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Enabling 40GbE/100GbE Using A Retimed Interface

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Agenda

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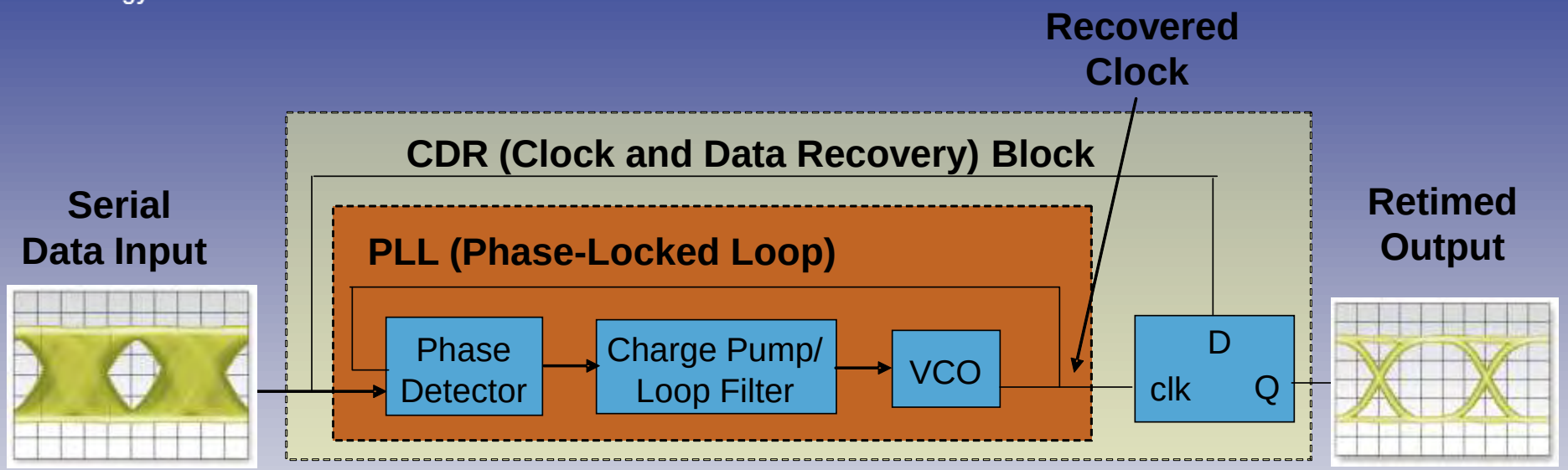
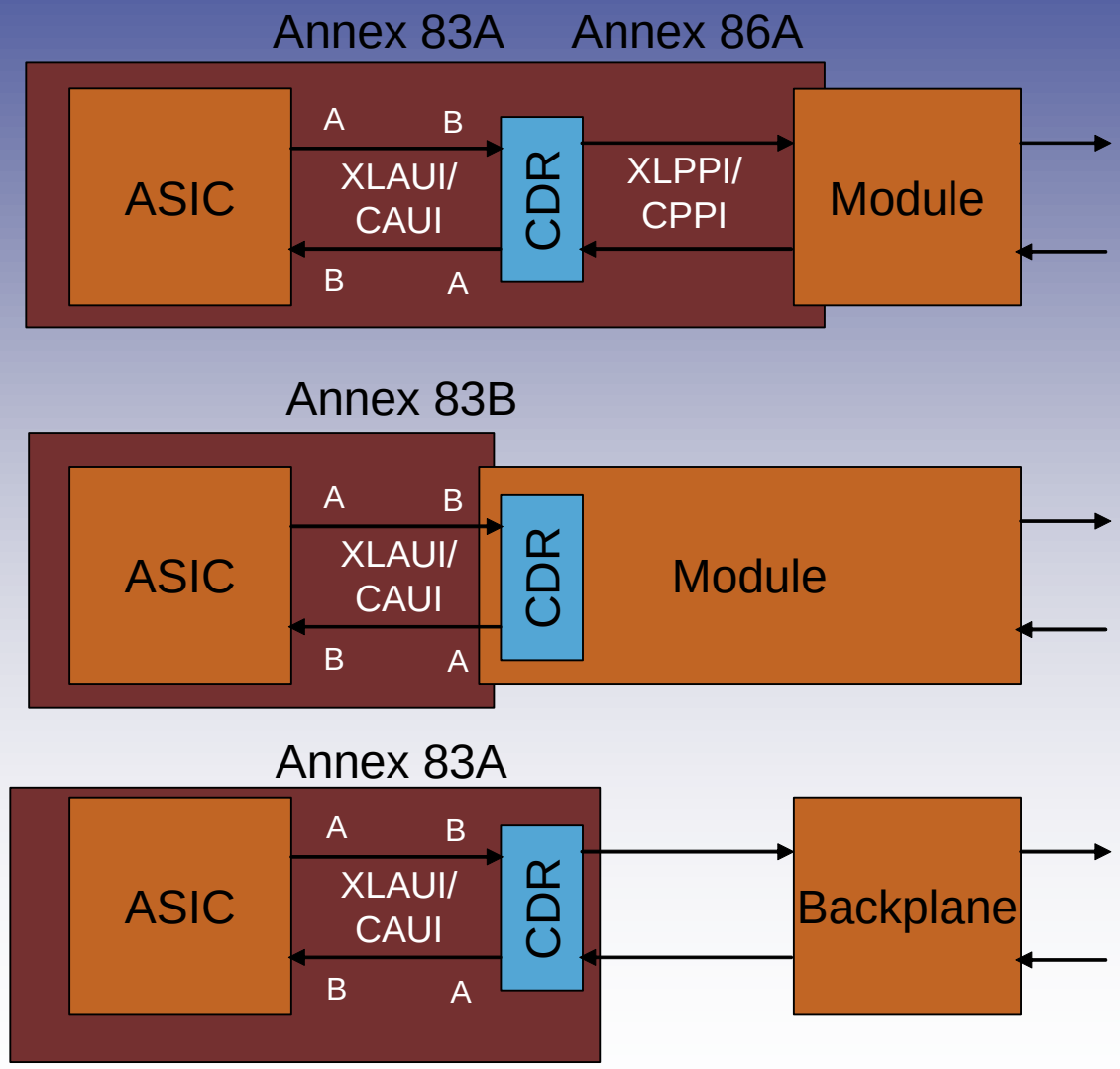
- Definition of retiming
- Retiming architectures
- Key terms for 40GbE/100GbE
- Benefits of retiming architecture
- Design examples
  - QSFP line card
  - Active Copper cable assembly
  - Optical Module
- Summary

Key Definition - Retiming



- Serial Data Input
  - High amounts of noise/jitter (timing uncertainty)
  - Difficult for receiver to distinguish between 0 and 1
- Retimed Output
  - Uses recovered clock to retime the serial data stream
  - Removes high frequency noise
  - Results in low output jitter
  - Easier for receiver to distinguish between 0 and 1

Retiming Architectures for 40GbE/100GbE



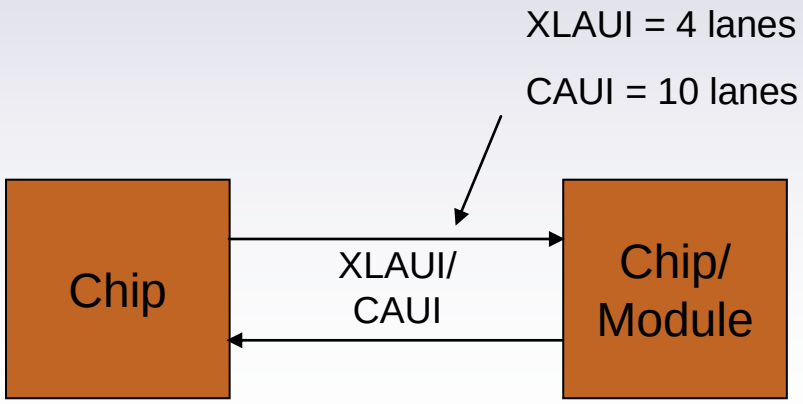
- XLAUI/CAUI is a chip-to-chip or chip-to-module interface
- XLAUI/CAUI requirements are defined in IEEE 802.3ba Annex 83A and Annex 83B

Parameter	Value
Maximum transmitter output jitter (A)	0.32UI
Maximum receiver input jitter (B)	0.62UI
Maximum loss of XLAUI/CAUI channel at 5.15GHz	10.5dB

Key Terms

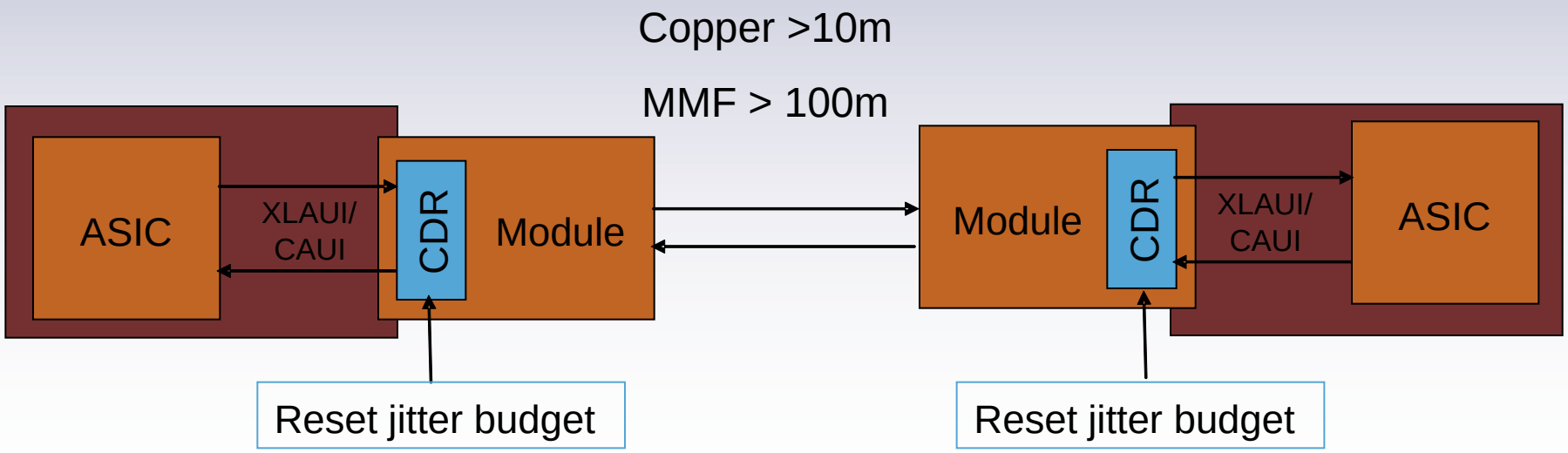
- **XLAUI/CAUI (40Gb / 100Gb Attachment Unit Interface)**
  - XLAUI for 40Gb/s, organized into 4 lanes
  - CAUI for 100Gb/s, organized into 10 lanes
  - Each lane runs at 10.3125Gb/s
  - Intended for chip-to-chip or host-to-module interface
  - Differential AC-coupled signalling with low voltage swings
  - Utilization 64b/66b coding

- **XLPPI/CPPI (40Gb / 100Gb Parallel Physical Interface)**
  - Used for SR links not using a CDR



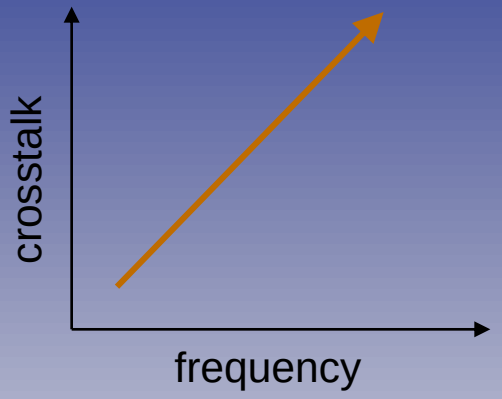
Benefits of Retiming Architecture

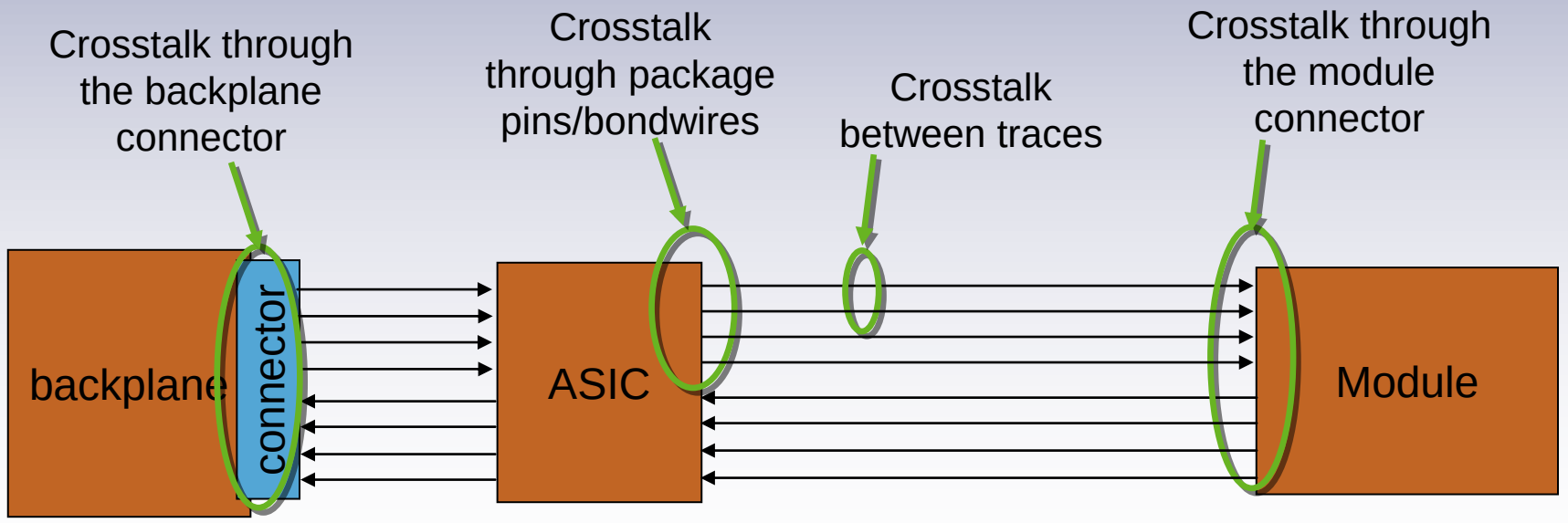
- **Retiming architecture enables longer link length and longer trace lengths**
  - Retimer resets the jitter budget, so jitter budget can be distributed amongst fewer components
  - Enables copper cable assemblies >15m vs. 7m goal
  - Enables MMF links of 300m vs. 100m goal
  - Enables XL/CAUI channel with loss up to 10.5dB, vs max loss of XL/CPPI of 6.5dB



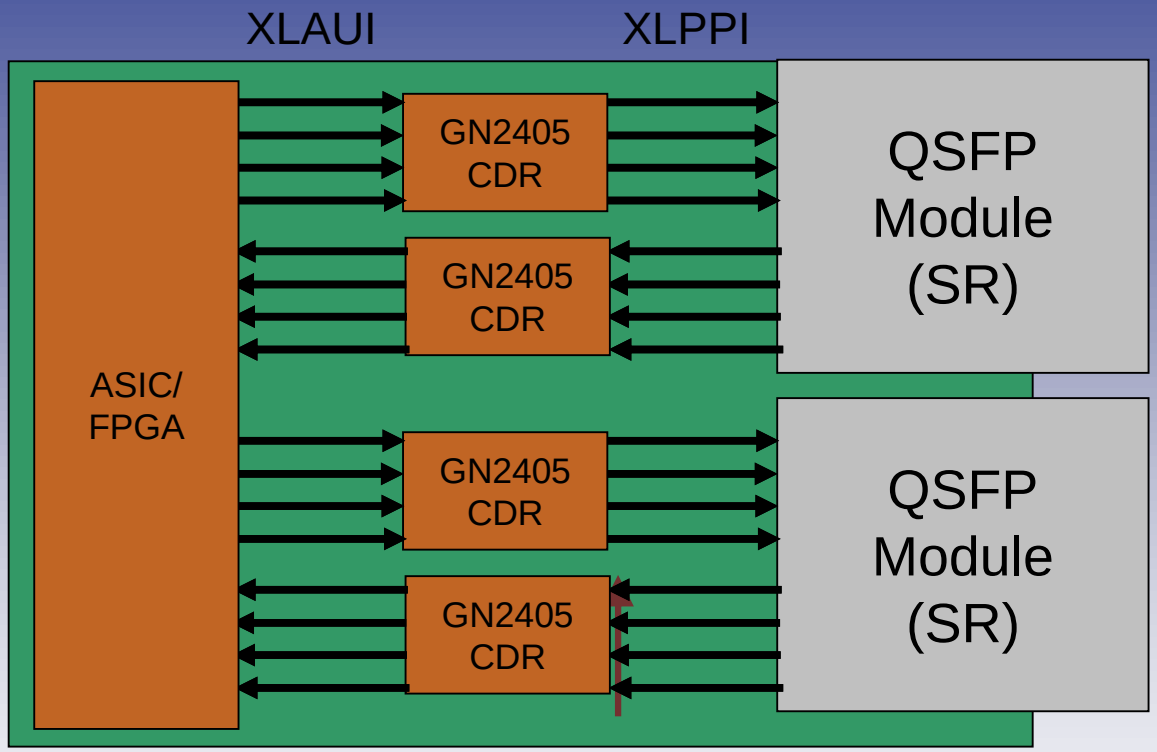
Benefits of Retiming Architecture

- **Retiming architecture reduces crosstalk**
  - XLAUI and CAUI will result in many 10Gb/s lanes routing over long traces and through connectors
  - Retimer removes jitter due to crosstalk





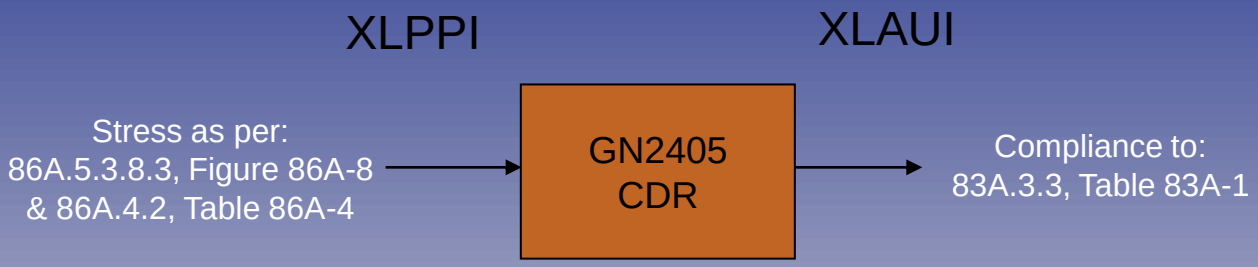
Design Examples – QSFP line card



GN2405 is a Quad 10Gb/s CDR with an integrated Equalizer and Tx De-emphasis

- Goal: Design QSFP line card
- Challenge: QSFP SR module is XLPPI compliant, but ASIC I/Os are XLAUI compliant
- Solutions: Use CDR to convert between XLAUI and XLPPI

XLPPI to XLAUI Compliance Test



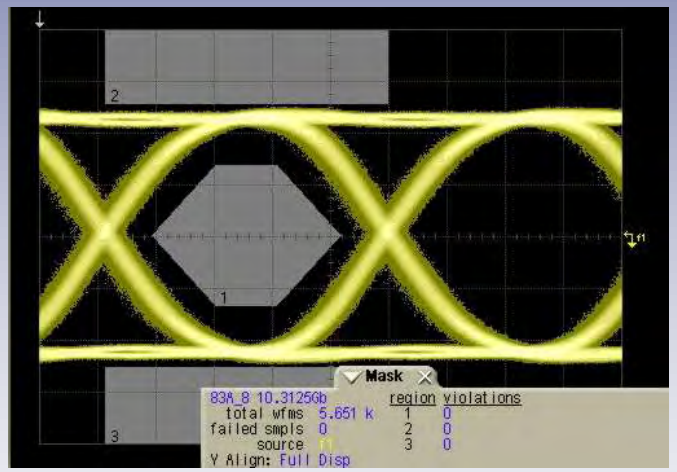
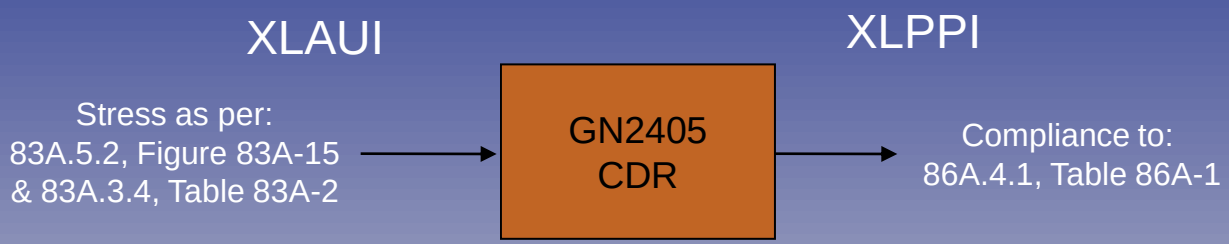
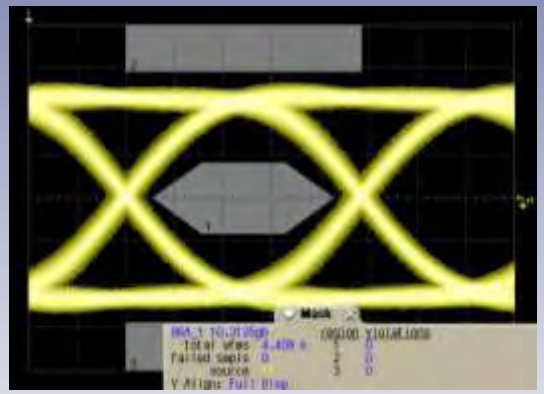


Figure 83A-8 XLAUI Transmitter Compliance Mask with stressed input

The CDR is able to successfully receive a stressed XLPPI input and transmit an XLAUI compliant signal

XLAUI to XLPPI Compliance Test





Eye Diagram at TP1a with Mask with stressed input

The CDR is able to successfully receive a stressed XLAUI input and transmit an XLPPI compliant signal

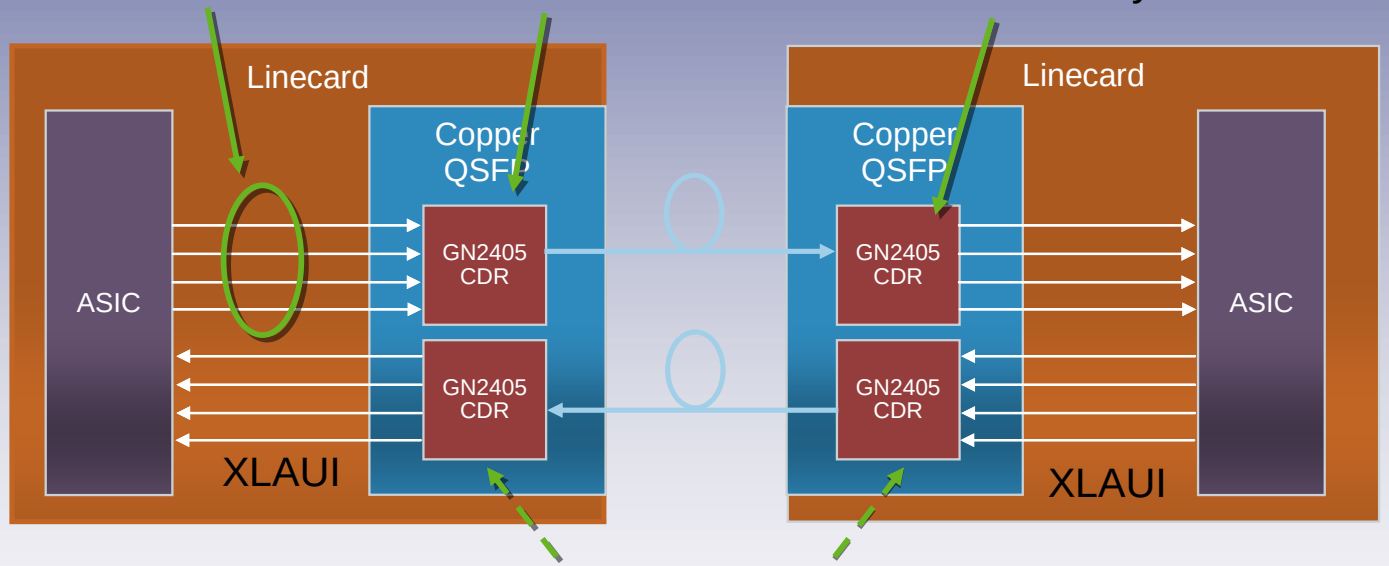
Conclusion: Use of Retiming architecture enables the QSFP line card design

Design Example - Active Copper Cable Assembly

Retimer allows flexibility on trace length between host and module

Retimer in module removes crosstalk accumulated through the connector

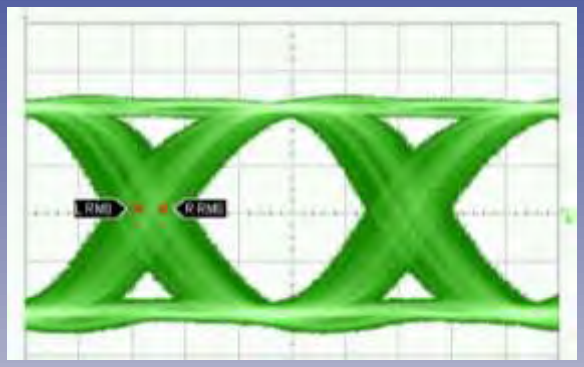
Retimer in module creates low jitter output that can be easily handled by the ASIC



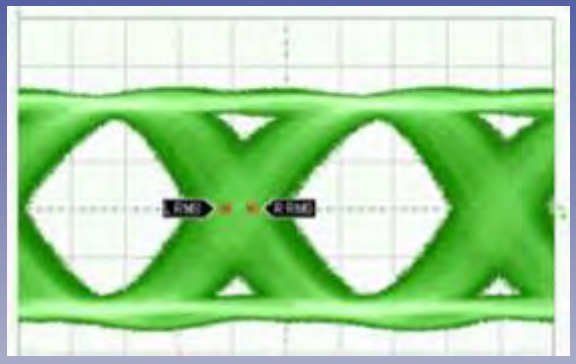
Retimer resets jitter budget at both ends of the cable

GN2405 is a Quad 10Gb/s CDR with an integrated Equalizer and Tx De-emphasis

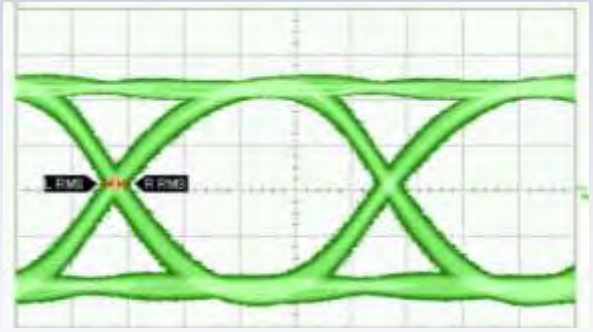
40Gb/s Active Copper Cable Assembly – Test Results



Output of QSFP cable assembly with no crosstalk, no retimer



Output of QSFP cable assembly with crosstalk, no retimer (crosstalk reduced jitter margin)



Output of QSFP cable assembly with CDR

- Test results for 15m, 26 AWG cable
- Crosstalk takes up portion of jitter budget, but CDR helps
- CDR required for low jitter output
- CDR enables direct connection from module to ASIC

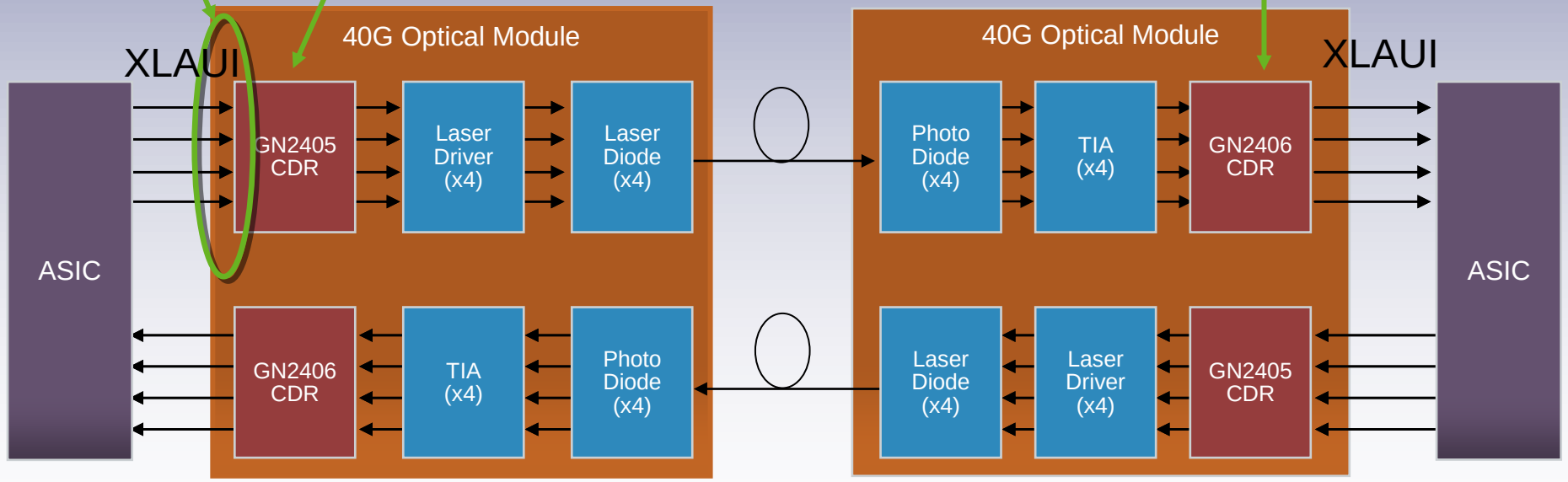
Design Example – Optical Module

CDR enables XLAUI compliant module

CDR resets jitter budget,

Optical eye will be clean, regardless of ASIC used

CDR resets jitter budget, allowing robust link between module and ASIC



Note: Optical Mux/Demux not shown

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Next Generation 100G module

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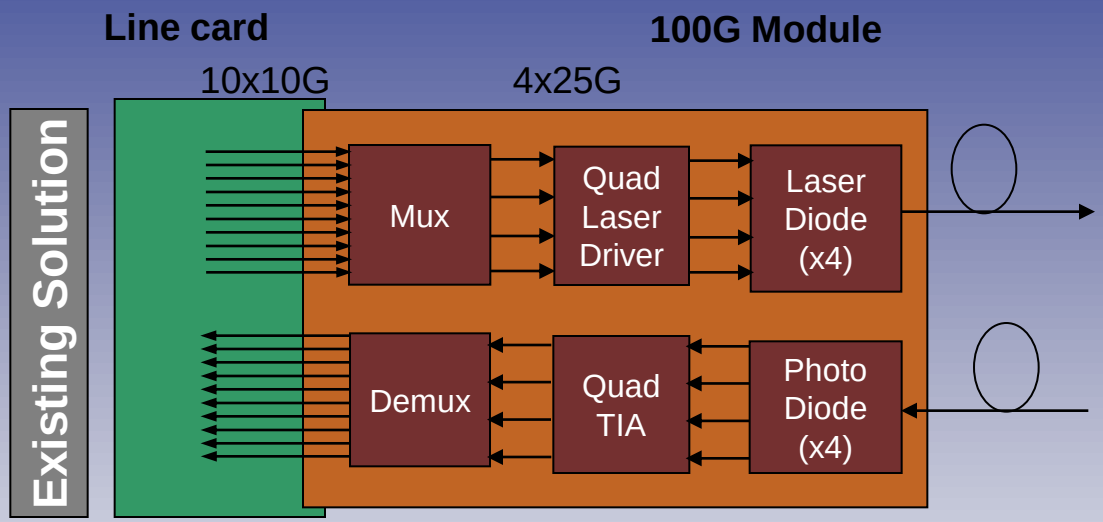

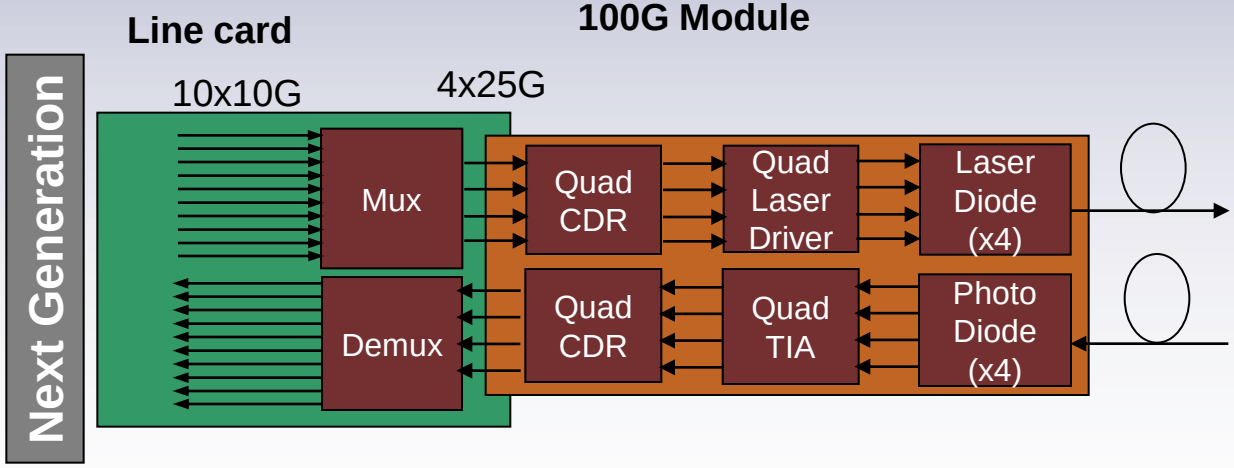

- Existing solution uses a 10x10Gb/s electrical interface, and therefore a large module is required
- Mux/Demux adds power to the module
- Limits density

- Next Generation will use a 4x25Gb/s electrical interface, allowing for a smaller module
- Mux/Demux moved to line card and CDR used in module to solve jitter issues (analogous to 300-pin to XFP transition)
- Increases density

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Summary

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- **XLAUI/CAUI are chip-to-chip or chip-to-module interfaces for 40Gb/s or 100Gb/s**
- **A retimed interface enables 40GbE/100GbE designs**
  - Resets the jitter budget along the channel
  - Increases the link length
  - Reduces the requirements of the ASIC
  - Provides design flexibility
  - Increases the robustness of the design
  - Retimed interface will enable next generation 100GbE module
- **A retimed interface can be used for 40GbE/100GbE Optical Modules, Copper Cable Assembly, Line Card and Backplane designs**

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Biography

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- Stephen Docking graduated with a Masters of Applied Science in Electrical Engineering from the University of Waterloo in 2002. He joined Gennum Corp. as an Analog IC designer in 2003. He transitioned to product management in 2006 and is currently a Senior Product Line Manager at Gennum, responsible for CDR products used in Optical modules, copper cable assemblies and line cards.

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Company Overview

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- Gennum Corporation (TSX: GND) designs innovative semiconductor solutions and intellectual property (IP) cores for the world's most advanced consumer connectivity, enterprise, video broadcast and data communications products. Leveraging the company's proven optical, analog and mixed-signal products and IP, Gennum enables multimedia and data communications products to send and receive information without compromising the signal integrity. A recognized award-winner for advances in high definition (HD) broadcasting, Gennum is headquartered in Burlington, Canada, and has global design, research and development and sales offices in Canada, Germany, India, Japan, Korea, Mexico, Taiwan, the United States and the United Kingdom.