

PHY Layer Monitoring

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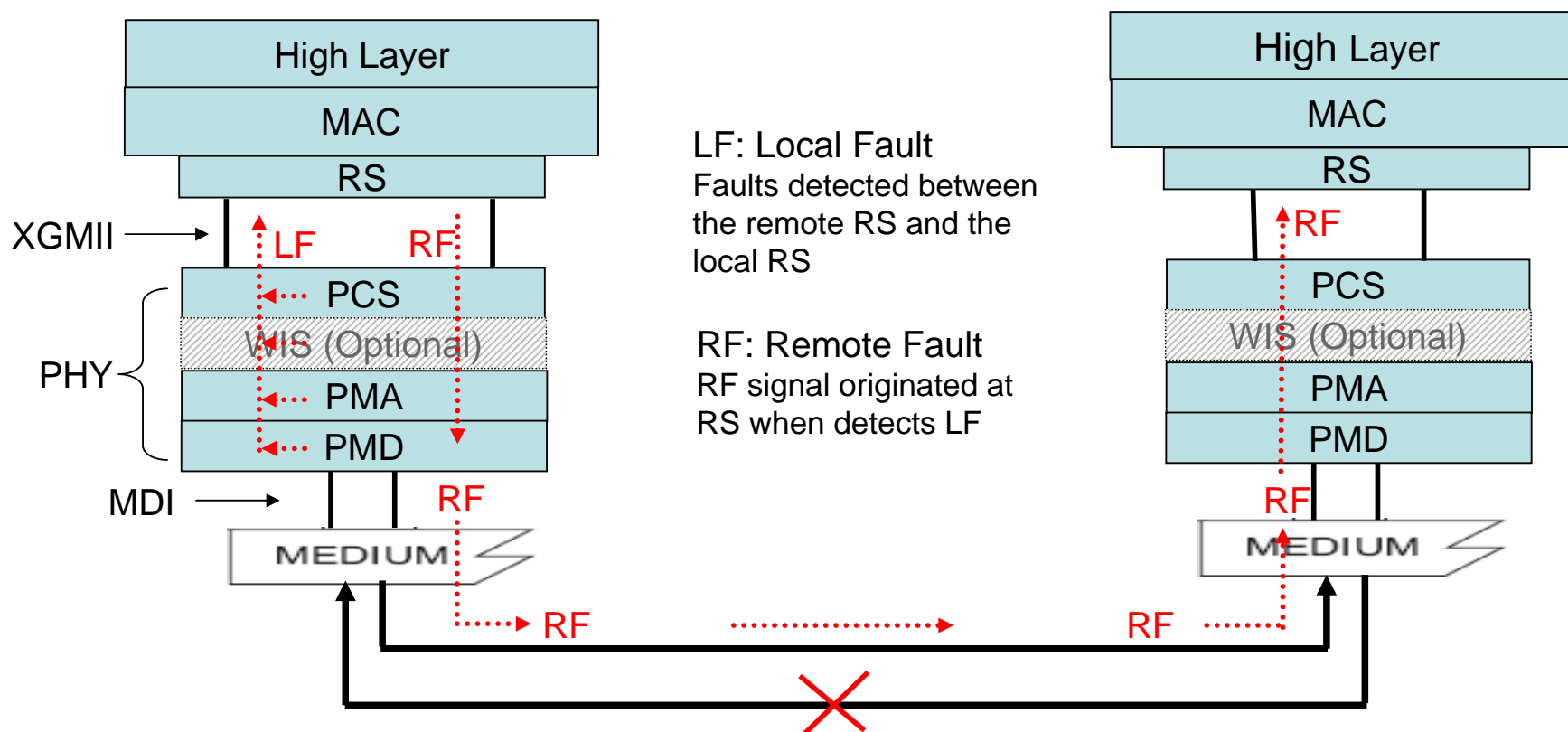


Outline

- **PHY monitoring in 10GE**
- **100GE PHY Monitoring**
 - Improvement to multi-lane architecture
- **Detailed discussion on 100GE PHY Monitoring**
 - PHY OAM block definition
 - Transmission mechanism of PHY OAM

PHY Monitoring in 802.3ae

- There is a Link Fault Signaling mechanism in 10GE
 - Reside in Reconciliation Sublayer (RS)
 - To monitor link status between local RS & remote RS and perform link status notification
 - Sublayers within the PHY are required to detect faults that render a link unreliable



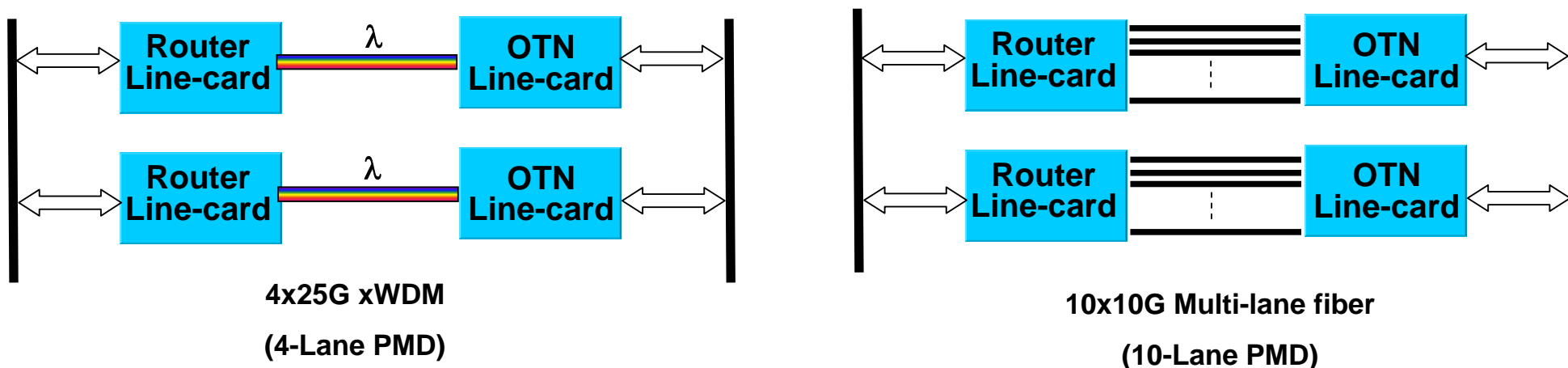
PHY Monitoring in 802.3ae

- **Link fault status covers all possible defects detected between local RS and remote RS**
 - I/O Signal Detect
 - Protocol Detect, includes:
 - CODEC Synchronization
 - Lane Alignment (Multi-Lane Only, 10GBASE-X)
 - WIS Frame/Payload Acquisition
 - Link Status Report Recognized
- **RS reports the fault status of the link**
 - Local Fault indicates a fault detected on the receive data path
 - Remote Fault indicates a fault on the transmit path
- **RS response to the link fault status**
 - LF: Stop sending MAC data, and continuously generate a RF status on the transmit path when LF status reaches the RS
 - RF: Stop sending MAC data, and continuously generate Idle on the transmit path when RF status received by the RS

100GE PHY Monitoring Suggestion

- **Inherit Link Fault Signaling mechanism from 10GE**
- **Improve 100GE multi-lane architecture to provide enhanced PHY OAM function**
 - Monitor each lane separately
 - Distinguish between lane status and link status
 - LLF: Local Lane Fault
 - RLF: Remote Lane Fault
 - Indicate more detailed link or lane status information for management
 - Signal fault/defect, Protocol fault/defect, Synchronization error, etc.?
 - Fault location indicate
 - Mapping between 100GE PHY OAM and transport network OAM
 - Some more functions to be considered
 - BER monitor
 - Auto negotiate via PHY OAM

100GE PHY Monitoring Suggestion



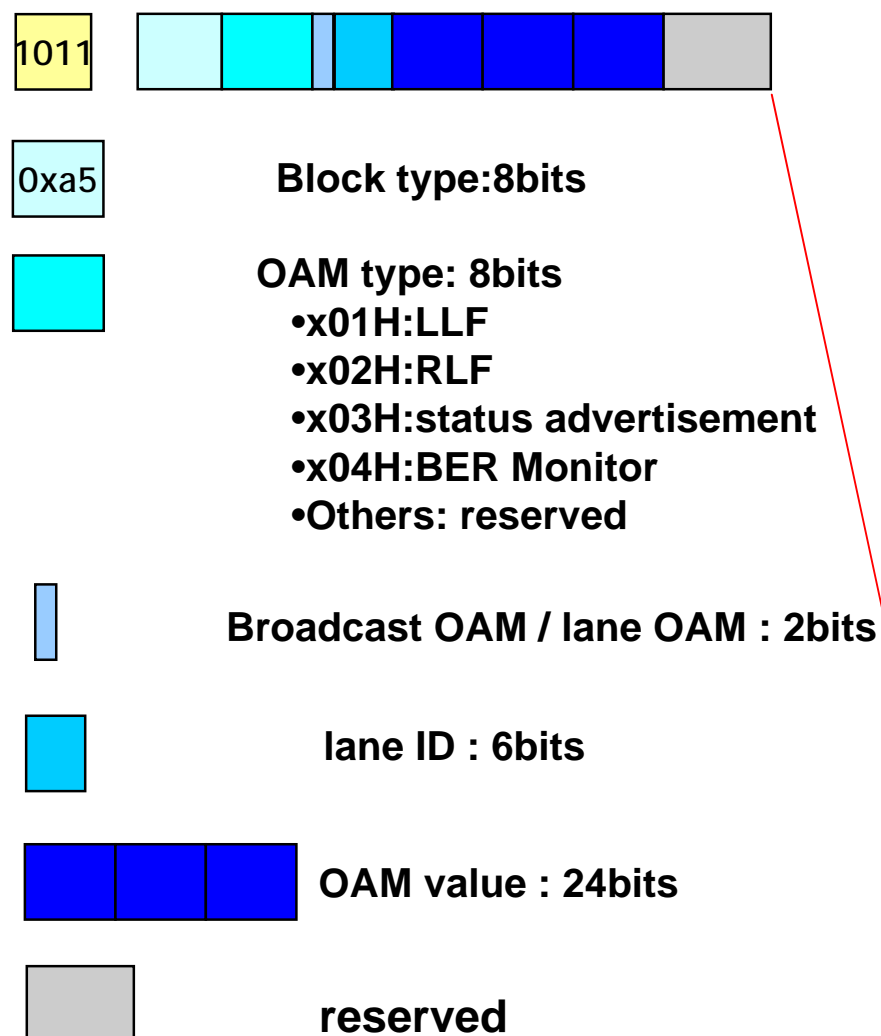
- **New PCS architecture will be introduced in 100GE, and multi-lane PHY monitoring should be supported to per lane or per lambda**
 - Independent laser monitoring (fault, performance, laser degradation)
 - Improve Ethernet PHY reliability

PHY OAM Process

- **PHY OAM is defined as a new block type.**
- **Two options may be considered to transmit PHY OAM on lane**
 - Insert PHY OAM by stealing from IPG without extra bandwidth
 - Increase line rate to carry the PHY OAM
- **Receive and notify the PHY OAM information**
 - Detect PHY OAM information at receive path
 - Indicate PHY OAM information to upper layer

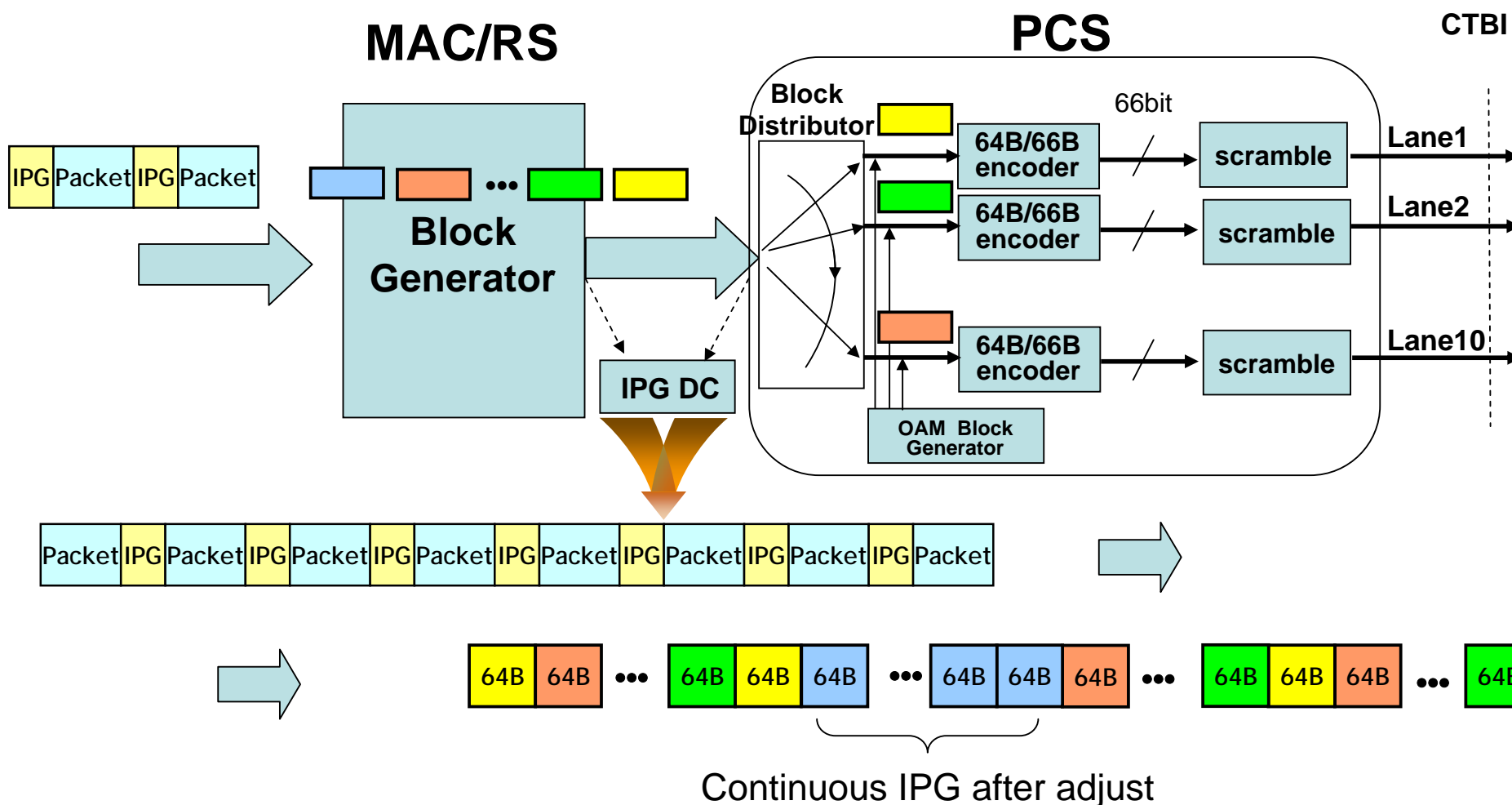
What Should the OAM Block Look like?

•OAM block: 64-bit data + 4-bit ctrl



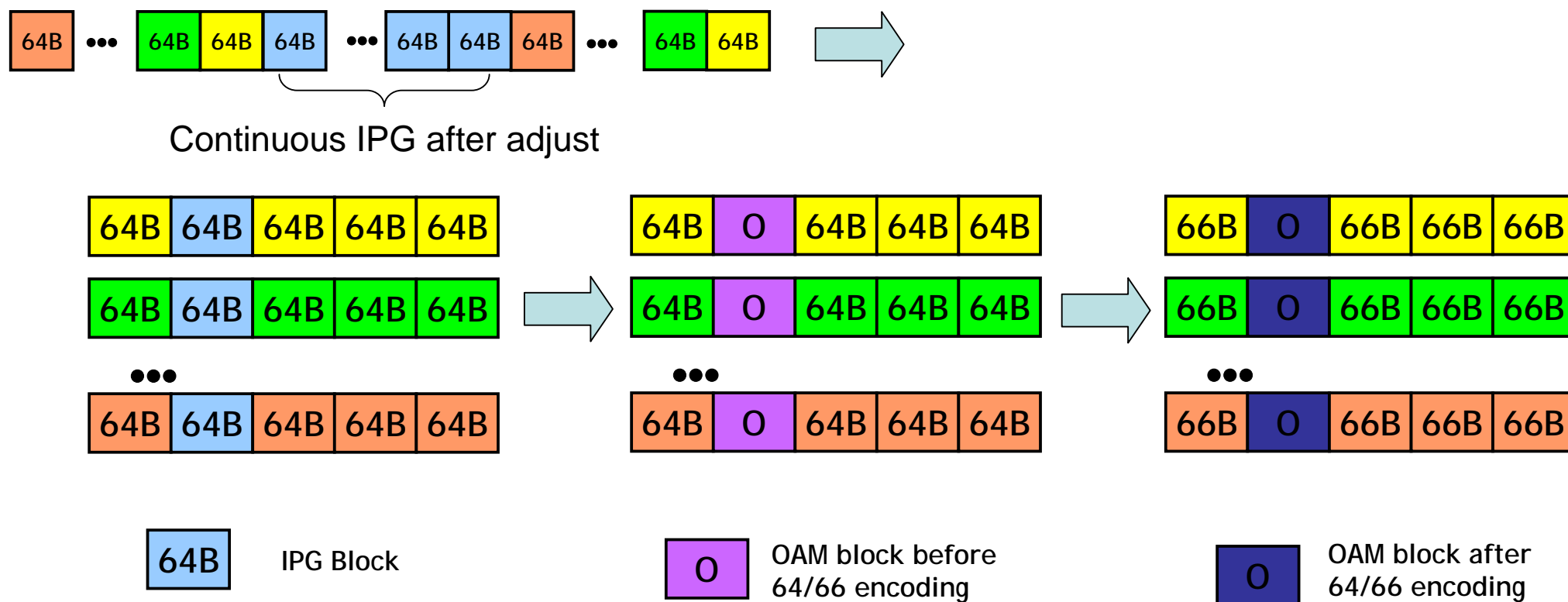
TXD/RXD								TXC/RXC	Description
D	D	D	D	D	D	D	D	0000	Data
S	D	D	D	D	D	D	D	1001	Start
C	C	C	C	S	D	D	D	1010	Start
T	C	C	C	C	C	C	C	1000	Terminate
D	T	C	C	C	C	C	C	0111	Terminate
D	D	T	C	C	C	C	C	0110	Terminate
D	D	D	T	C	C	C	C	0101	Terminate
D	D	D	D	T	C	C	C	0100	Terminate
D	D	D	D	D	T	C	C	0011	Terminate
D	D	D	D	D	D	T	C	0010	Terminate
D	D	D	D	D	D	D	T	0001	Terminate
C	C	C	C	C	C	C	C	1111	Control
A	A	A	A	A	A	A	A	1101	Alignment
O	O	O	O	O	O	O	O	1011	OAM
N	N	N	N	N	N	N	N	New	Null
X	X	X	X	X	X	X	X	New	Reserve

Insert OAM Block by Stealing from IPG



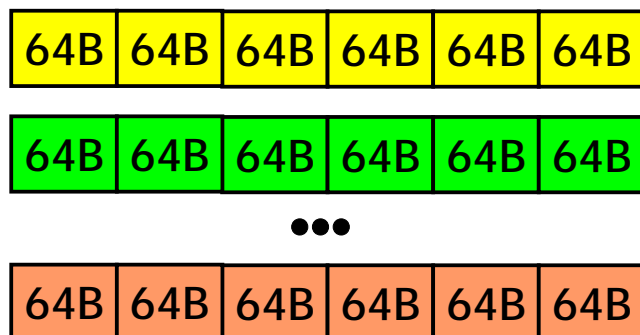
- IPG adjustment gains enough bandwidth for inserted OAM
- Introduce Deficit Counter mechanism to collect extra IPG
- OAM blocks cover the extra IPG (generator)

Insert OAM Block by Stealing from IPG

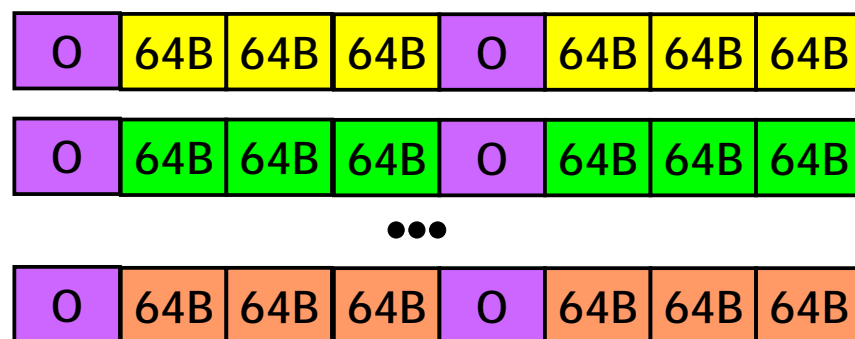


- Adjusts IPG together
- Distributes IPG blocks into each lane
- PHY OAM replaces the IPG block on each lane

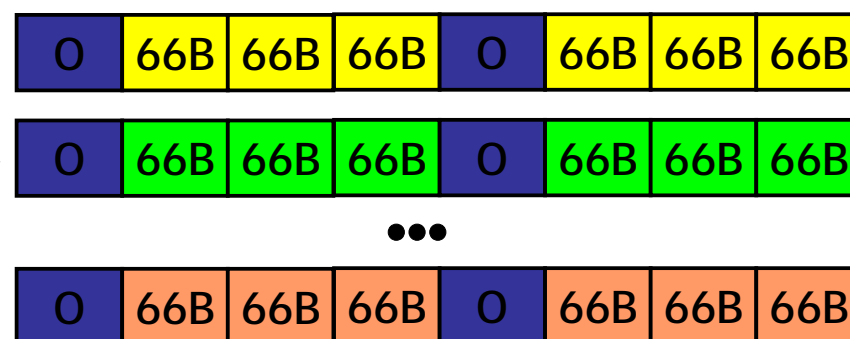
Insert OAM Block by Increasing Line Rate



- Line rate increased
- PHY OAM blocks are inserted periodically

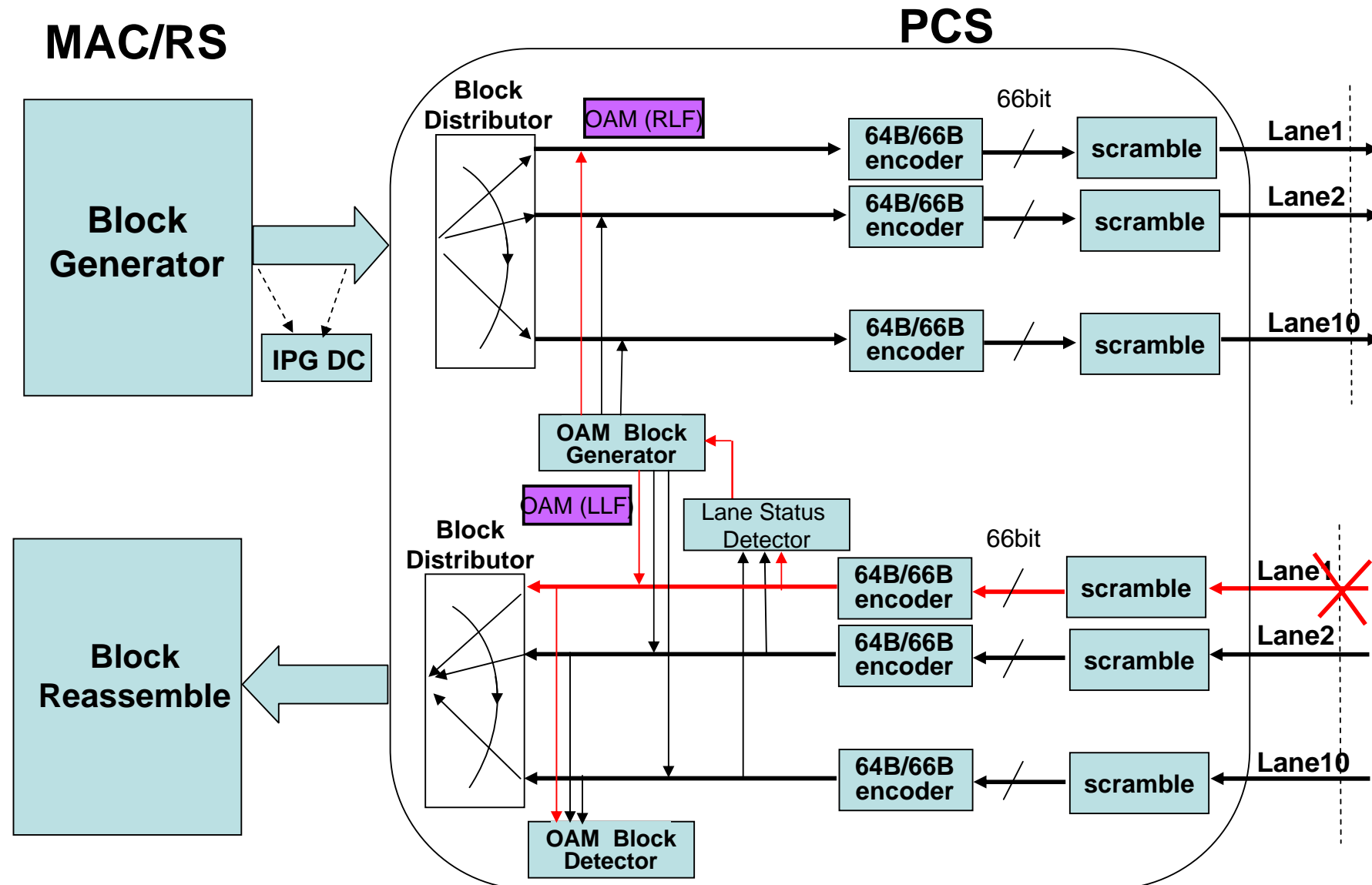


OAM block before
64/66 encoding



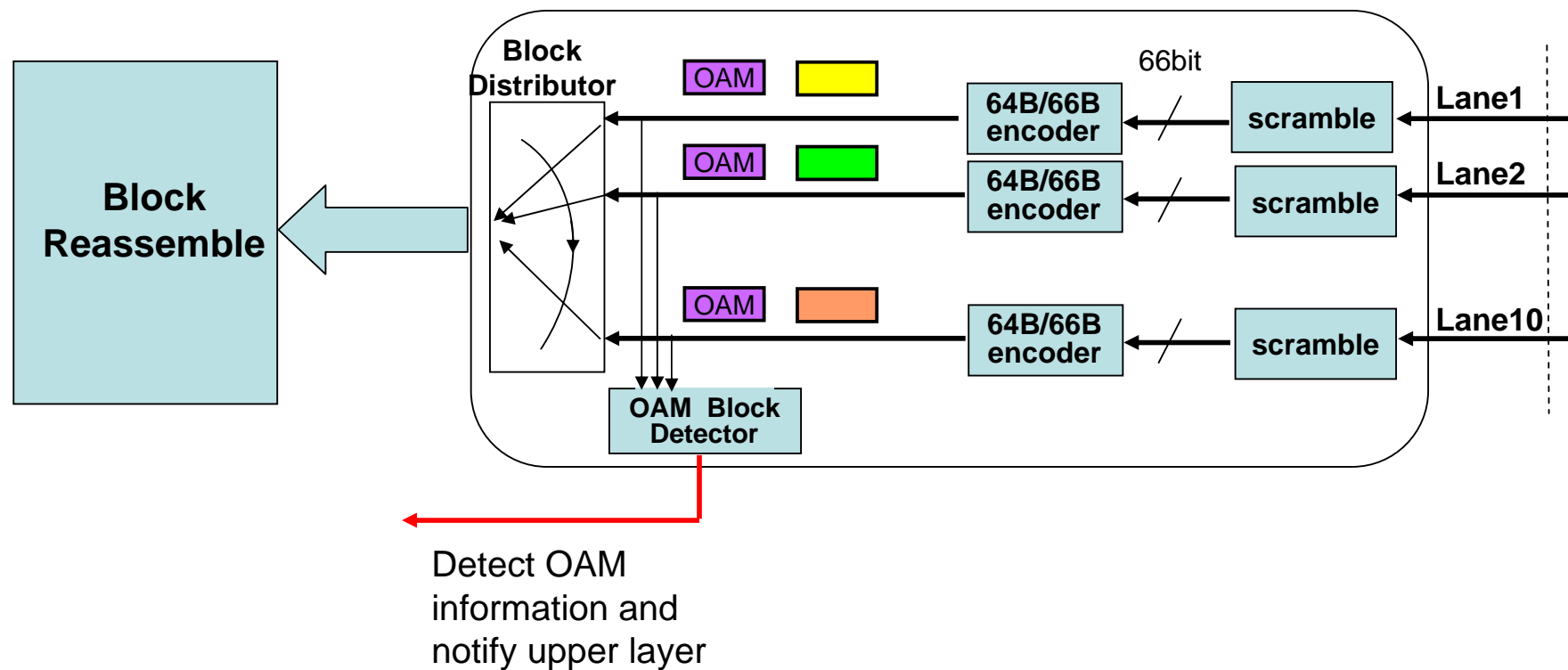
OAM block after
64/66 encoding

LLF&RLF Generation



Detect lane unavailable, transmit a Remote Link Fault signaling on transmitting path

PHY OAM Indication



- OAM Block Detector picks up the PHY OAM information on lane
- Notify the PHY OMA information to upper layer

Conclusions

- **PHY OAM providing monitoring status of a physical lane**
 - Lane failure will be indicated: (LLF/RLF)
 - More functions may be defined by PHY OAM
 - Auto Negotiate
 - BER monitor
 - information advertisement
- **Implementation of PHY monitoring/PHY OAM**
 - PHY OAM will be defined in block format
 - Provide lane fault detection and notification
 - Two options for OAM block transmission
 - Option 1: utilization of IPG space
 - Option 2: increasing line rate to provide reliable and periodical OAM transmission bandwidth

Thank You