

MPCP Timing and 64b/66b Line Coding

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MPCP and Laser Control

- MPCP is located in MAC Control Sublayer
- MPCP is not aware whether 8b/10b or 64b/66b encoding is used. MPCP is based on time (time unit = 16 ns).
- Laser on/off is controlled by Data Detector function in PCS (IEEE802.3-2005, section 65.2.2 Burst-mode operation).
- **Data Detector should be able to turn laser on/off on 66-bit block boundary.**

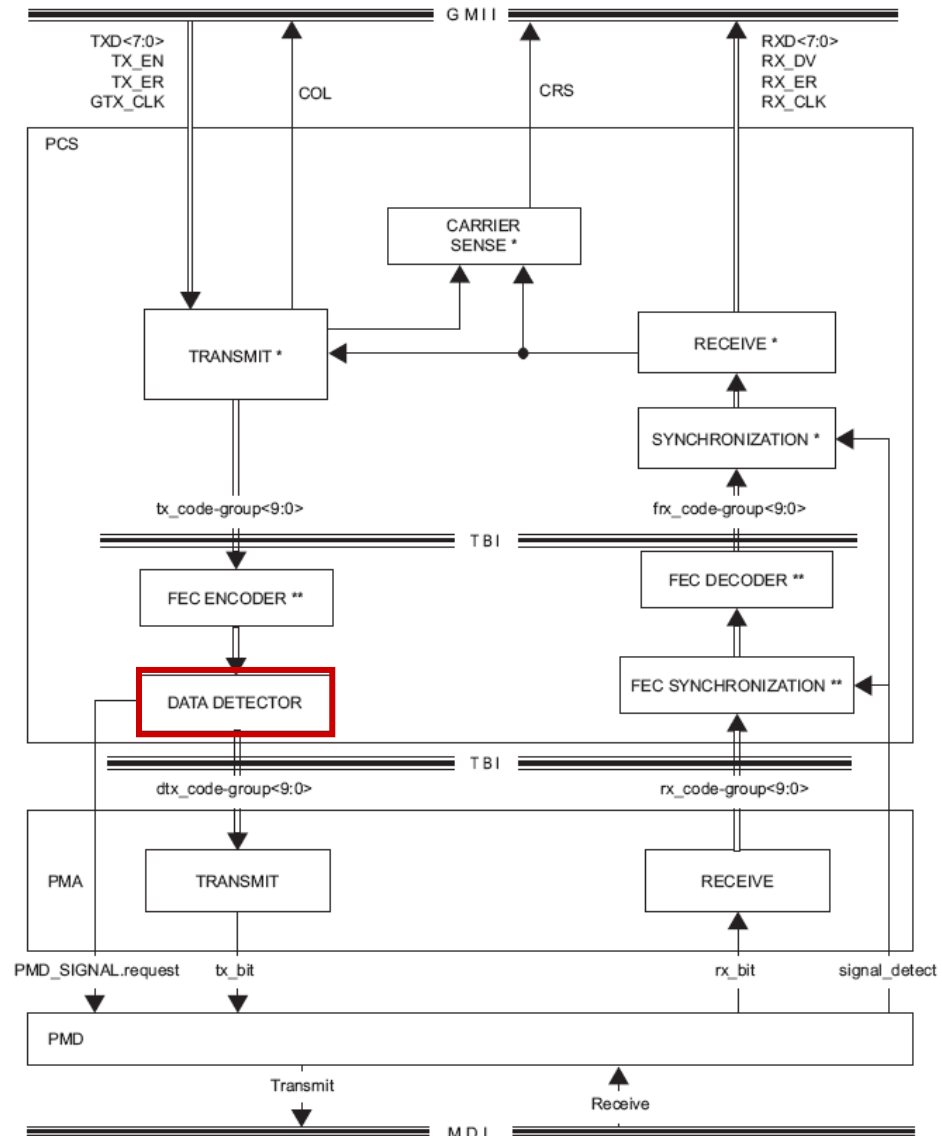
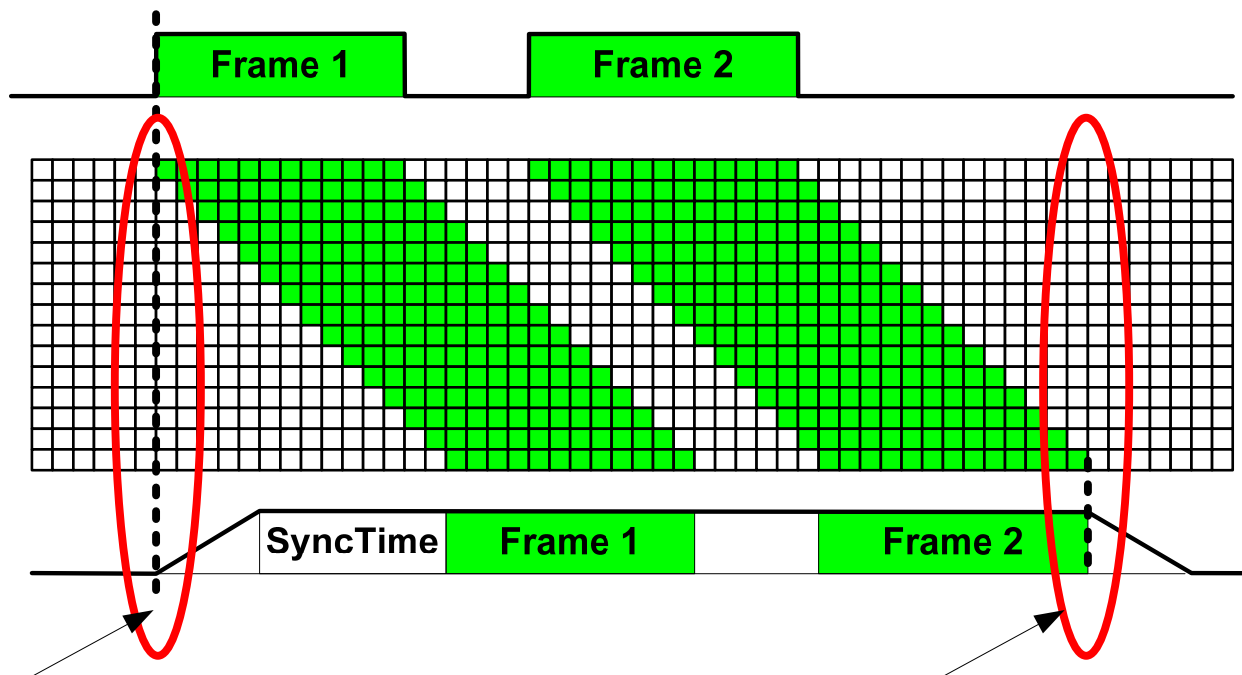


Figure 65-4—PCS Extension functional block diagram

Data Detector

- Data detector is simply a delay line (FIFO buffer)
- Data detector monitors the state of the FIFO buffer.
 - If the FIFO has any non-idle code-groups, the laser stays on.
 - IF the FIFO has only idles, the laser turns off.
- FIFO delay should be sufficient to turn laser on and synchronize ($delay \geq T_{ON} + syncTime$)

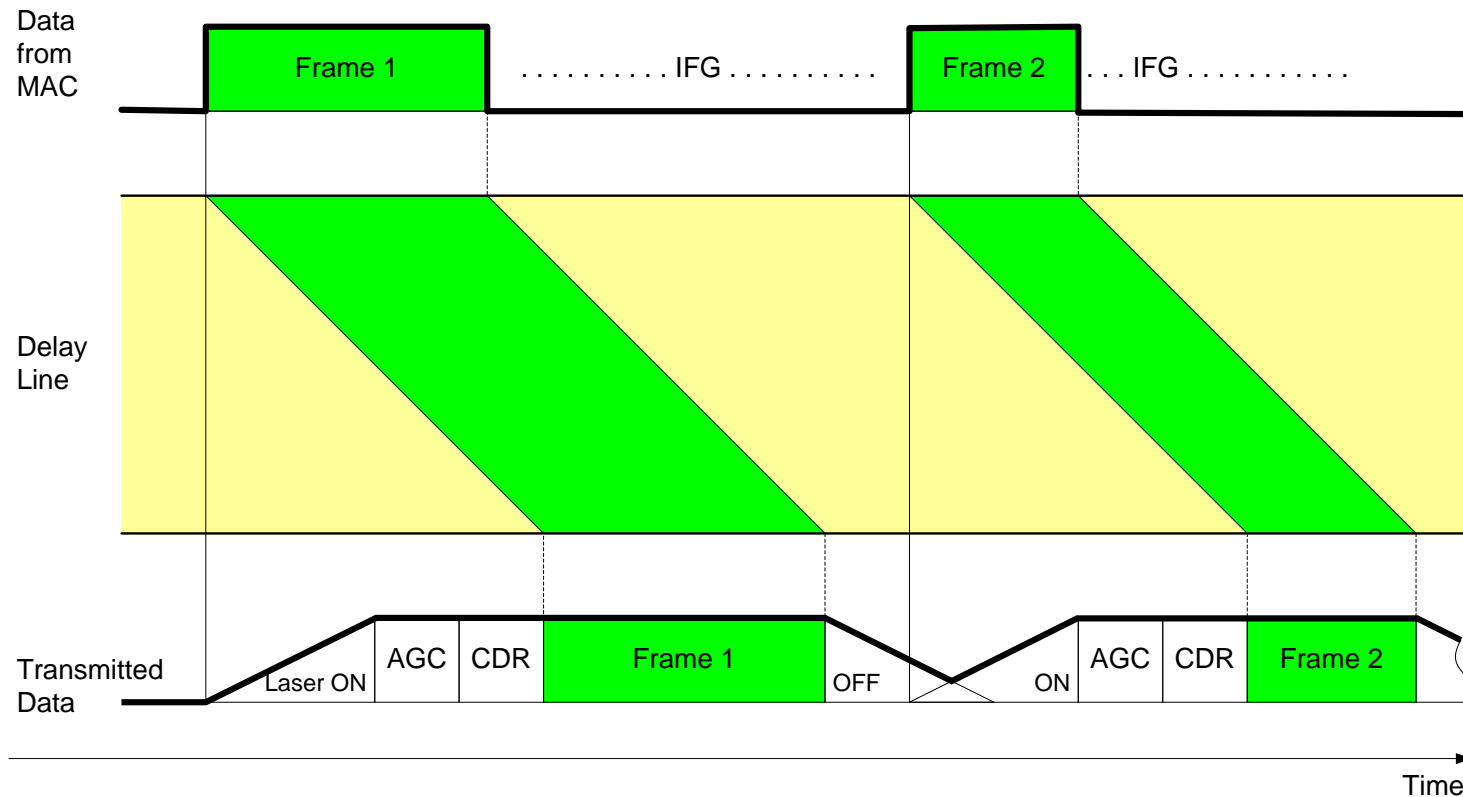


when the first non-idle character enters in the queue, **start turning laser on.**

when the last non-idle character leaves the queue, **start turning laser off.**

Data Detector Behavior

- If there is a long run of IDLEs in the middle of the burst, the laser will shut down.
- Laser will only shut down if it has enough time to turn on and synchronize before the next frame (if any)



Laser Control with 8b/10b Line Coding (802.3ah)

IsIdle(tx_code-group) is used to determine whether *tx_code-group* represents an IDLE or Configuration (/I/ or /C/). This function returns true if *tx_code-group* is /K28.5/ or any code-group that follows a /K28.5/ or any two consecutive /D/ code-groups that follow /K28.5/D21.5/ or /K28.5/D2.2/. Otherwise, the *IsIdle* function returns false.

DelayBound represents the delay sufficient to initiate the laser and to stabilize the receiver at the OLT. The default value of *DelayBound* is based on default values of *laserOnTime* and *SyncTime*

IdleLength represents the length of the consecutive interval of idles ending with the most recent *tx_code-group*. If the most recent *tx_code-group* is a non-idle character, the *IdleLength* is reset to 0.

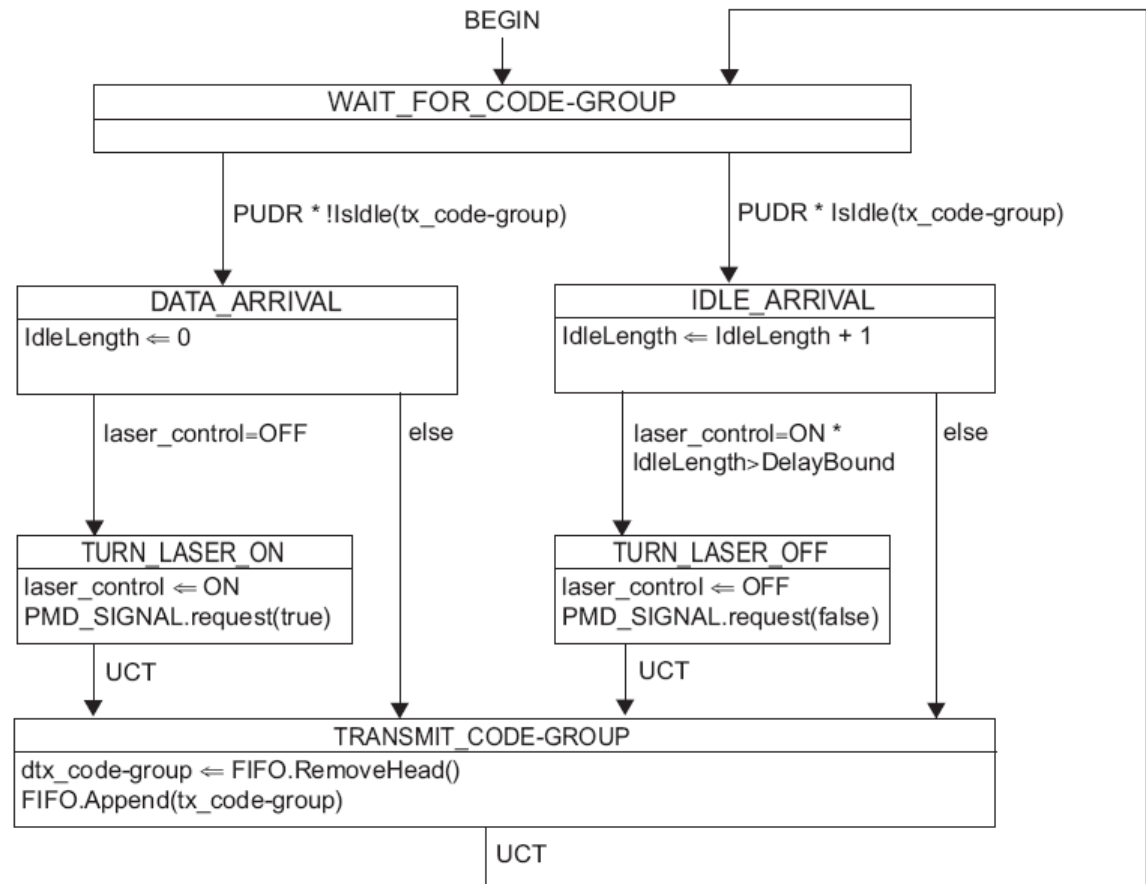


Figure 65-6—ONU data decoder state diagram

Laser Control with 64b/66b Line Coding

- 66-bit blocks should be transmitted without segmentation
- The 10Gb/s Data Detector instead of looking at 10-bit code-groups can look at 66-bit blocks (see state machine).
- This would force laser_on and laser_off signals to be asserted only on 66-bit block boundaries.

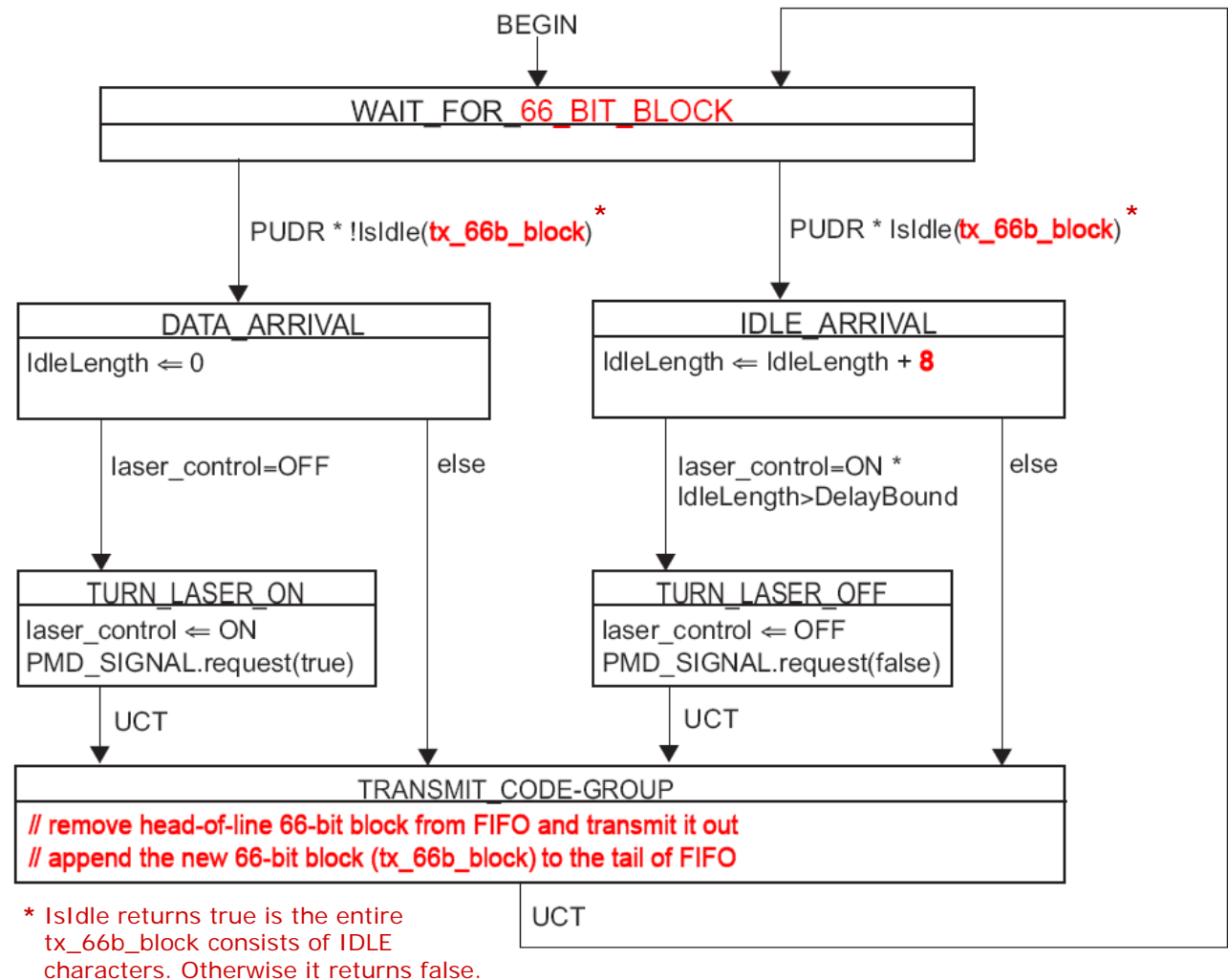


Figure 65-6—ONU data decoder state diagram (for 64b/66b)

Modified `IsIdle()` Function

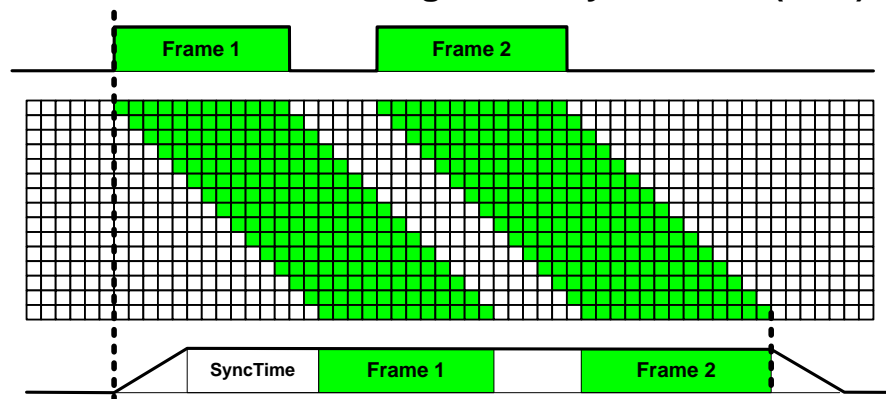
- `IsIdle()` function operates over an entire 66-bit block
 - Returns **True** is entire 66-bit block contains only IDLEs
 - Otherwise, return **False**

Input Data (first RS transfer / second RS transfer)	Sync		Bit fields										<u>IsIdle()</u>								
	[0]	[1]	[2]	D ₀		D ₁		D ₂		D ₃		D ₄		D ₅		D ₆		D ₇		[65]	
D ₀ D ₁ D ₂ D ₃ /D ₄ D ₅ D ₆ D ₇	0	1		D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	D ₆	D ₇										FALSE
Z ₀ Z ₁ Z ₂ Z ₃ /Z ₄ Z ₅ Z ₆ Z ₇	1	0	0x1e "01111000"	C ₀	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇										TRUE
Z ₀ Z ₁ Z ₂ Z ₃ /S ₄ D ₅ D ₆ D ₇	1	0	0x33	C ₀	C ₁	C ₂	C ₃			D ₅	D ₆	D ₇									FALSE
S ₀ D ₁ D ₂ D ₃ /D ₄ D ₅ D ₆ D ₇	1	0	0x78		D ₁	D ₂	D ₃	D ₄		D ₅	D ₆	D ₇									FALSE
T ₀ Z ₁ Z ₂ Z ₃ /Z ₄ Z ₅ Z ₆ Z ₇	1	0	0x87			C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	C ₇									FALSE
D ₀ T ₁ Z ₂ Z ₃ /Z ₄ Z ₅ Z ₆ Z ₇	1	0	0x99	D ₀			C ₂	C ₃	C ₄	C ₅	C ₆	C ₇									FALSE
D ₀ D ₁ T ₂ Z ₃ /Z ₄ Z ₅ Z ₆ Z ₇	1	0	0xaa	D ₀	D ₁			C ₃	C ₄	C ₅	C ₆	C ₇									FALSE
D ₀ D ₁ D ₂ T ₃ /Z ₄ Z ₅ Z ₆ Z ₇	1	0	0xb4	D ₀	D ₁	D ₂			C ₄	C ₅	C ₆	C ₇									FALSE
D ₀ D ₁ D ₂ D ₃ /T ₄ Z ₅ Z ₆ Z ₇	1	0	0xcc	D ₀	D ₁	D ₂	D ₃			C ₅	C ₆	C ₇									FALSE
D ₀ D ₁ D ₂ D ₃ /D ₄ T ₅ Z ₆ Z ₇	1	0	0xd2	D ₀	D ₁	D ₂	D ₃	D ₄			C ₆	C ₇									FALSE
D ₀ D ₁ D ₂ D ₃ /D ₄ D ₅ T ₆ Z ₇	1	0	0xe1	D ₀	D ₁	D ₂	D ₃	D ₄	D ₅			C ₇									FALSE
D ₀ D ₁ D ₂ D ₃ /D ₄ D ₅ D ₆ T ₇	1	0	0xff	D ₀	D ₁	D ₂	D ₃	D ₄	D ₅	D ₆											FALSE

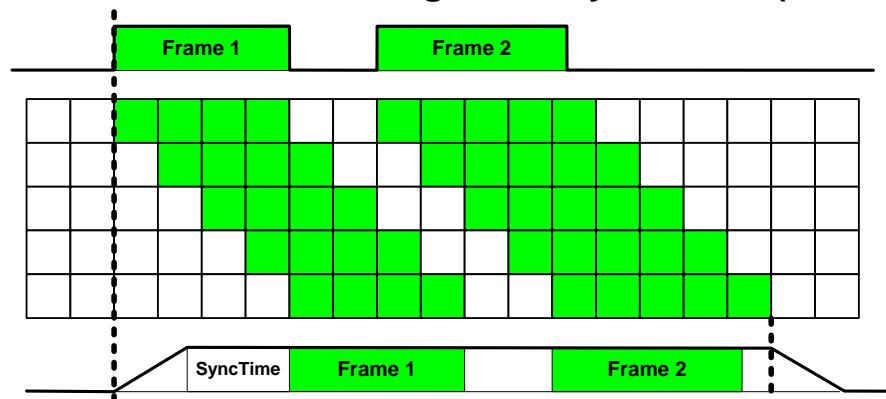
MPCP compatibility with 64b/66b Encoding

- The laser_on signal is moved **down** to the nearest 66-bit block boundary (turn on early by 0 or 4 bytes).
- The laser_off signal is moved **up** to the nearest 66-bit block boundary (turn off late by 0..7 bytes).
- This may increase the laser_on time by $\leq 4 + 7 = 11$ bytes per burst, or 0.55 TQ in the worst case.
- According to IEEE 802.3ah, MPCP clock has tolerance of 8 TQ or 12 TQ
 - guardThresholdONU = 8 TQ
 - guardThresholdOLT = 12 TQ
- Rounding up to 66-bit is within granting accuracy of existing MPCP and does not result in any additional overhead

1 Gb/s EPON: laser_on granularity = 10 bits (8 ns)

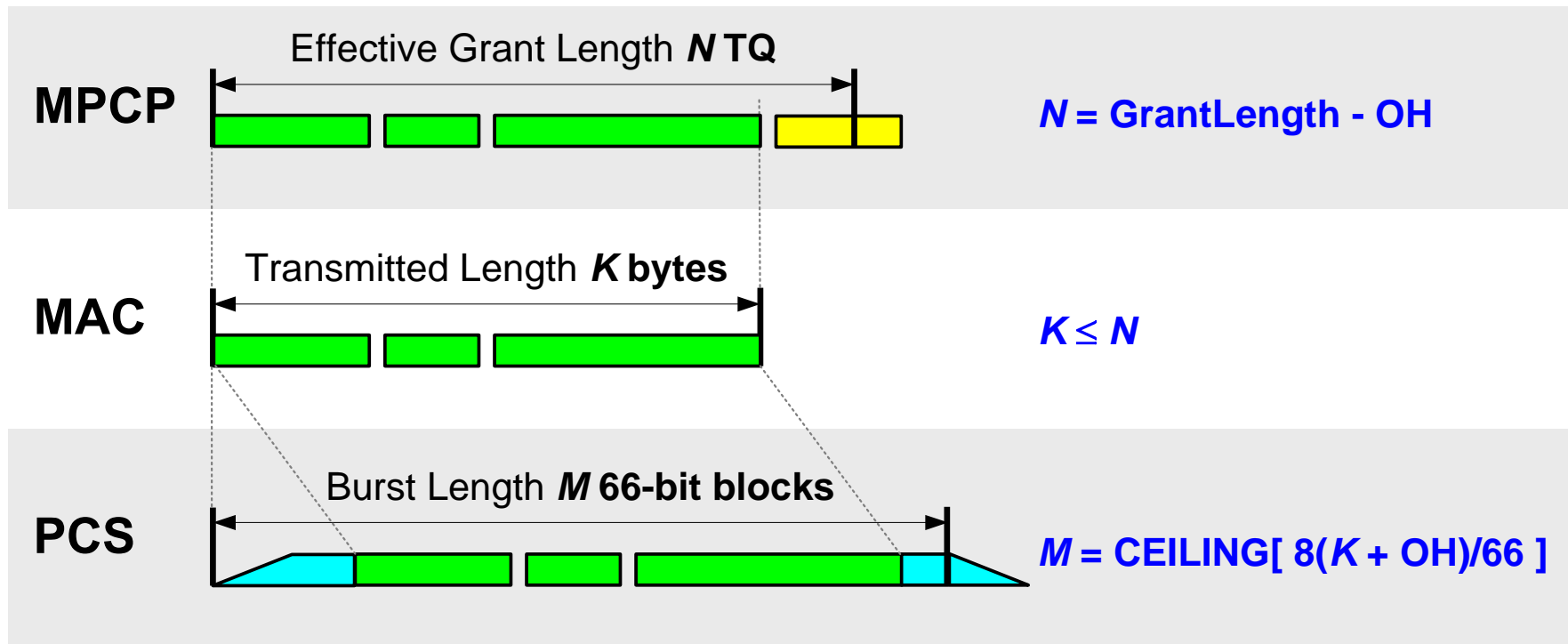


10 Gb/s EPON: laser_on granularity = 66 bits (6.4 ns)



PHY block size is independent of TQ

- Time Quanta is known only to MPCP
- MPCP decides how many bytes to send
- Based on number of bytes sent, the PCS decides how long to keep laser on (rounded to 66b boundary).



Conclusion

- Data detector is a function of PCS.
 - Data detector should operate on Xb/Yb encoder output blocks (10 bits for 8b/10b; 66 bits for 64b/66b).
 - Data detector always turns laser on and off on a block boundary.
- No changes to MPCP are required to use 64b/66b.
- (Note: this presentation made no conclusions about MPCP timing compatibility with various FEC framing schemes)