

Architectural Implications of Retimed, Limiting, and Linear Interface for nx10G

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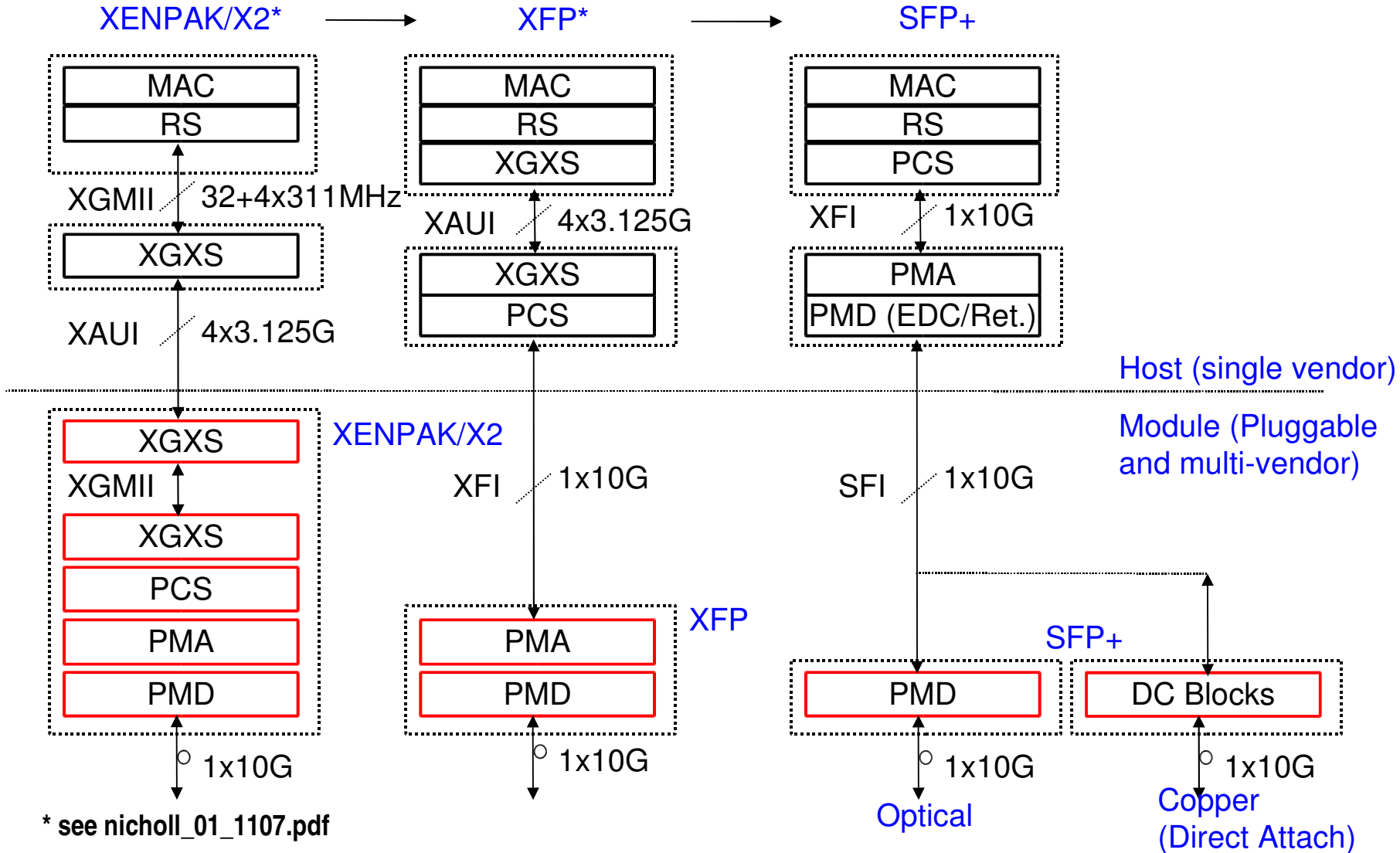
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Overview

- **Evolution of 10G**
- **Emergence of direct attach copper and fiber**
- **Comparisons of nx10G electrical interface implementations**
 - Retimed
 - Limiting with possible host CDR
 - Linear
 - Hybrid (Linear and Limiting)
- **Architectural implication to use copper and fibre in to the same port must be considered.**

Evolution of 10GbE Implementation

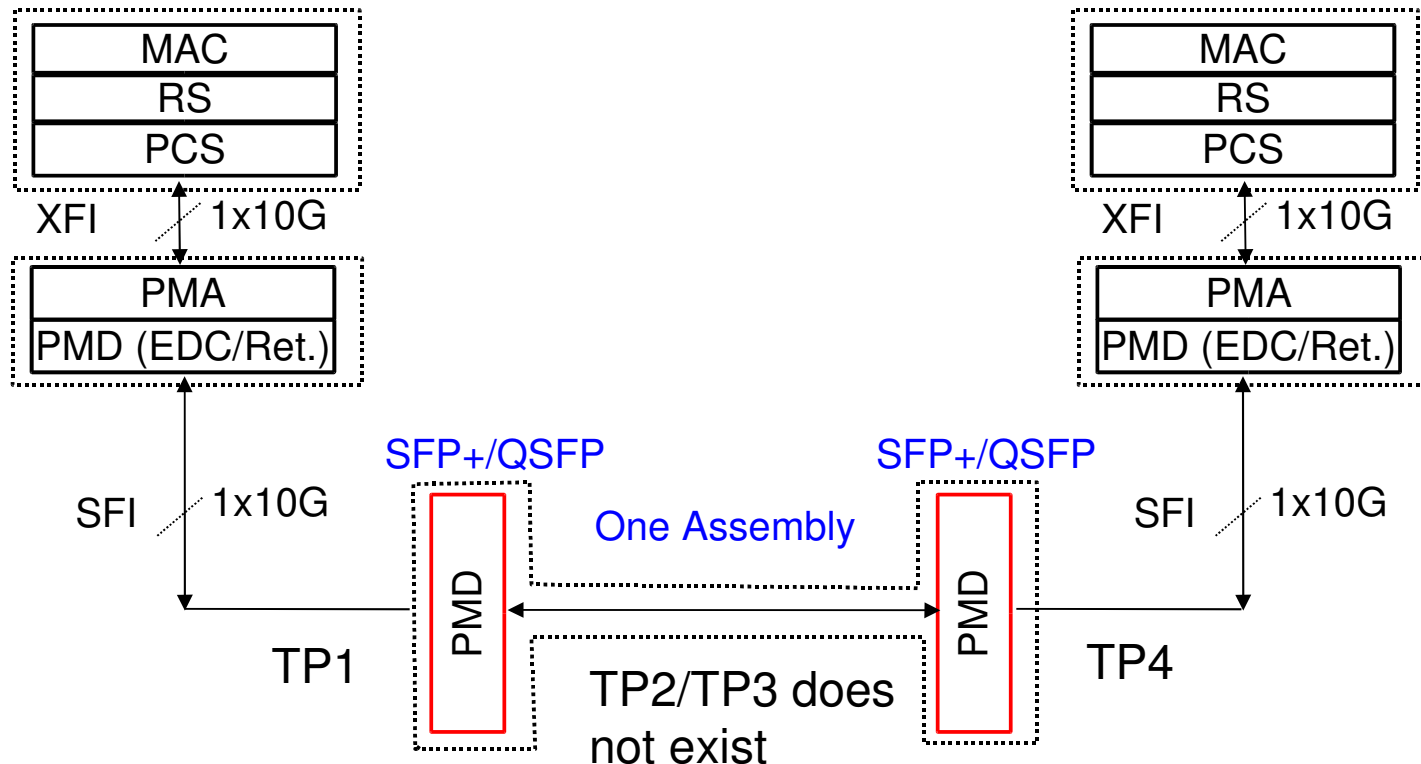
- For best value 4x10 / 10x10G should start with Gen3 as the technology is here now!



* see nicholl_01_1107.pdf

Emergence of SFP+ Direct Attach

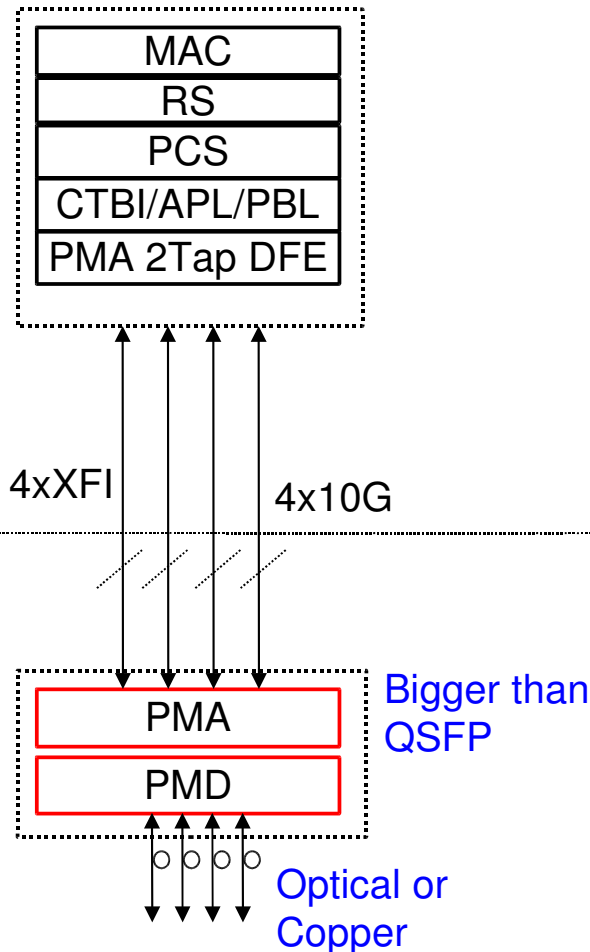
- With both SFP+ and QSFP direct attach concept are emerging
- The two PMD's may connected with optical fiber or metallic conductor
- The cable assembly may be linear or limiting.
- To support direct attach assemblies it requires defining TP1 and TP4.



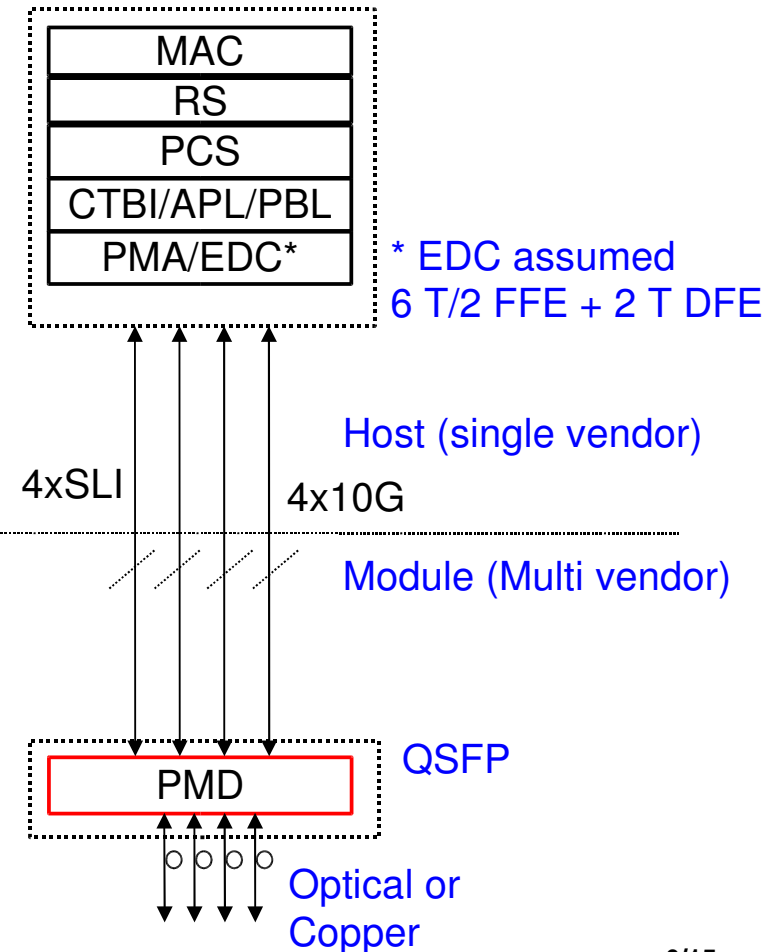
Linear vs Retimed nx10GbE Implementation

- For simplicity diagrams in this presentations are drawn with 4x10G but the same applies for 10x10G.

Retimed



Linear

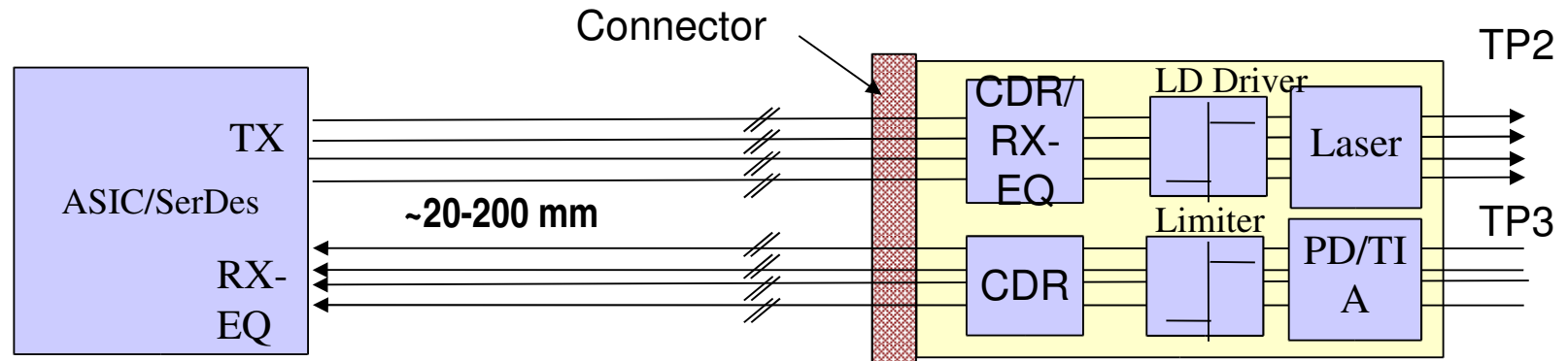


Observation and Implications of nx10G Interface

- **Copper has real value if it can plug in to the same socket as an optical module does.**
 - **The host must be linear or a retimer/EDC must be put in the copper module**
 - **Copper assembly must be active if there is no host EDC!**
- **Direct attach is going to exist for both copper and fibre as way to eliminate a connector and lower the cost.**
 - **In some cases it may be difficult to distinguish if the media is optical or metallic.**
- **The direct attach concept requires definition of TP1 and TP4 in the IEEE as there may not be a TP2 or TP3 present in the link!**
 - **A combined optical and copper cable AdHoc is desirable to avoid creating two sets of incompatible TP1 and TP4 specifications.**

Retimed Electrical Interface for nx10G

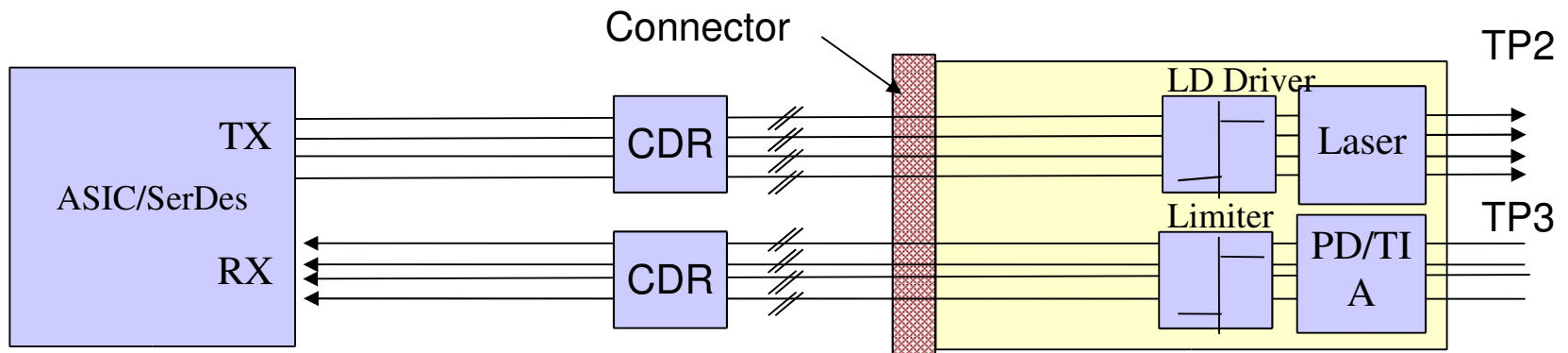
- **Similar to XFI**
- **Advantage**
 - Relax ASIC and Module electrical specifications
 - Support 200 mm of FR4
- **Disadvantage**
 - Module size may grow due to CDR power dissipation
 - Higher cost
 - Direct attach copper will be active



RX_EQ could be an analog contentions time filter or a single tap DFE equalizer

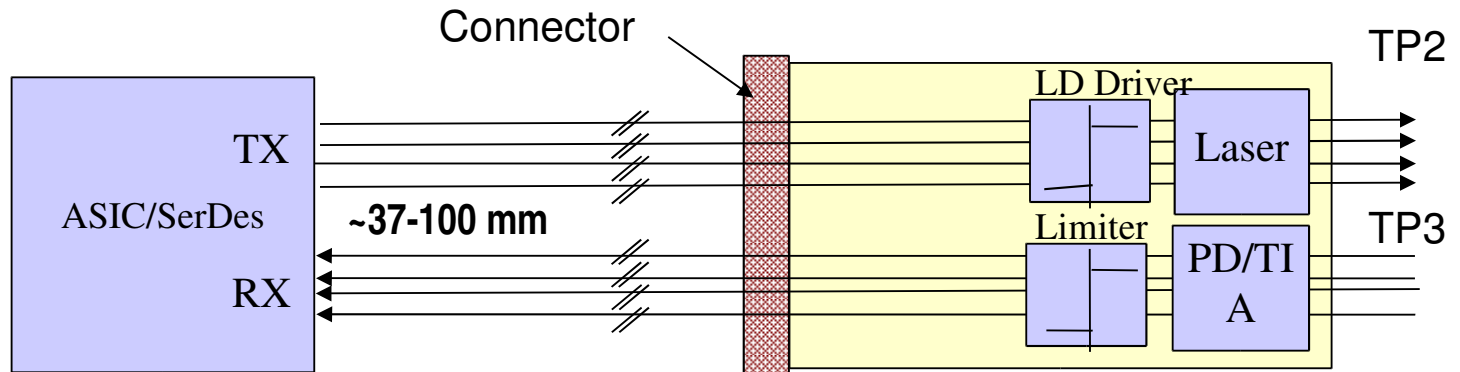
Limited Electrical Interface with External CDR for nx10G

- Similar to XFI but moving the CDR from the module to the host
- Advantage
 - Module size will not grow and low power module
 - Relax ASIC/SerDes specifications similar to XFI
- Disadvantage
 - Jitter budget may still be tight due to connector impairments
 - Module must still have good return loss
 - Additional power and space for the CDR on the host board



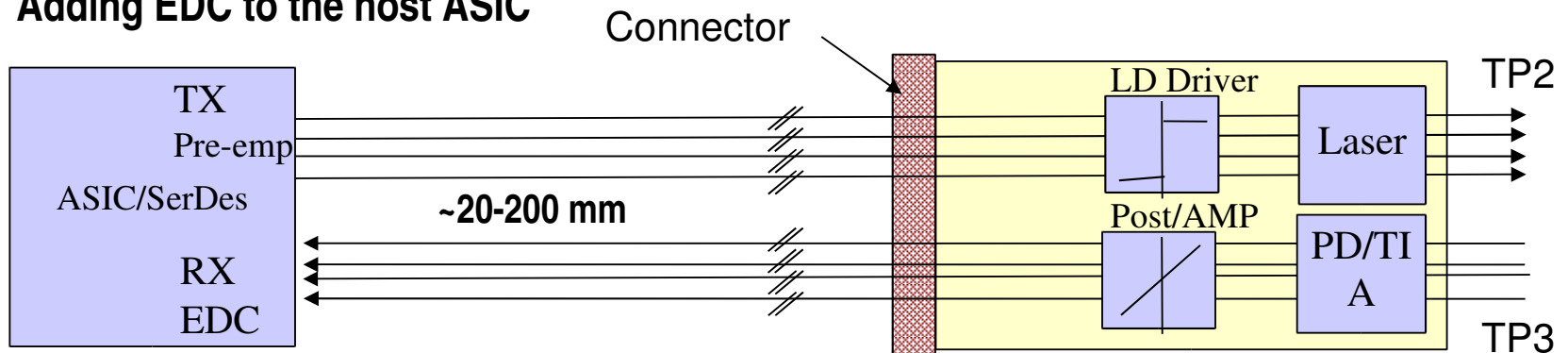
Limited Electrical Interface for nx10G

- Similar to SFI limiting but with additional margin for crosstalk, PCB routing, parasitics, and nx10G connectors
- Advantage
 - Module size will not grow and low power module
- Disadvantage
 - Tight jitter budget and return loss specifications
 - Standard ASIC may not be able to meet the jitter or return loss
 - It may not be able to support FR4 traces shorter <37 mm and longer >100 mm traces



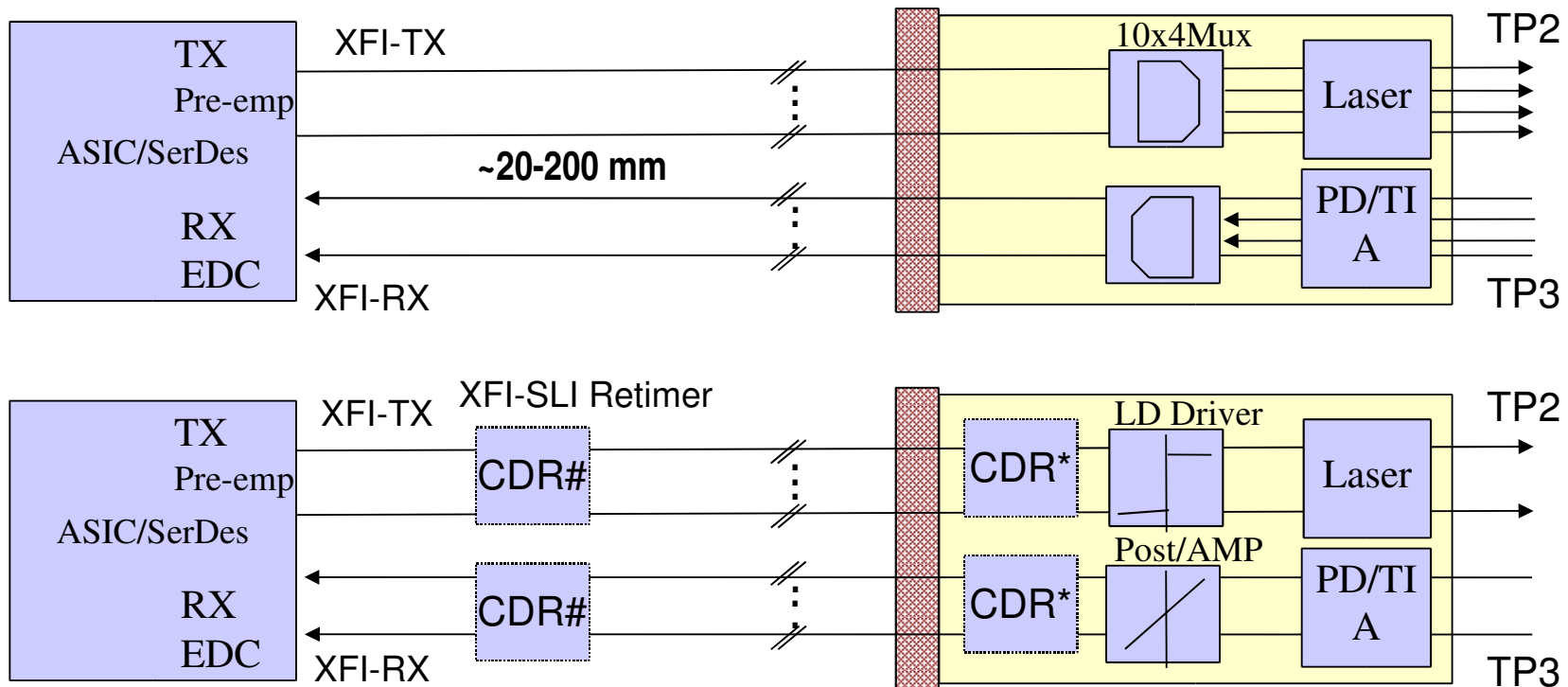
Linear Electrical Interface for nx10G

- Similar to SFI linear but with simpler EDC as defined by “SLI” see ghiasi_01_1107.pdf
- Advantage
 - Module size will not grow and low power
 - Support 200 mm of FR4 traces
 - Host EDC can provide extra margin for the electrical channel impairments, relax the optics, and possibly extend the fibre reach on SR to 220 m or 300 m.
 - Ubiquitous interface supporting linear optics, direct attach copper, and limiting optics.
- Disadvantage
 - Adding EDC to the host ASIC



Hybrid Approach for nx10G Electrical Interface Assuming XFI ASIC

- Use XFI for the retimed module and SFI for linear module and copper.
- It has all the benefit of linear and limiting, allows smallest module size for parallel implementation and all module with Mux they can operate with more relaxed XFI due to retiming in the module.



* Large form factor module may put the CDR in the module for operation with limiting host.

Host operating with small form factor module will place the CDR on the host board.

Compatibility Requirement Between Limiting and Linear Interfaces

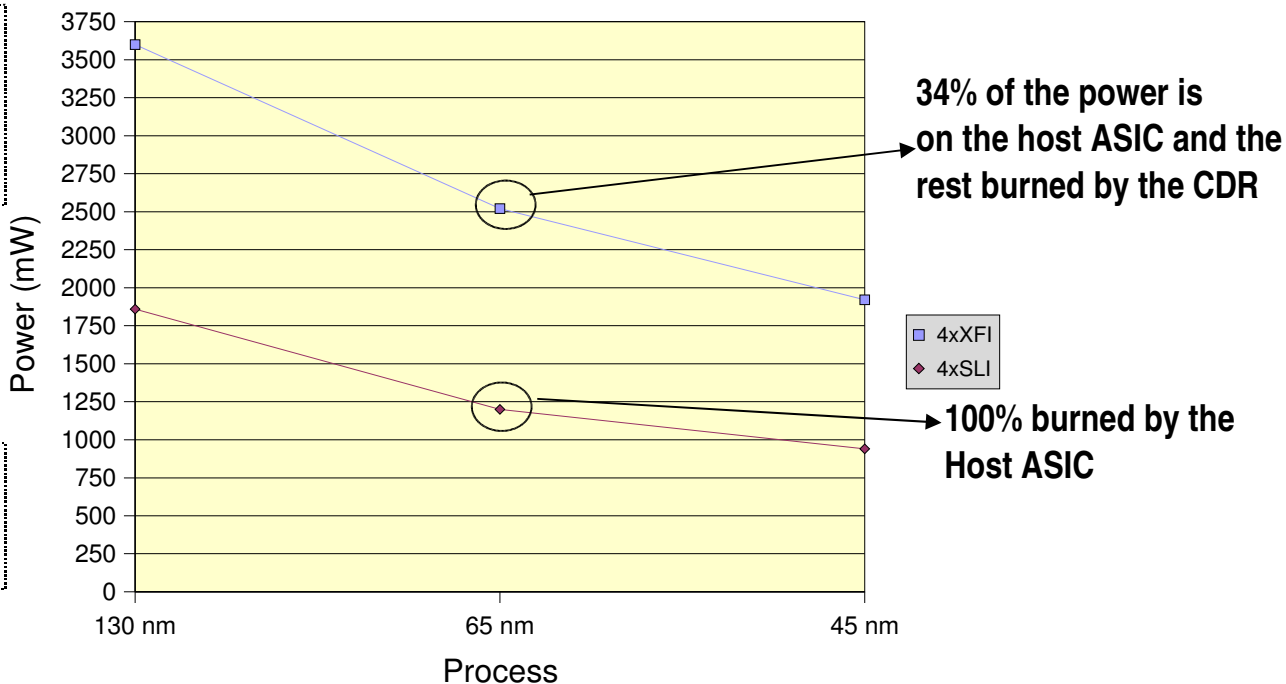
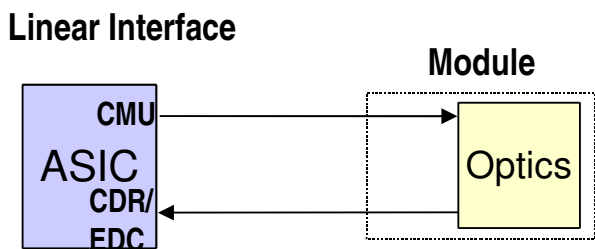
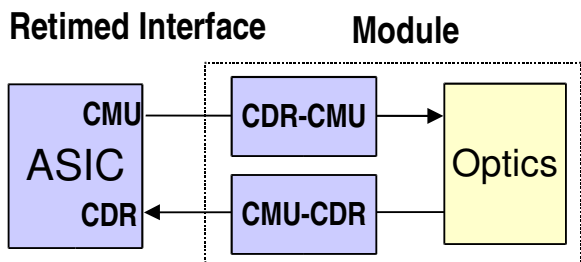
- Propose use of linear and limiting module
 - All modules with a mux will be limiting
 - All modules with 10G baudrate and without a mux will be linear.
 - A limiting module can plug in to a linear host

Solution	Link Bit Rate (Gb/s)	Elec Lanes	Elec Symbol Rate (Gbaud)	Limiting Module	Linear Module	Retime Module	Compatible with Adp EDC Host
XFP	10	1	10	x		x	x
SFP+ (Limiting)	10	1	10	x			x
SFP+ (Linear)	10	1	10		x		x
4x10G (SR)	40	4	10		x		x
10x10G (SR)	100	10	10		x		x
4x25G Gen 1	100	10	10	x		x	x
4x25G Gen 2	100	4	25	x		x	TBD

Power Comparison Between Retimed and Linear Interface

- Relative power for the 4x10G interface

- SLI interface is about 1/2 the PD of the retimed XFI, and lower PD than LRM EDC
- SLI can bring the SFP+ cost advantage now instead of 2-3 generation from now



The retime interface power consist of $(3 \text{ CDR} + 3 \text{ CMU}) * 4$

The linear interface power consist of $(\text{EDC/CDR} + \text{CMU}) * 4$

Conclusion

- **Implication of supporting copper and fibre in the same socket must be considered.**
 - **Direct attach implementation may be passive or active.**
 - **This requires defining TP1 and TP4.**
 - **Copper cable group must work closely with the fibre AdHoc toward ubiquitous interface.**
- **SFP+ which is the 3rd generation 10 GbE offers ubiquitous interface supporting SR, LR, and copper.**
 - **nx10G interface should spring off SFP+ architecture to deliver highest density with maximum line card I/O capacity.**
- **If 802.3ba choose not to define TP1 and TP4 the specifications at TP2 and TP3 should be written in such a way to take advantage of EDC with linear interface for nx10G.**