

100GbE Front Panel Ports Based on 4 Lanes

**IEEE 802.3 Interim
Incline Village**

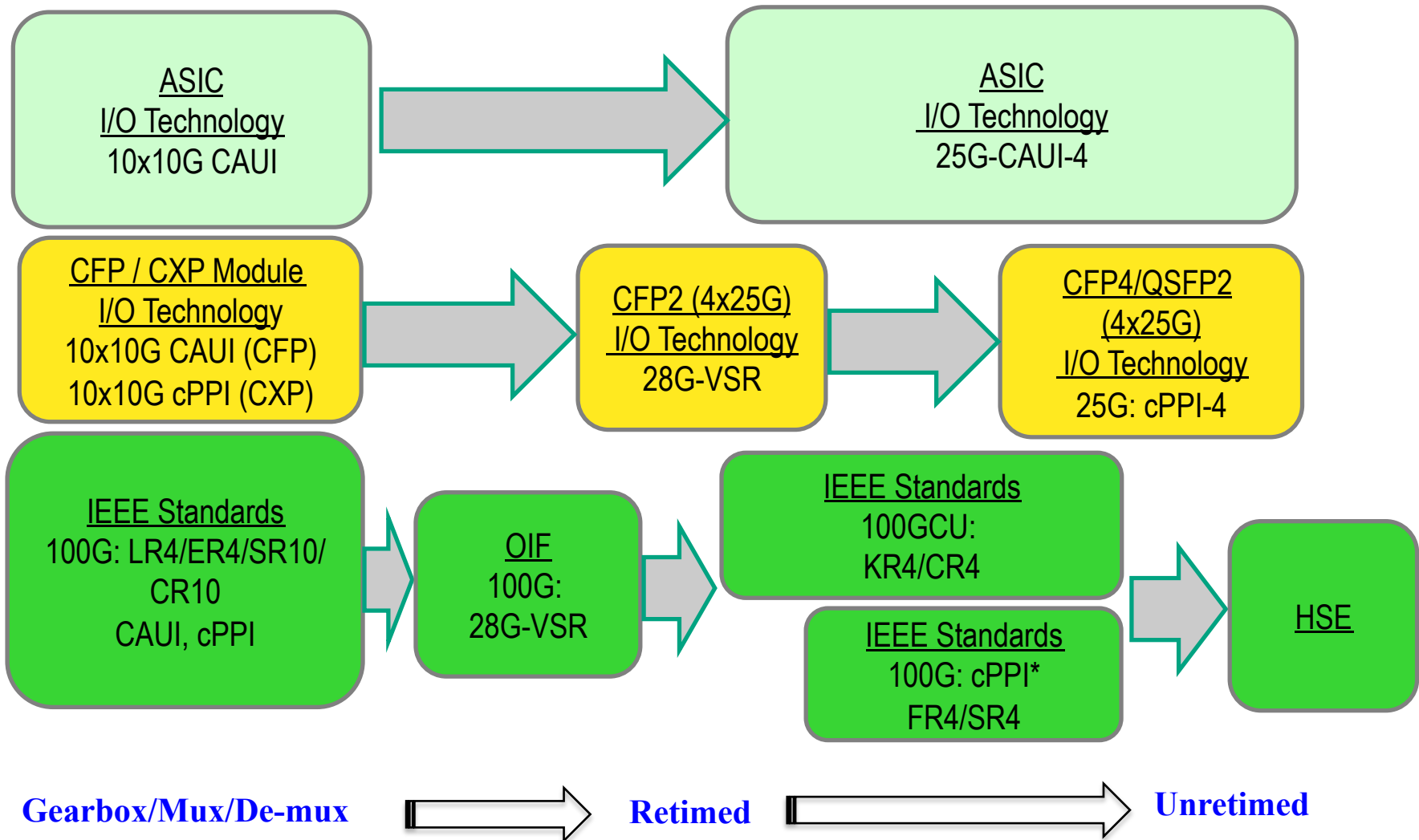
Ali Ghiasi

May 25, 2011

Overview

- **How would 100GBase-CR4 coexist with upcoming cPPI-4 interface**
- **Understanding the application can help setting the expectation of host PCB loss**
- **10GSFP+ ports and 40/100G unretimed ports offer optical as well as Cu PMDs for the same port**
 - In the case of 10GSFP+Cu the max reach is 8 m
 - In case of 40G/100G CR4/CR10 is 7 m
- **10/40/100 GbE are successful because one port type could support copper or optical interface**
 - A copper port with reach of only 2-3 m address one 48" rack and may bring enough burden where it will split the market into Cu only ports and optical only ports
 - To increase broad market potential of CR4 at least 5 m must be supported.

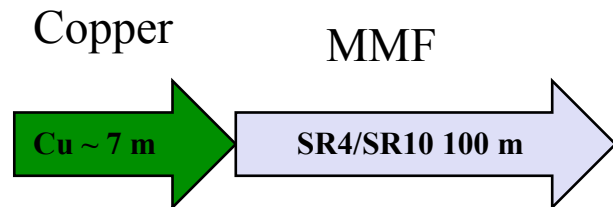
100GbE Front Panel I/O Trends



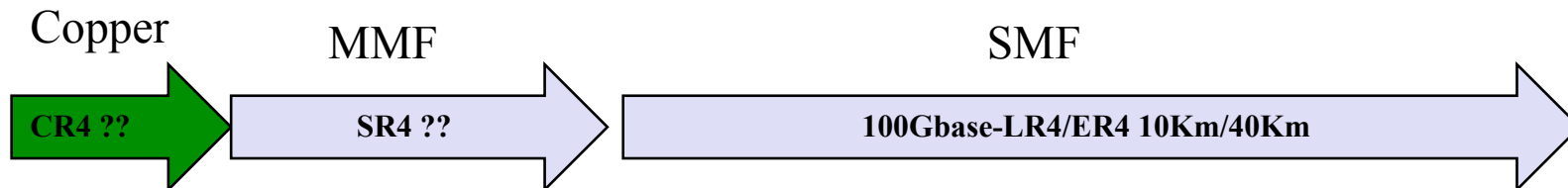
* CFI July 2011

Cable Landscape

- 100 GbE PMD's based CPPI-10/CR10 interface

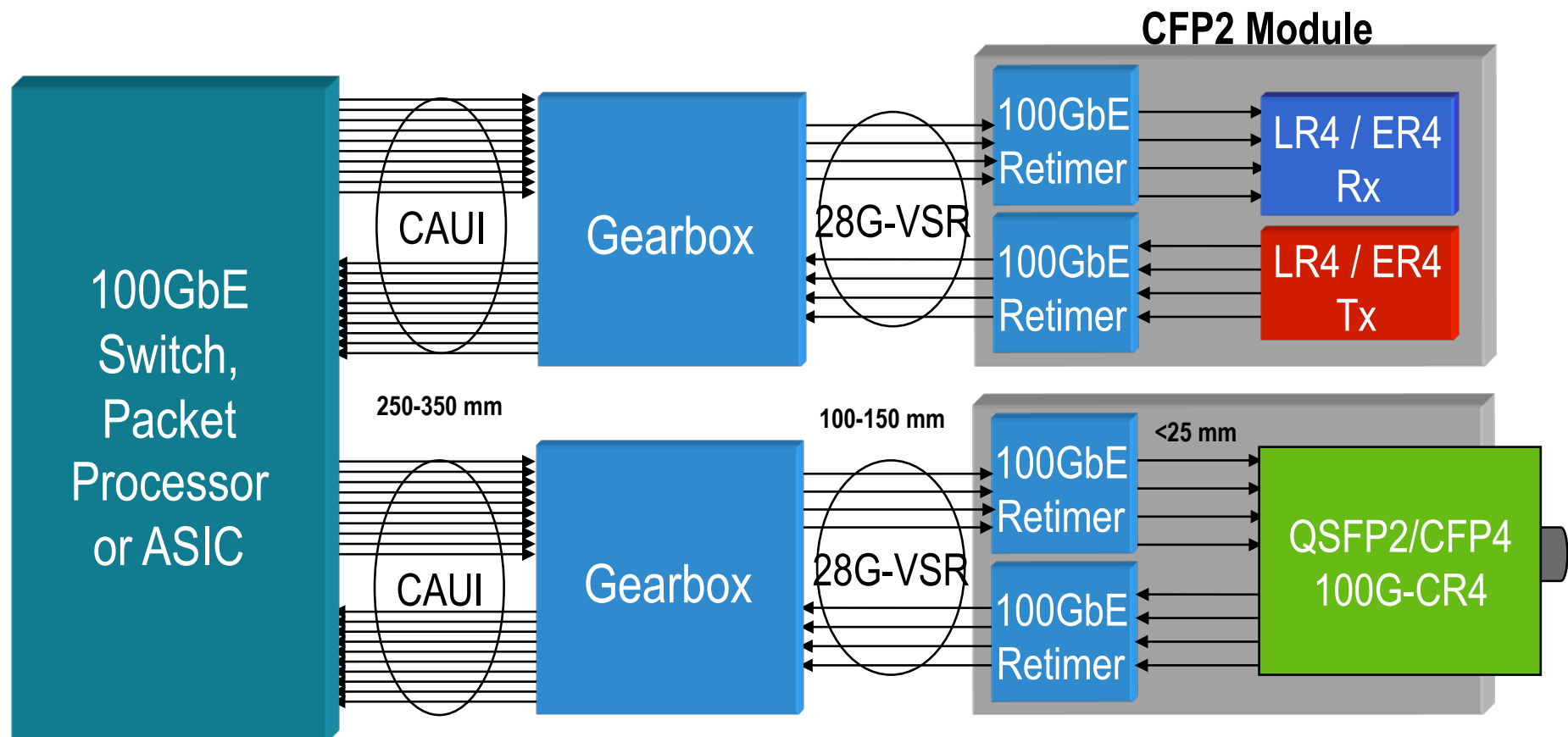


- cPPI-4 could be used for optical PMDs based on unretimed 4x25G as well as 100G-CR4
 - 100GBase-SR4 to be defined in July 2011 CFI



Current Implementation CFP2

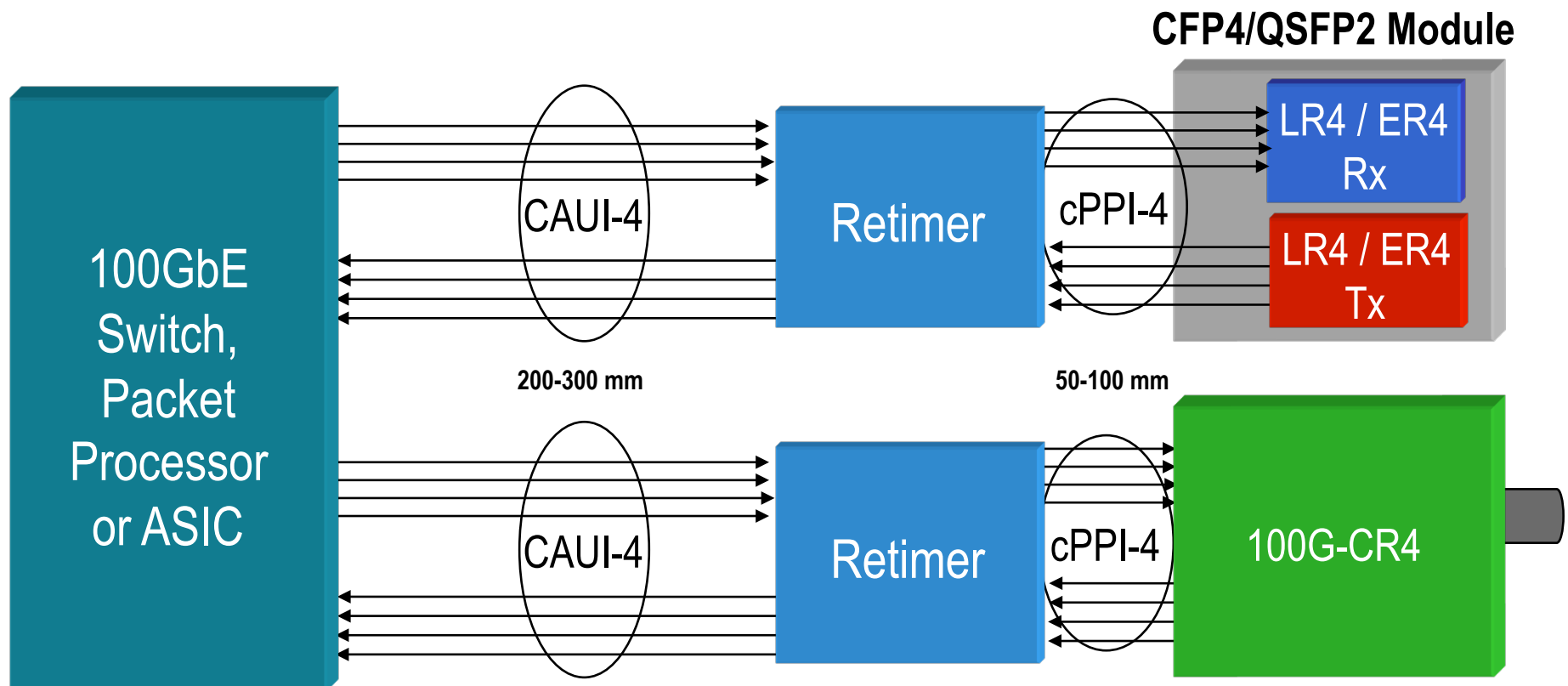
- CFP2 can be retrofitted to accommodate 100Gbase-CR4 with QSFP2/CFP4 plug
 - The retimer in case of CR4 could be NRZ to NRZ or NRZ to PAM4



Next Generation

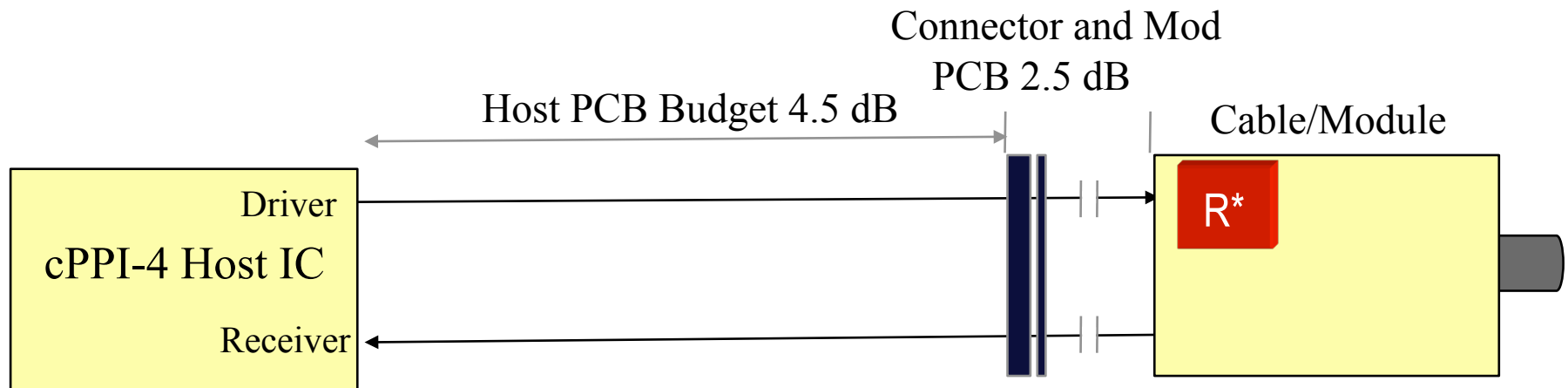
Implementation CFP4/QSFP2

- In majority of line card applications a retimer will be required due to line card loss and can be placed near the module/plug
 - Needed to implement unretimed module and to support longer cable reach



cPPI-4 Architecture Compatible with 100G-CR4

- Follows 802.3 CL86(nPPI) and CL85
- Host PCB loss are limited to 4.5 dB at 12.89 GHz in order to support common optical and Cu port type and increase Cu reach
- An option to extend Cu reach is half retime as shown below



cPPI-4 Host Loss Budget

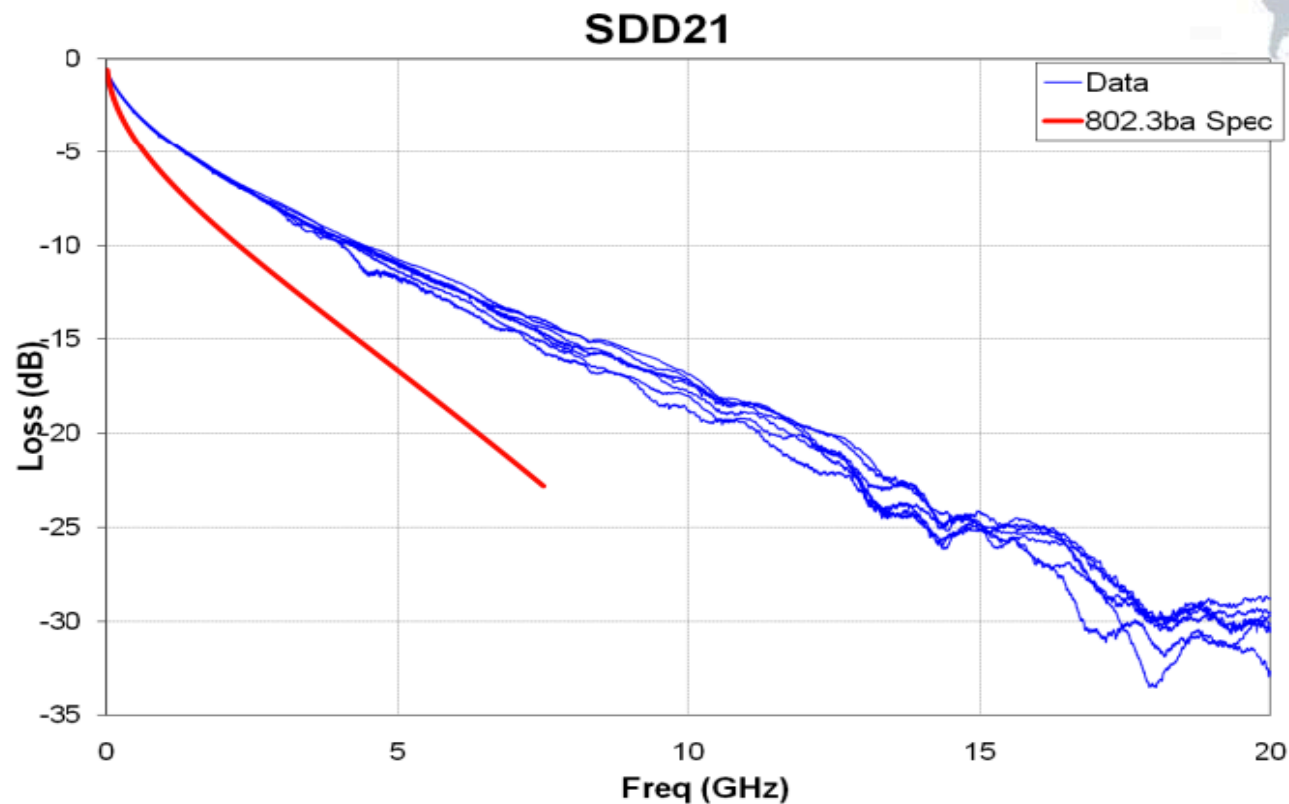
- Attach cPPI-4 with 4.5 dB loss at 12.89 GHz could support 100GBase-CR4 with reach of 5 m as well as next generation unretimed optical PMDs

Traces	FR4-6	N4000-13	N4000-13SI	Megtron 6
Loss at 6.89 GHz /in *	1.23	0.9	0.79	0.6
Loss at 12.85 GHz /in *	2	1.4	1.2	0.95
Host PCB loss at 12.85 GHz	4.5			
Connector and mod PCB loss at 12.85 GHz	2.5			
Host PCB Trace Length Based on Loss at 12.85 GHz Assuming Optical PMD Must be Supported	2.2500	3.2143	3.7500	4.7368
Ratio of loss at 6.89 GHz and 12.85 GHz from FR4 to Megtron-6 is not constant due reduction in dielectric loss and improvement in surface roughness				

Copper Cable Loss

- Source http://www.ieee802.org/3/100GCU/public/jan11/bugg_01_0111.pdf

- Cable assembly loss was 3.4 dB/m at 12.89 GHz
- Cable assembly loss is ~2.4 dB/m at 6.445 GHz



How Feasible is 5 m Reach Objective

- Assume host PCB length is determined by the need to support optical PMDs
- Several viable options NRZ, NRZ half retimer, and PAM-4 exist to support 5 m reach objective

Traces	NRZ	NRZ Half Retimer*	PAM-4
Baudrate, GBd	25.7813	25.7813	12.8913
Host PCB Loss x2	9	4.5	6
Connector and Paddle Board x2	5	3.5	3
Bulk Cable Loss for 5 m	17	17	12.5
Total Loss	31.0000	25.0000	21.5000
* Half retimer assumes TX retimer and allocate 1 dB PCB loss between retimer and bulk cable			

Copper Cable Reach Objective

- If CR4 reach is limited to only 2-3 m then within the rack applications are addressed
 - With 2-3 m Cu the more immediate application switch to switch is not addressed and is not worth burdening optical ports with Cu requirements
 - But it will address future top of the rack applications emerging in 2017 http://www.ieee802.org/3/100GCU/public/mar11/chalupsky_02_0311.pdf
- 40GbE/100GbE offer 7 m of Cu reach addressing not only TOR but also switch applications
 - During 802.3ba plenary significant amount of discussions were made around copper reach reduction from 10 m to 5-7 m http://www.ieee802.org/3/ba/public/jul09/minutes_01_0709_approved.pdf, the group felt 5 m was non starter
 - In SG meeting http://www.ieee802.org/3/100GCU/public/mar11/minutes_01_0311_unapproved.pdf straw poll #4 indicate any reach <5 m is non starter
- 100GCU need to support more immediate 100G application requiring a reach of at least 5 m.

Summary

- Based on 802.3ba meeting in July 2009 as well as SG meeting in March 2011 the 100Gbase-CR4 reach must be at least 5 m
- Some of the option to reach 5 m reach objective are
 - NRZ
 - End to end loss is currently 31 dB but could be reduced to 29 dB with improve cable and further loss management
 - NRZ with half retime
 - With just loss of 25 dB straightforward but require time domain test methodology
 - PAM-4
 - With end to end loss of 21.5 dB could possibly increase the reach to even 7 m
- Having common Cu and optical port is very valuable to the industry but if we make the Cu reach too short 2-3 m then we will end up with a Cu only port and an optical only port!