

IEEE P802.3
Higher Speed Study Group

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Dallas, TX

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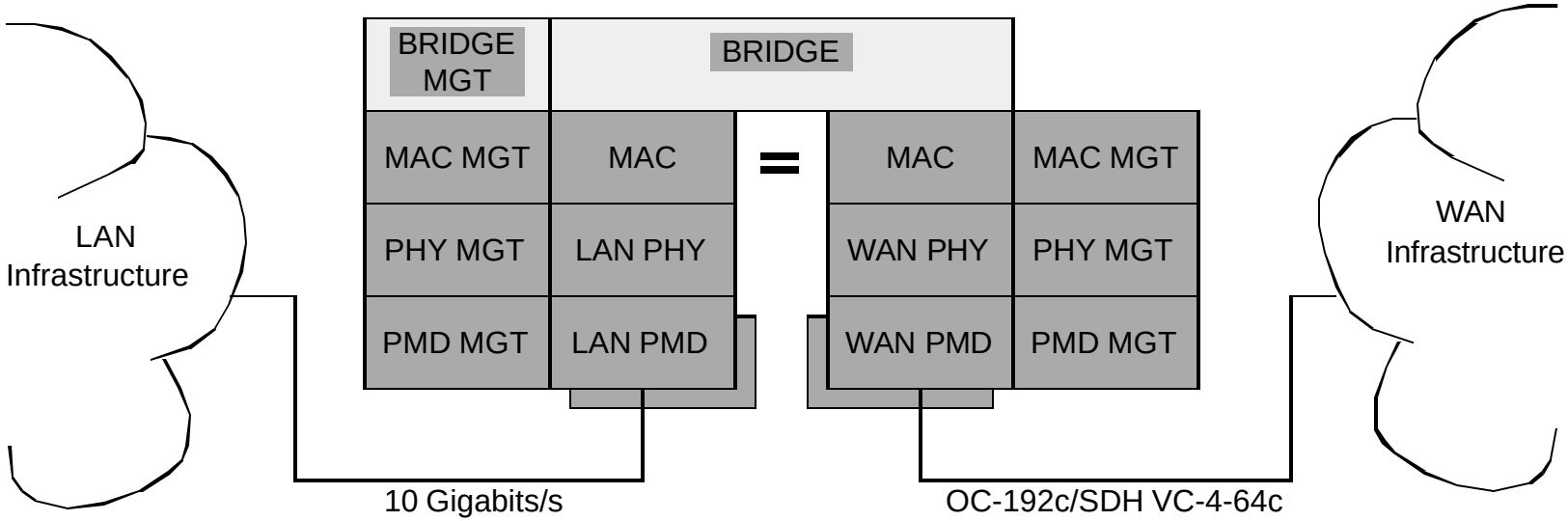
Bridging the LAN and WAN

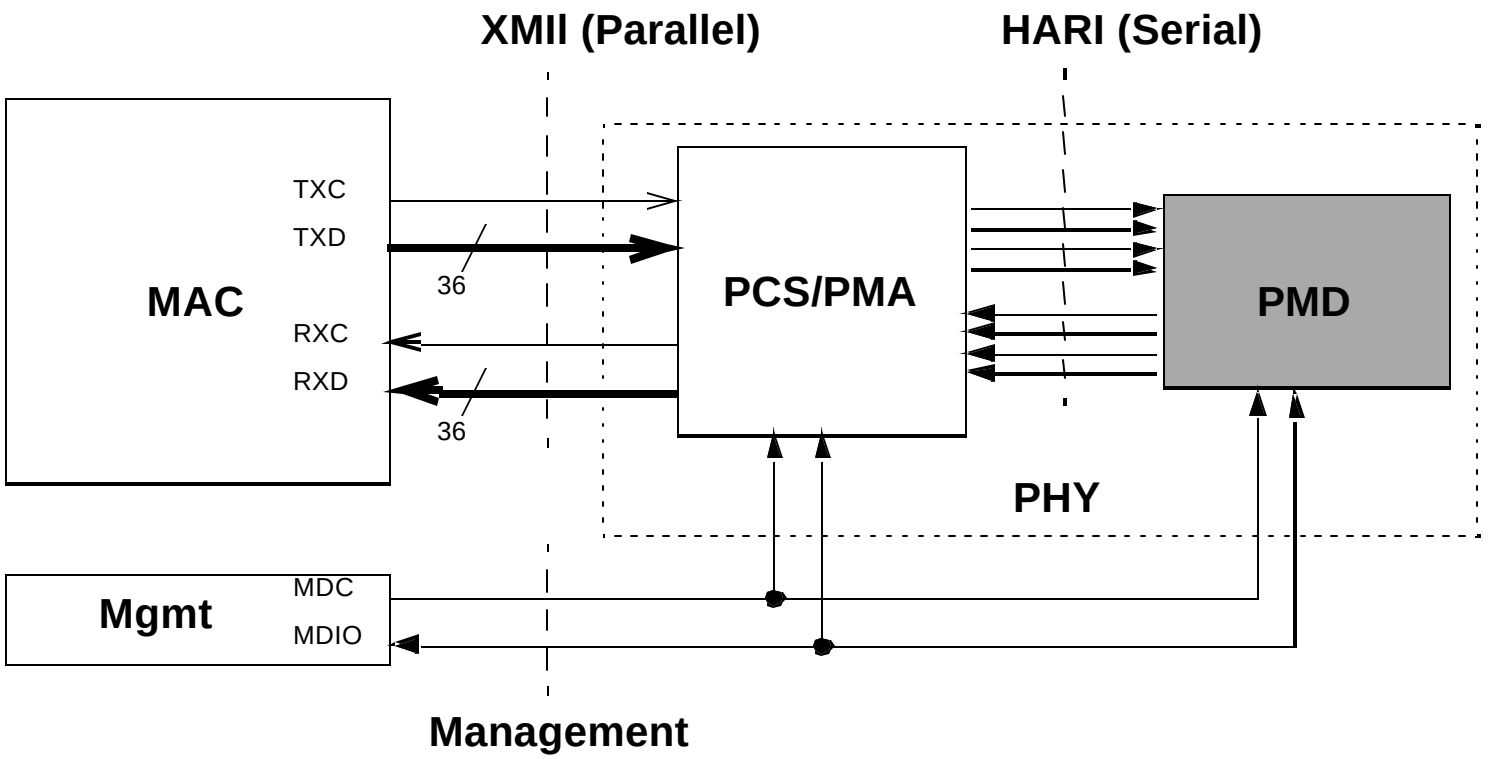


Two Physical Layers for 10 Gigabit Ethernet - H. Frazier- September, 1999
http://grouper.ieee.org/groups/802/3/10G_study/public/sept99/frazier_1_0999.pdf

Objections to “Two PHY” proposal

- Unnecessary differentiation between PMDs for LAN and WAN
  - Requires two different sets of optics
  - Will limit economies of scale

Interfaces



10Gig MII Update - H. Frazier- November, 1999
http://grouper.ieee.org/groups/802/3/10G_study/public/nov99/frazier_1_1199.pdf

Objections to “Interfaces” proposal

- Unfair cost burden for WAN PHY
- No provision for rate adaptation for WAN PHY

Why do a WAN PHY?

- Carry native Ethernet packets over the WAN infrastructure, which has:
  - An installed base with a specific architecture and specific signaling requirements
  - Operations, Administration, Management, and Provisioning (OAM&P) facilities

Why do a LAN PHY?

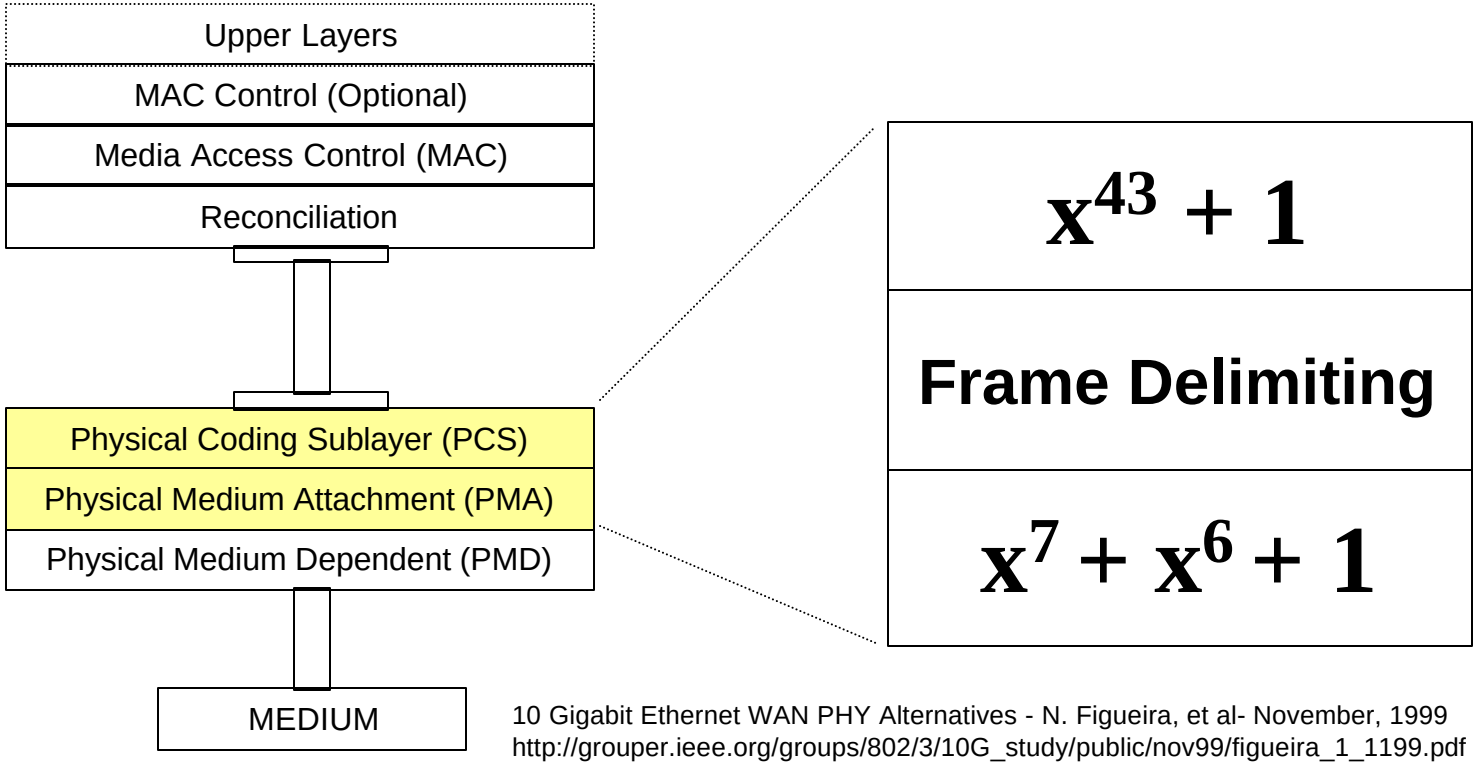
- Upgrade existing enterprise networks with:
  - Minimal cost
  - Minimal complexity
  - Maximum compatibility with 10/100/1000 Mb/s

Goals For This Presentation

- Propose a PHY architecture suitable for serial transmission on both LAN and WAN
  - Operating in a LAN at a data rate of 10.0000 Gb/s
  - Operating in a WAN at a data rate which is compatible with the payload rate of OC-192c/SDH VC-4-64c
- Propose a mechanism to adapt the MAC/PLS data rate to the WAN PHY data rate

WAN PHY (EOS)

10 Gigabit Ethernet Reference Model



10 Gigabit Ethernet WAN PHY Alternatives - N. Figueira, et al- November, 1999
http://grouper.ieee.org/groups/802/3/10G_study/public/nov99/figueira_1_1199.pdf

WAN PHY (EOS)

- Use a 2 polynomial scrambler system
  $x^7 + x^6 + 1$ over all data
  $x^{43} + 1$ from MAC DA through MAC CRC

- Perform frame delimiting using
  <length> <type><hcs> pointer chains

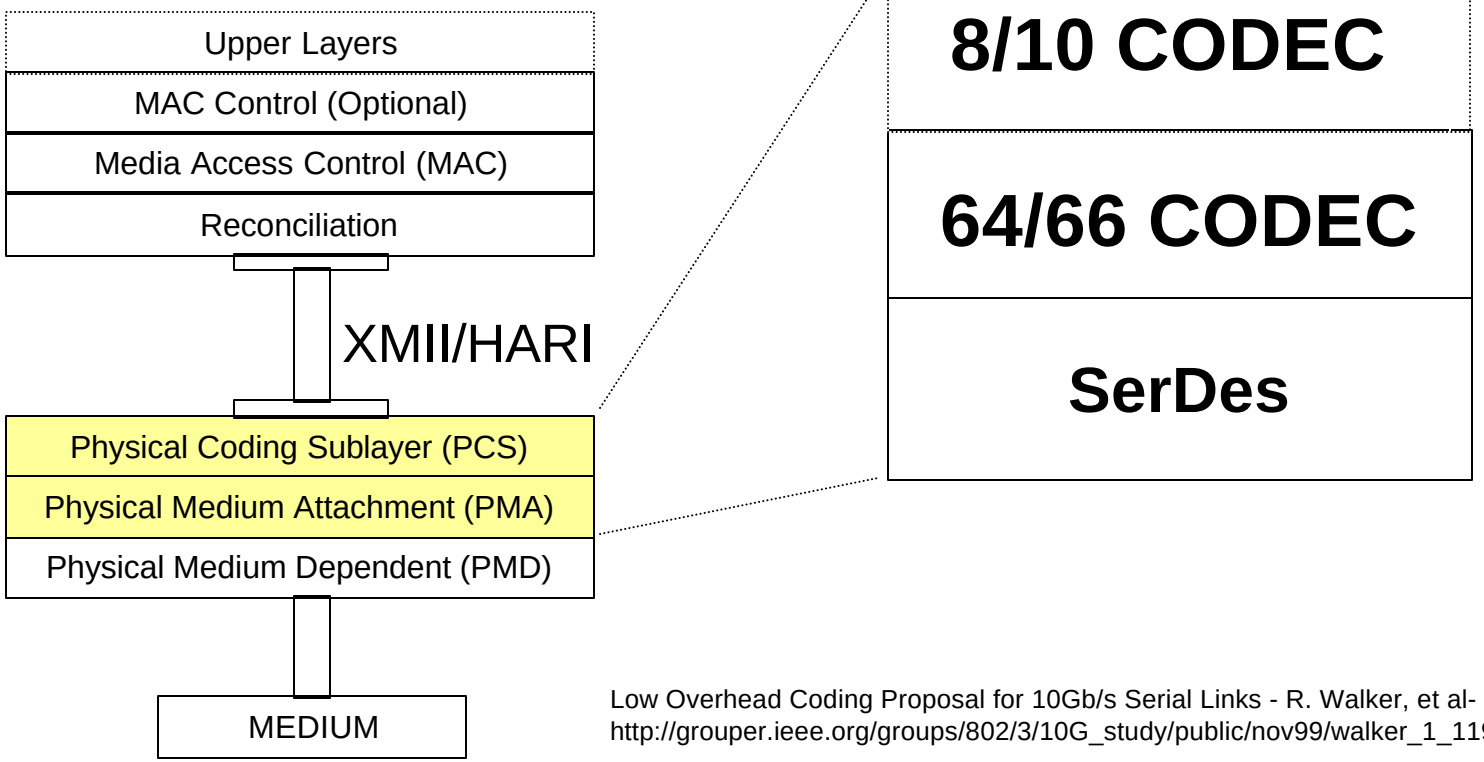
- $x^7 + x^6 + 1$ is periodically resynchronized
- $x^{43} + 1$ self synchronizing

Issues with EOS

- Must know the length of the frame before transmission
- MAC must pass length to PHY
- PHY must overwrite the Ethernet preamble with the <length><type><hcs> pointer chain

10 Gb/s Serial LAN PHY Proposal

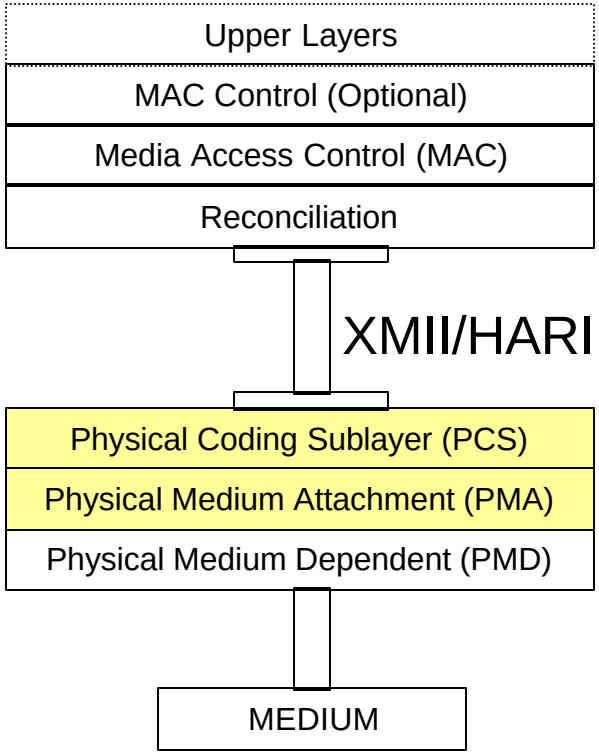
10 Gigabit Ethernet Reference Model

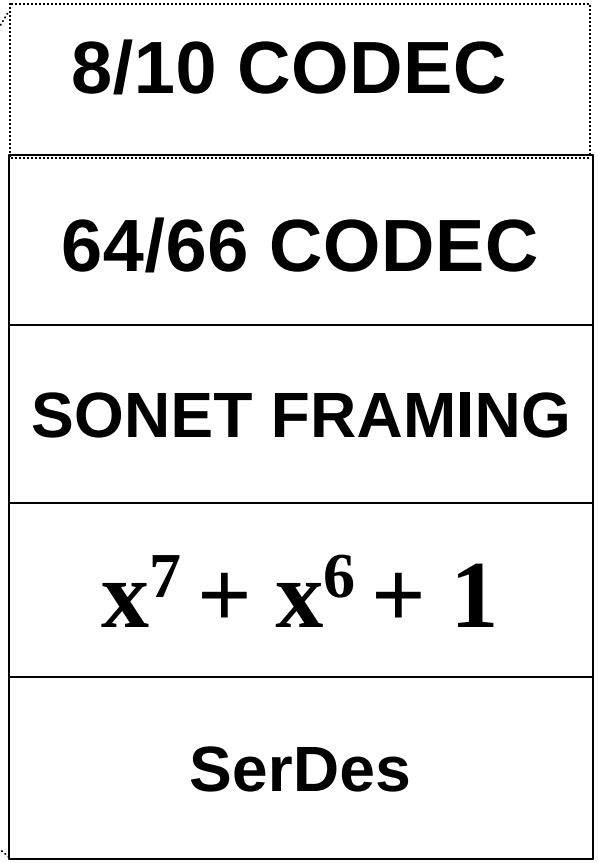


Low Overhead Coding Proposal for 10Gb/s Serial Links - R. Walker, et al- November, 1999
http://grouper.ieee.org/groups/802/3/10G_study/public/nov99/walker_1_1199.pdf

Alternate WAN PHY Proposal

10 Gigabit Ethernet Reference Model





Alternate WAN PHY Proposal

- Use a 2 polynomial scrambler system
  - **$x^7 + x^6 + 1$** over all data
  - **$x^{58} + x^{19} + 1$** over Preamble thru CRC
  - $x^7 + x^6 + 1$ is periodically resynchronized
  - $x^{58} + x^{19} + 1$ is self synchronizing
- 64/66 coding provides robust frame delimiters
  - no need to know the length of the frame
  - no need to overwrite preamble

64/66 Coding

- Break bit stream up into 64 bit frames
- Scramble each frame using $x^{58} + x^{19} + 1$
- Prepend each frame with a 2 bit preamble

Data frame

Control frame

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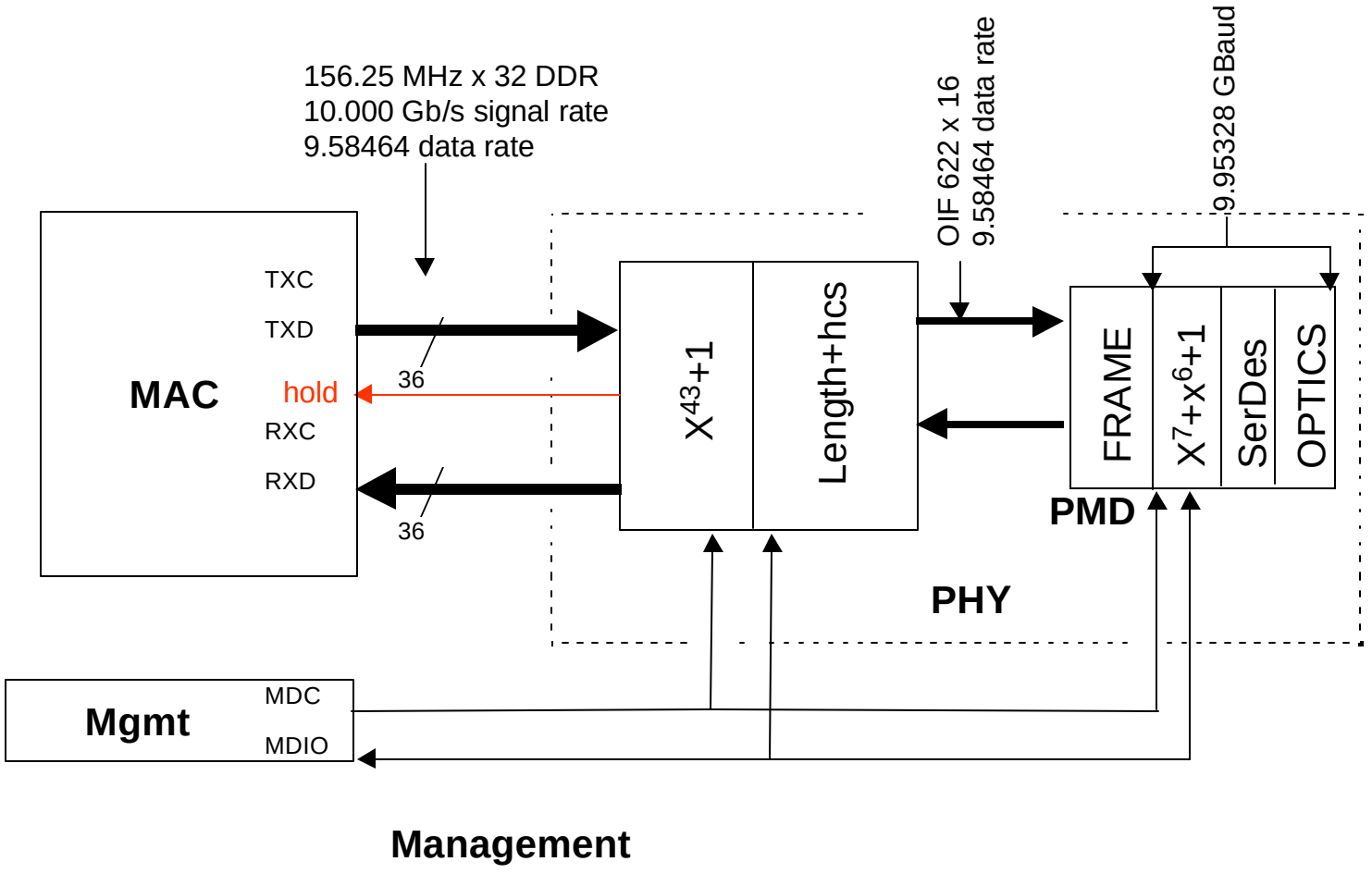
Data and Signal Rate Comparison

	LAN PHY (8B10B)	WAN PHY (EOS)	LAN PHY (64/66)	WAN PHY (64/66)
MAC Data Rate	10.0000 Gb/s	9.58464 Gb/s	10.0000 Gb/s	9.29419 Gb/s
XMII signal rate	156.25MHz x 32 DDR	156.25MHz x 32 DDR	156.25MHz x 32 DDR	156.25MHz x 32 DDR
XMII Data rate	10.0000 Gb/s	9.58464 Gb/s	10.0000 Gb/s	9.29419 Gb/s
Encoded Data Rate	12.5 GBaud	9.95328 GBaud	10.3125 GBaud	9.58464 GBaud
Serial Signal rate	12.5 GBaud	9.95328 GBaud	10.3125 GBaud	9.95328 GBaud

Word by Word Rate Control (EOS)

- Add a signal from PHY to MAC which tells MAC to “Hold” transmission for 1 clock cycle
  - Insert “nulls” into transmitted data stream
  - Insert “nulls” into received data stream

Word by Word Rate Control



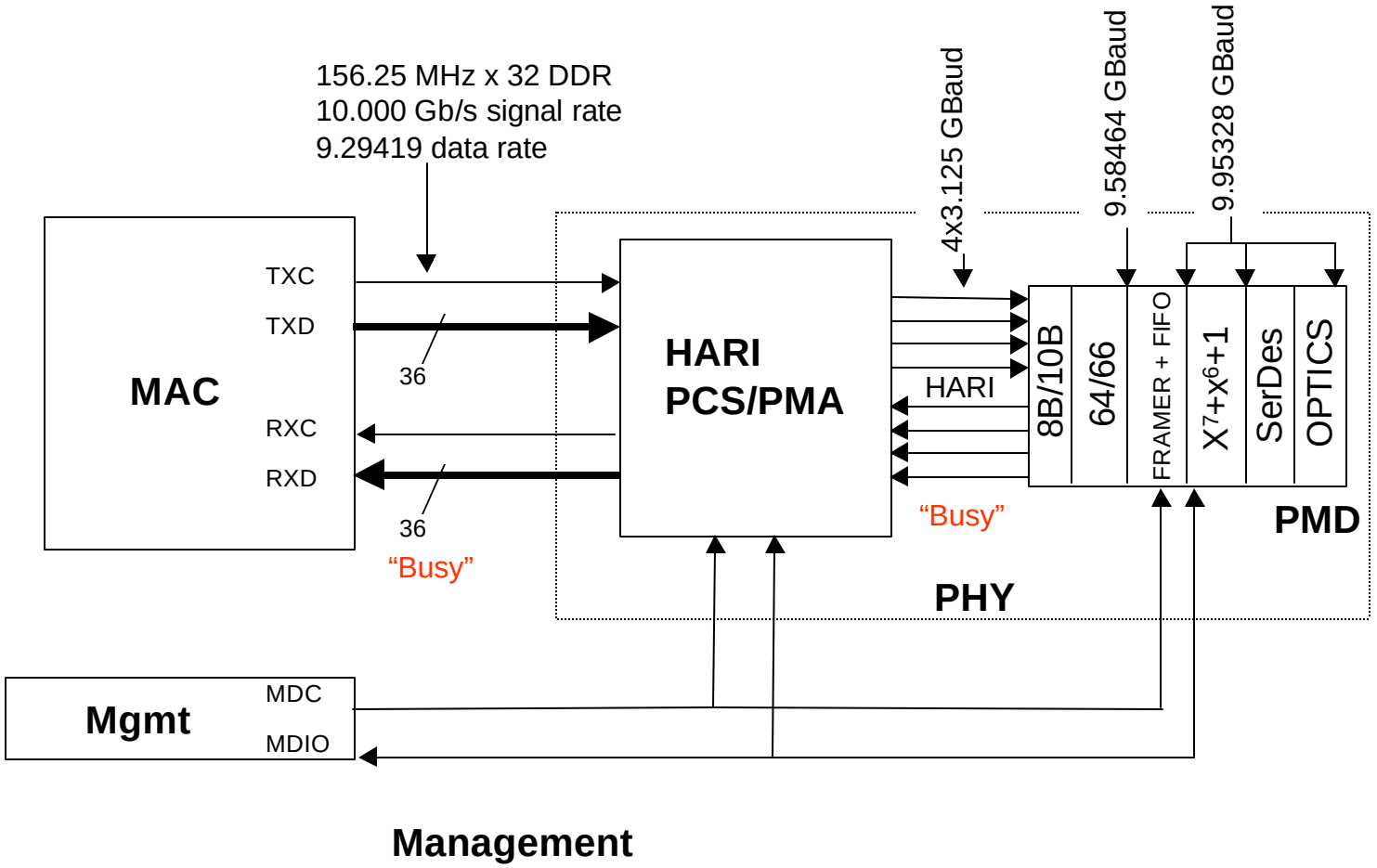
Issues with W-b-W Rate Control

- Interrupts flow of data through pipeline stages
- Makes buffer pre-fetching difficult
- Tricky timing
- Doesn’t work with HARI

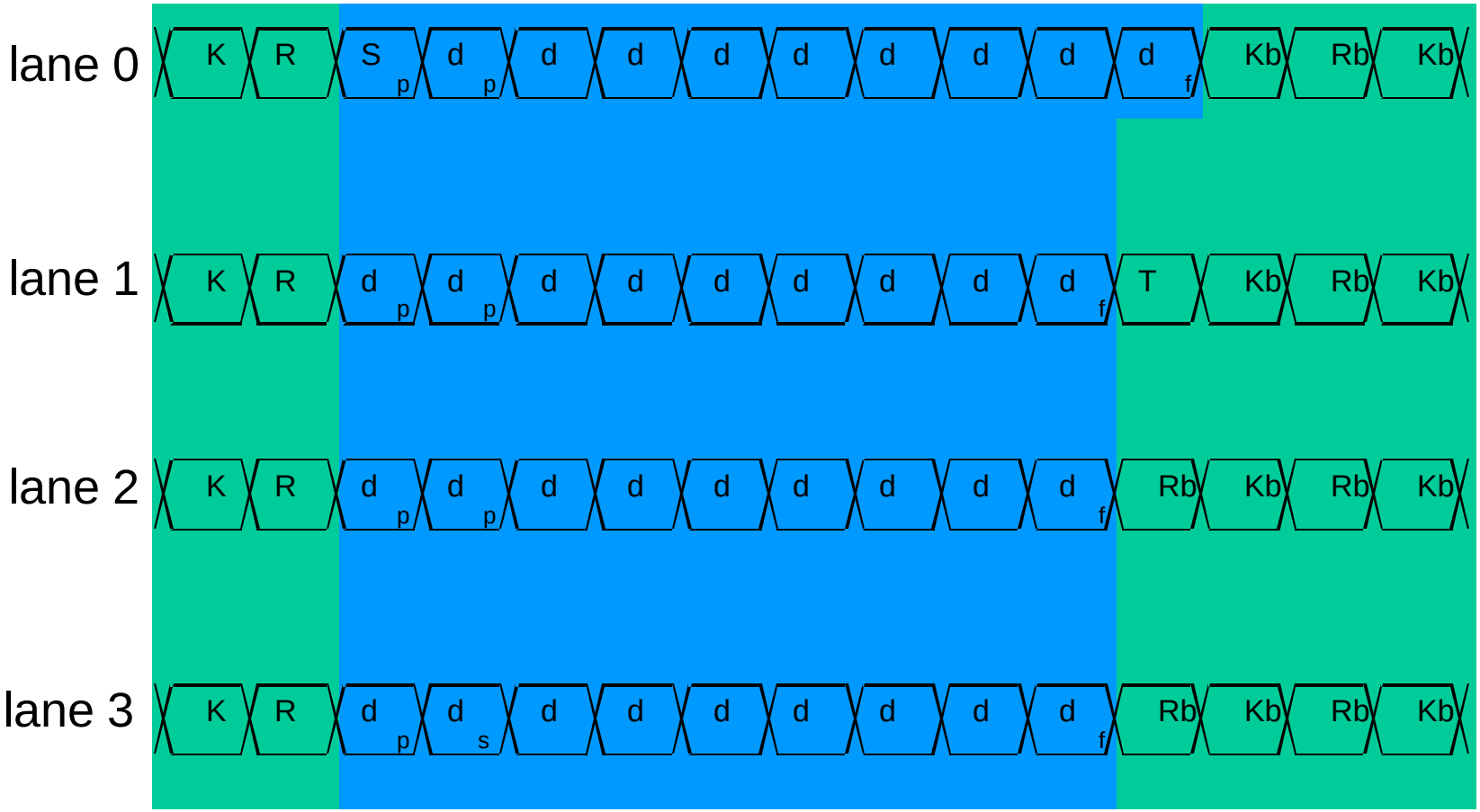
Busy Idle Rate Control

- PHY sends “Busy Idle” to MAC during IPG
  - MAC pauses transmission at frame boundary
- PHY sends “normal Idle” to MAC during IPG
  - MAC resumes transmission
- This works with HARI and XMII
  - Busy Idle encoded as Kb/Rb on HARI (K28.1/K23.7)
- Need a ~256 byte FIFO in WAN PHY TX path

Busy Idle Rate Control



HARI Busy Idle Example



Benefits

- Common interface (HARI) can be used for both LAN PHY and WAN PHY
- Common functions can shared between LAN PHY and WAN PHY
- Common optics can be shared between LAN PHY and WAN PHY

Benefits

- LAN PHY advocates get what they want:
  - Minimal cost
  - Minimal complexity
  - Maximum compatibility
- WAN PHY advocates get what they want:
  - Compatibility with photonic infrastructure
  - OAM&P