

# Link Signaling Sublayer (LSS) Proposal

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47 Individuals from 25 companies

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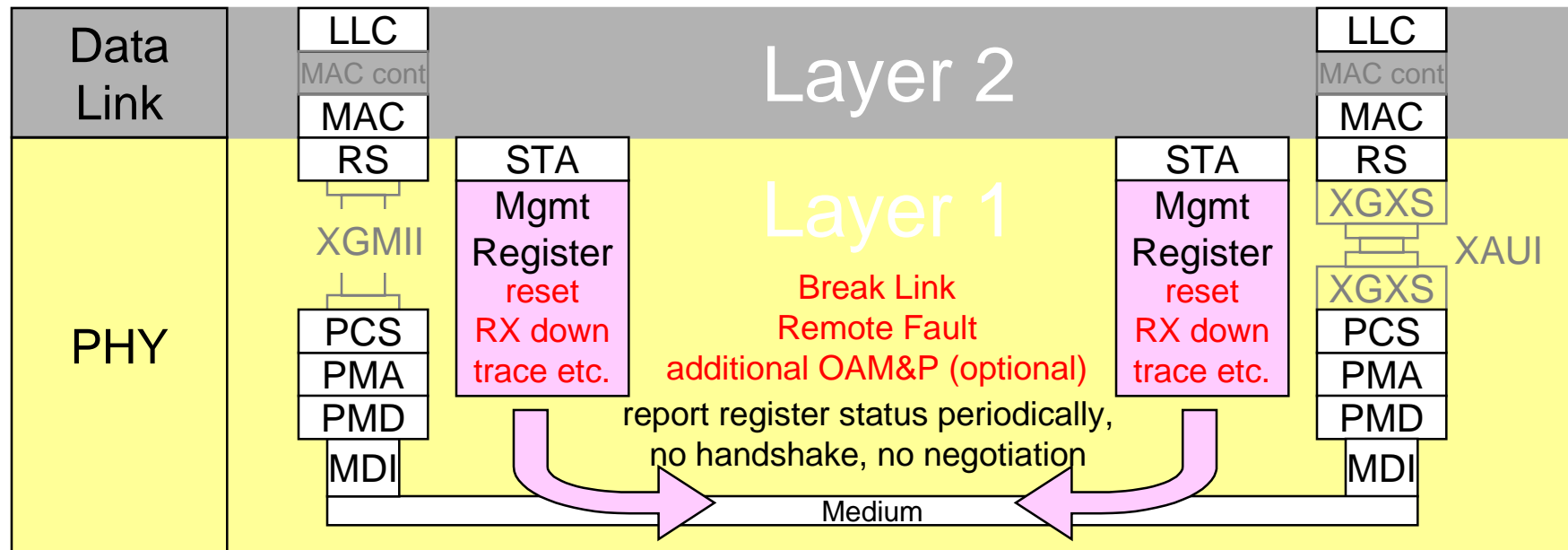
	IEEE 802.3ae	
New Orleans, LA	10 Gigabit Ethernet	LSS proposal (R1)
Sept 12-14, 2000		Slide 1

# Goals and Assumptions

- Provide simple Layer-1 signaling mechanism
  - Support Break Link and Remote Fault
- Support the other Layer-1 OAM&P (optional)
  - Minimal Operations, Administration, Management, and Provisioning (OAM&P) required for 40-km dark fiber application
- Support full duplex operation only
  - Allow PHY to be a simple server for MAC
- Avoid any auto-negotiation
  - Send Idle whenever the link is “down”
  - Specify no time-consuming start-up sequence

# What is Link Signaling?

- Report management register status periodically to its link partner
  - Reset (Break Link), RX down (Remote Fault), and trace etc. (other OAM&P)
- Serve STAtion management entity
  - Function regardless of MAC frames on XGMII



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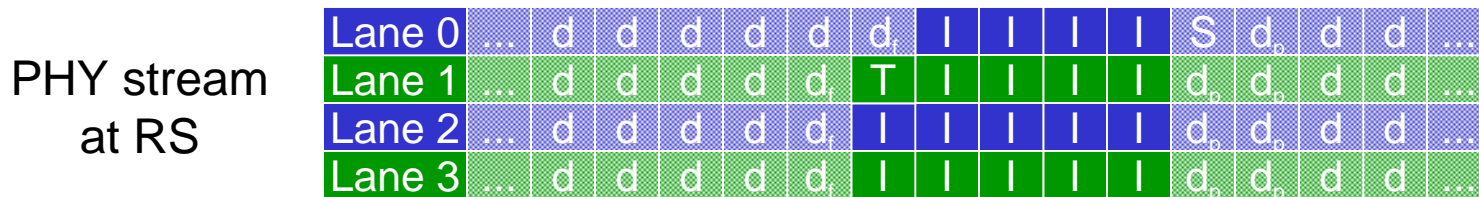
# Why do Link Signaling?

10 GbE		Differences	GbE (802.3z)	
<i>Full duplex only</i>	LAN extension up to 40 km	Objectives	LAN within 5 km	<i>Support CSMA/CD</i>
	Break Link Remote Fault + OAM&P*	Layer-1 signaling requirement	Break Link Remote Fault	<i>Mode Selection Carrier Extend</i>
<i>Simple client - server</i>		MAC - PHY model		<i>Complex integration</i>
Link Signaling <i>Use Idle stream</i> <i>Report status periodically</i> Support additional OAM&P*		Layer-1 signaling mechanism	Auto-Negotiation <i>Flapping initialization states</i> <i>Timer &amp; Handshake transition</i>	

\* OAM&P: Operations, Administration, Management, and Provisioning

# How does Link Signaling work?

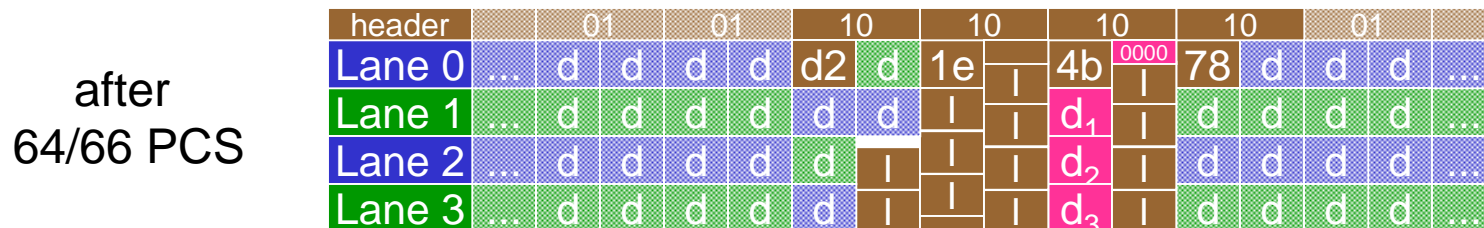
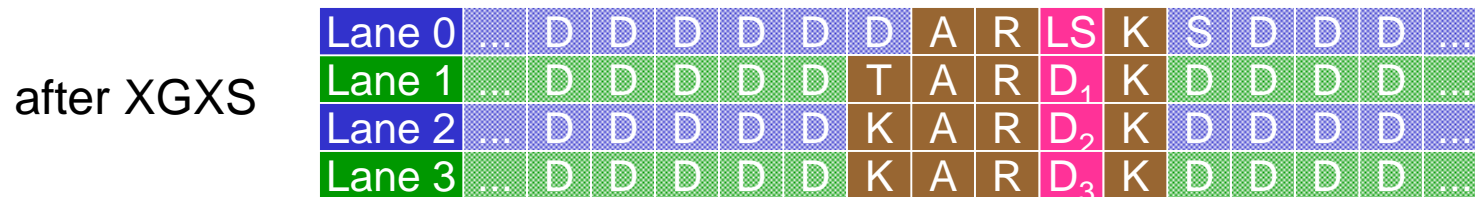
- Use Idle Column in PHY stream
  - regardless of MAC frames which rudely interrupt the Idle stream
- Replace Idle Column occasionally by Link Signaling Column [LS]
  - [LS] = / LS / d1 / d2 / d3 /      d1-d3: valid data bytes



- LSS is scalable to higher speeds
  - as long as Ethernet PHY performs clock adjustment by a unit of Idles

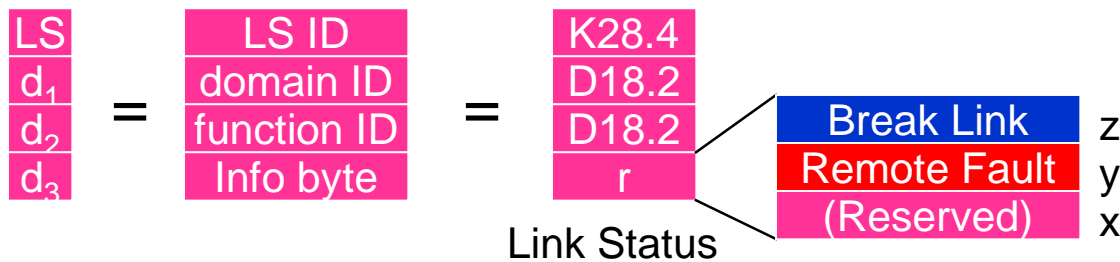
# Link Signaling Example

- Once an IPG leaves MAC, its period might be used in each PHY sublayer.
- At remote-end PHY, it is recovered to an IPG by removing all the PHY stuff.



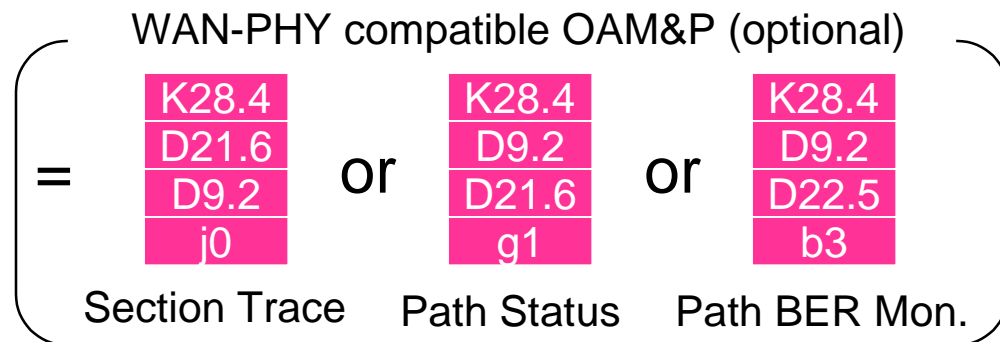
# Link Signaling Codes

- Use K28.4 (0x9c,1) for Link Signaling Identifier on Lane 0
  - Consistent with 64b/66b proposal (Page 19 of [walker\\_1\\_0700.pdf](#))
  - Any Link Status column does not change running disparity in 8b/10b



Hamming-protected code set  
(min. 4 bit for both 8b & 10b)

x y z	8b	10b	ID use	
0 0 0	0x52	D18.2	LAN-PHY	
0 0 1	0xd5	D21.6	Reserved	
0 1 0	0xce	D14.6		
0 1 1	0x49	D9.2		
1 0 0	0xb6	D22.5		
1 0 1	0x31	D17.1		
1 1 0	0x2a	D10.1		
1 1 1	0xad	D13.5		
* * *	0x67	D7.3		<i>IEEE voting Required</i>
* * *	0x98	D24.4		
* * *	0xfb	D27.7		

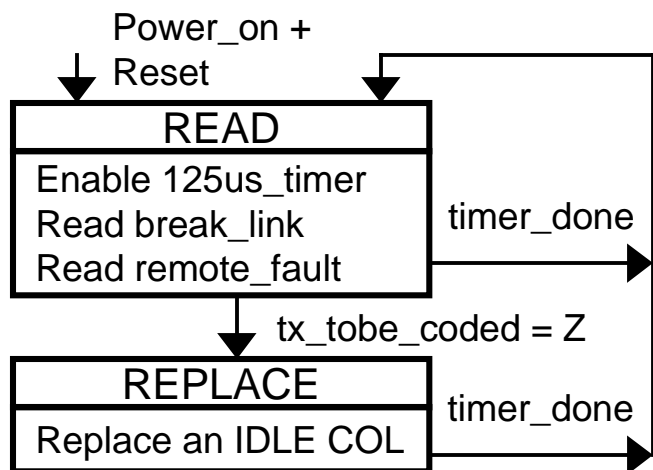


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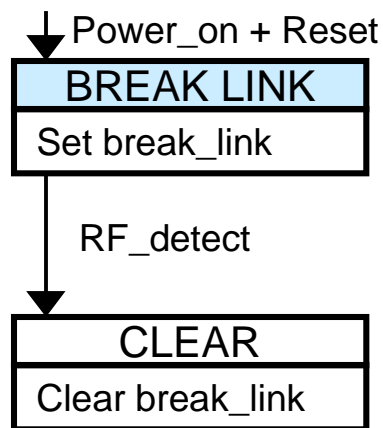
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# Link Status Transmit State Diagrams

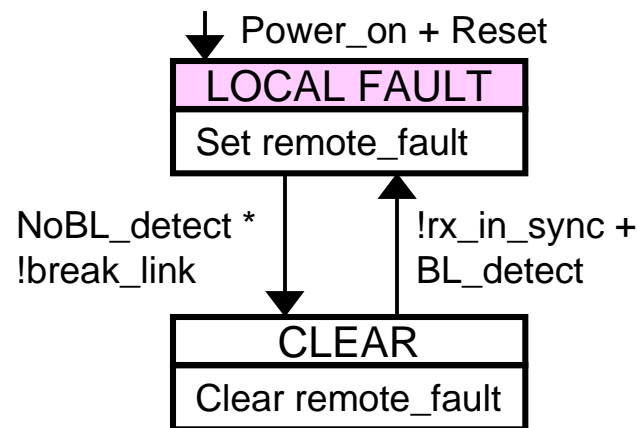
- Replace an Idle Column with the Link Status Code every 125 us
  - Convey break\_link and remote\_fault regardless of their True or False
- Set break\_link when the STAation management entity asserts Reset
  - Clear when the local receiver detects the RF signal
- Set remote\_fault whenever the local receiver is not ready to use
  - Include when the local receiver detects the BL signal



LS Code Transmit State Diagram



Break Link State Diagram



Local Fault State Diagram

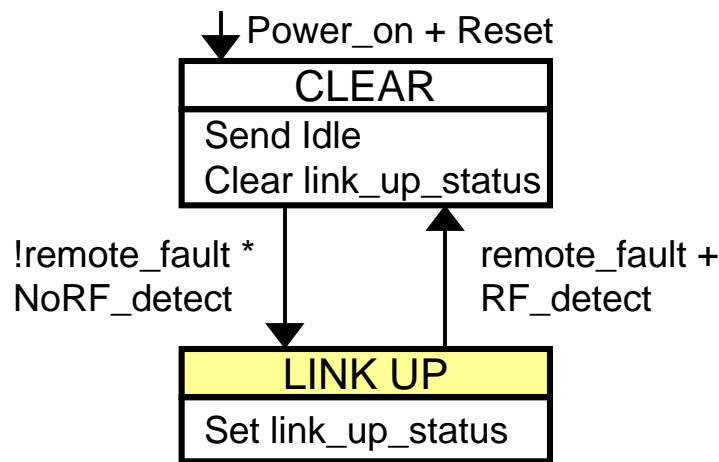
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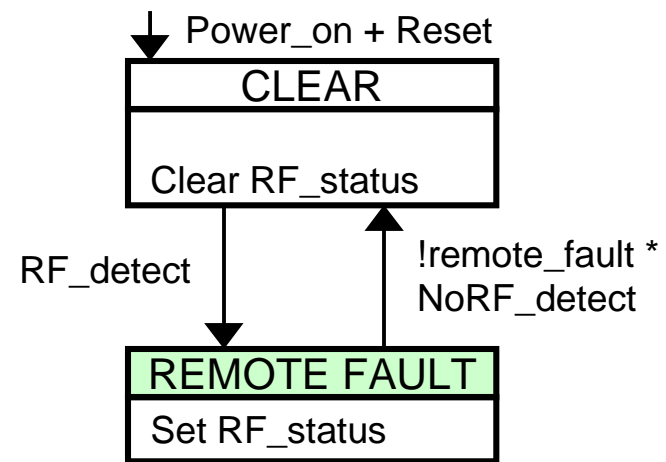


# Link State Diagrams

- Send Idle whenever link status is “down”
  - No need to “drop down” into time-consuming start-up sequence
  - Link can be “up” immediately when Local and Remote Faults disappear (similar to 100BASE-FX)
- Set the RF status bit when the local receiver detects the RF signal
  - Once set, the RF status bit is only cleared when link status is “up”



Link State Diagram

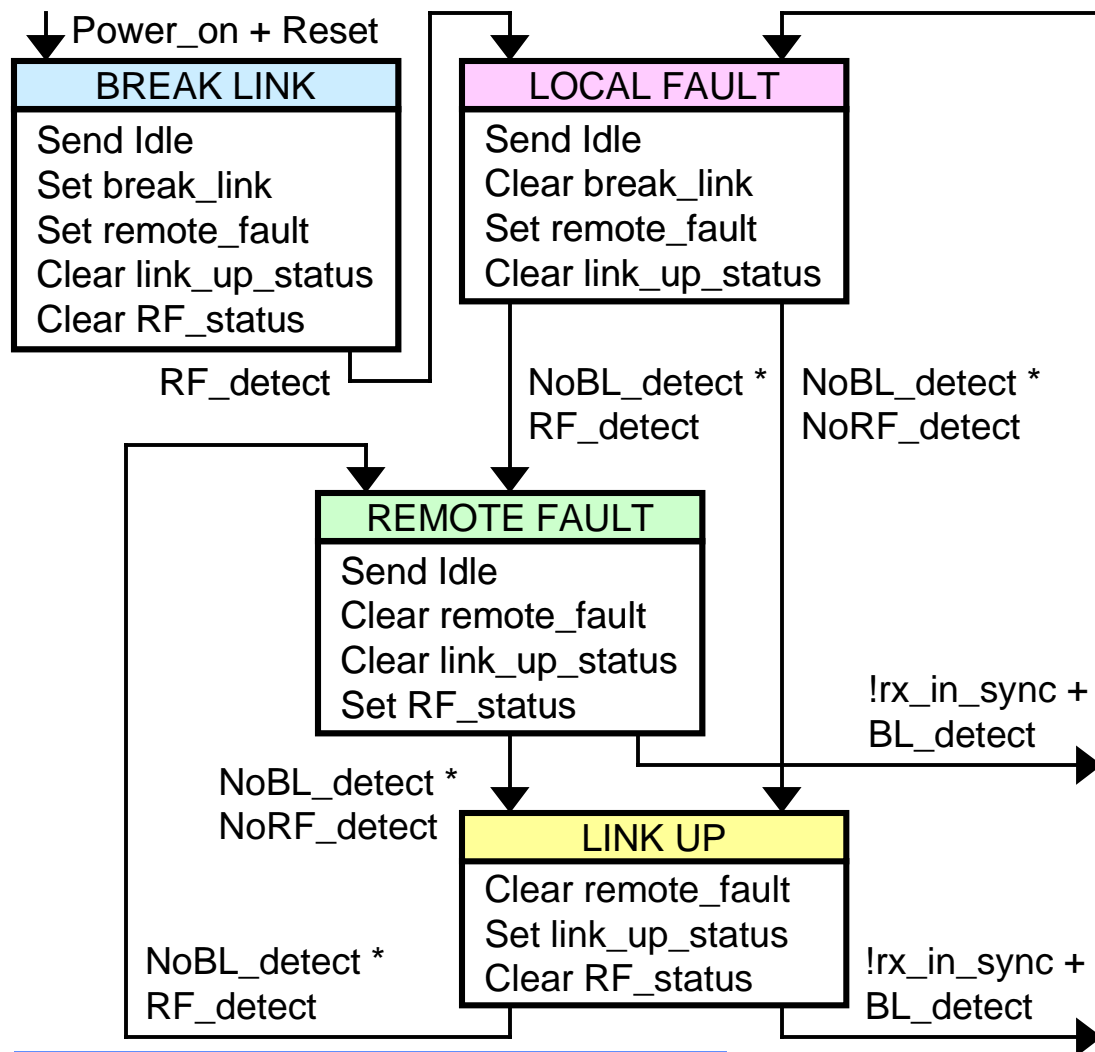


Remote Fault State Diagram

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# Overall Link State Diagram



## Notes:

$BL\_detect = LS\_detect * (lane3 = BL)$   
 $NoBL\_detect = LS\_detect * (lane3 = NB)$   
 $RF\_detect = LS\_detect * (lane3 = RF)$   
 $NoRF\_detect = LS\_detect * (lane3 = NR)$

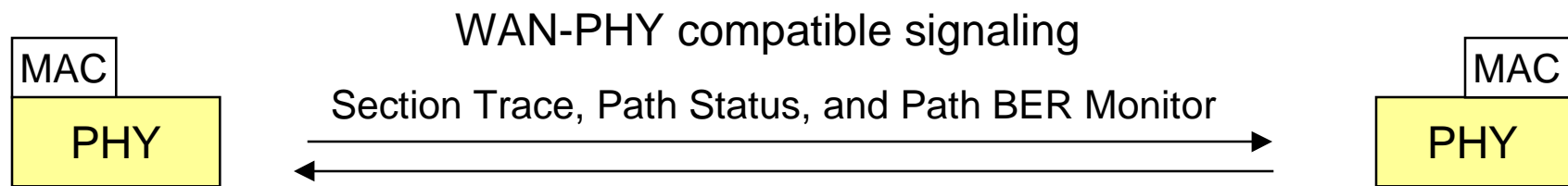
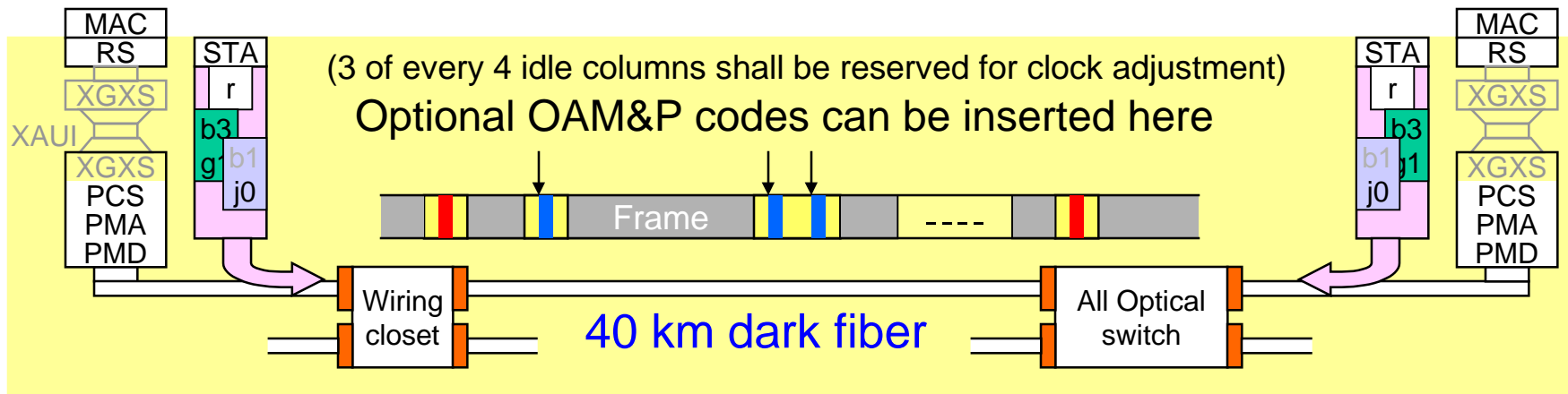
$LS\_detect = rx\_sync\_detect * (TYPE(rx\_tobe\_decoded)=Z) * (lane0 = K28.4) * (lane1 = D18.2) * (lane2 = D18.2)$   
 $BL = (D21.6 + D9.2 + D17.1 + D13.5)$   
 $NB = (D18.2 + D14.6 + D22.5 + D10.1)$   
 $RF = (D14.6 + D9.2 + D10.1 + D13.5)$   
 $NR = (D18.2 + D21.6 + D22.5 + D17.1)$   
 $rx\_sync\_detect = signal\_detect * sync\_done$   
 $sync\_done = frame\_lock * !hi\_ber$  (64/66 PCS)  
 $sync\_done = skew\_status$  (4 x 8/10 PCS)

$rx\_in\_sync = rx\_sync\_detect$ , or its qualified version with hysteresis timer

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# Additional OAM&P Signaling



All the Layer-1 Signaling is one way information flow  
no handshake, no negotiation, no synchronization

# LSS Benefits

- Simple Layer-1 signaling mechanism for
  - mandatory Break Link and Remote Fault
  - the other additional OAM&P for fiber plant management
- No impact to cost of LAN PHY
- Leverage by the compatibility with existing
  - WAN-PHY OAM&P
  - SONET OAM&P