A System's Perspective: CAUI-4 Chip-to-Chip

April 26, 2013

Rick Rabinovich – Alcatel-Lucent
Elizabeth Kochuparambil - Cisco Systems, Inc.

CAUI-4 PHY Interface Options

- Where we are
- Do we have Broad Market Potential?
- The Options
- CAUI-4 Chip-to-Chip Proposal
- Q&A

Where we are

- 802.3bm – CAUI-4 chip-to-chip
  Baseline adopted on March 21st, 2013 (Orlando Florida)

"

Move to adopt the proposal in slides 4 to 10 of latchman_02_0313_optx as the baseline for "a re-timed 4-lane 100G PMA to PMA electrical interface for chip to chip applications" (with the insertion loss of 15dB listed as To Be Confirmed)

"

Does 15dB cover a wide enough range of chip-to-chip applications?

The success of a standard is measured on how comprehensive it is
and how many projects/designs will adopt it

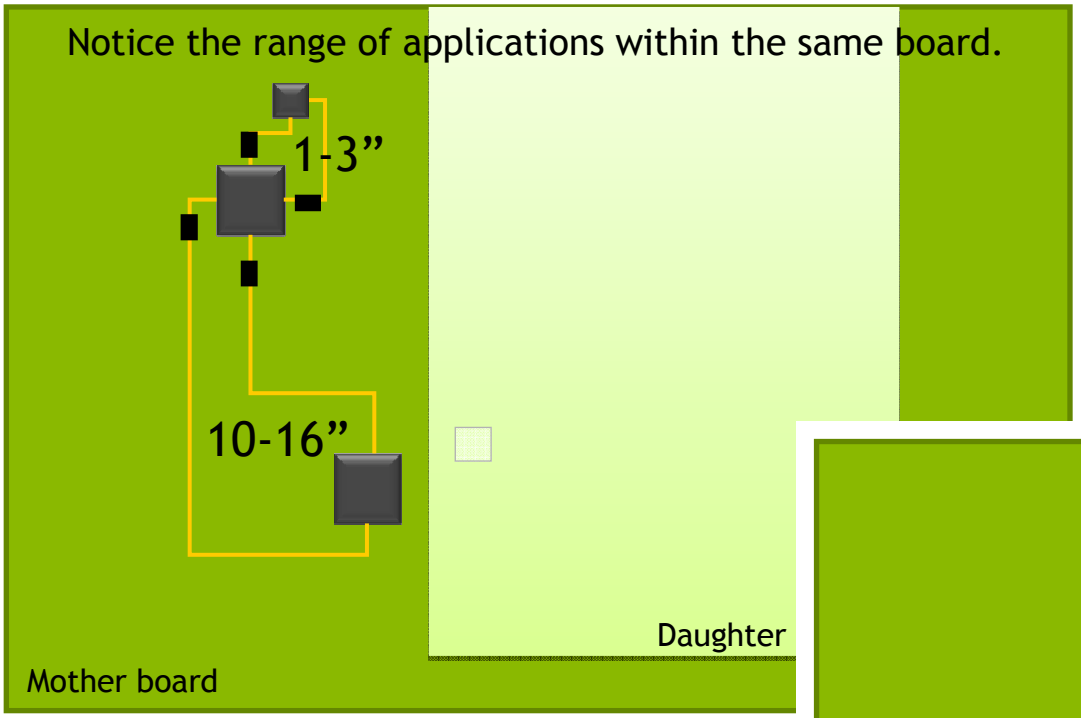
- Product breadth
  - Generally a system vendor has numerous product families across product portfolio
  - Switching – low-end access to high-end core
  - Routing – low end access to high-end core
  - Transport – low-end access to high-end core
  - Server – low-end server to high-end blade server
- Applications / Products – lots of different types
  - High-end, mid, low-end
  - Different capacities to support
  - Different cost targets
- The application, its economics and competitive considerations will dictate the solution

(from Nowell_01_0112)

cisco Alcatel·Lucent

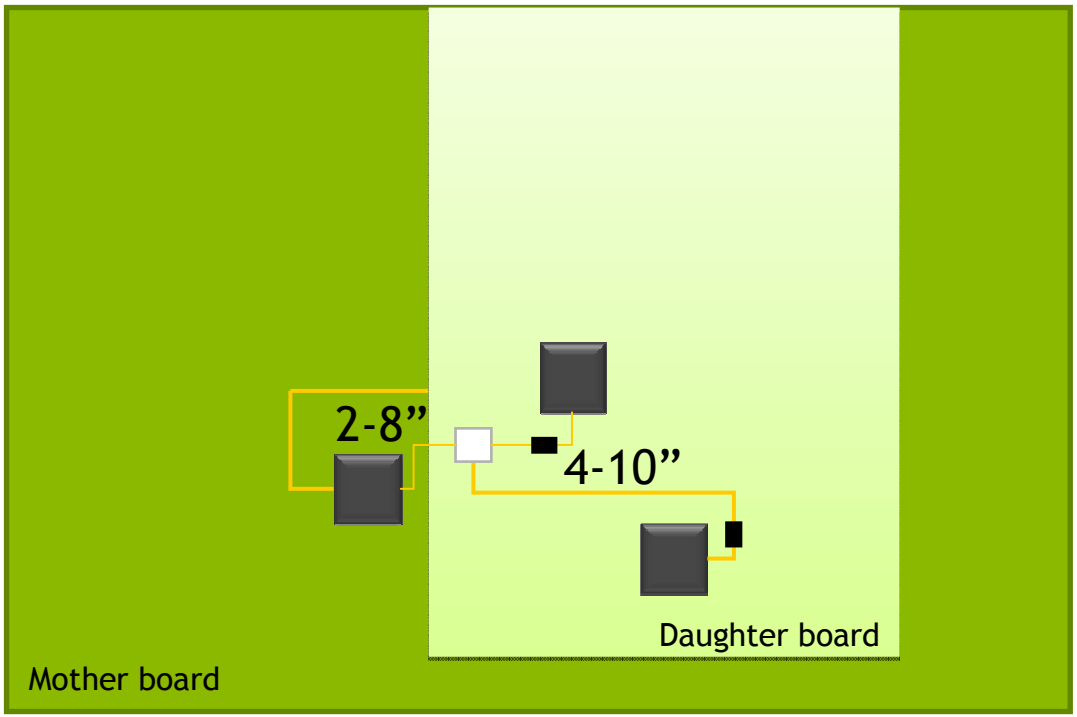
Example Applications (2)

- Chip-to-Chip channel - single-board



Cisco Example

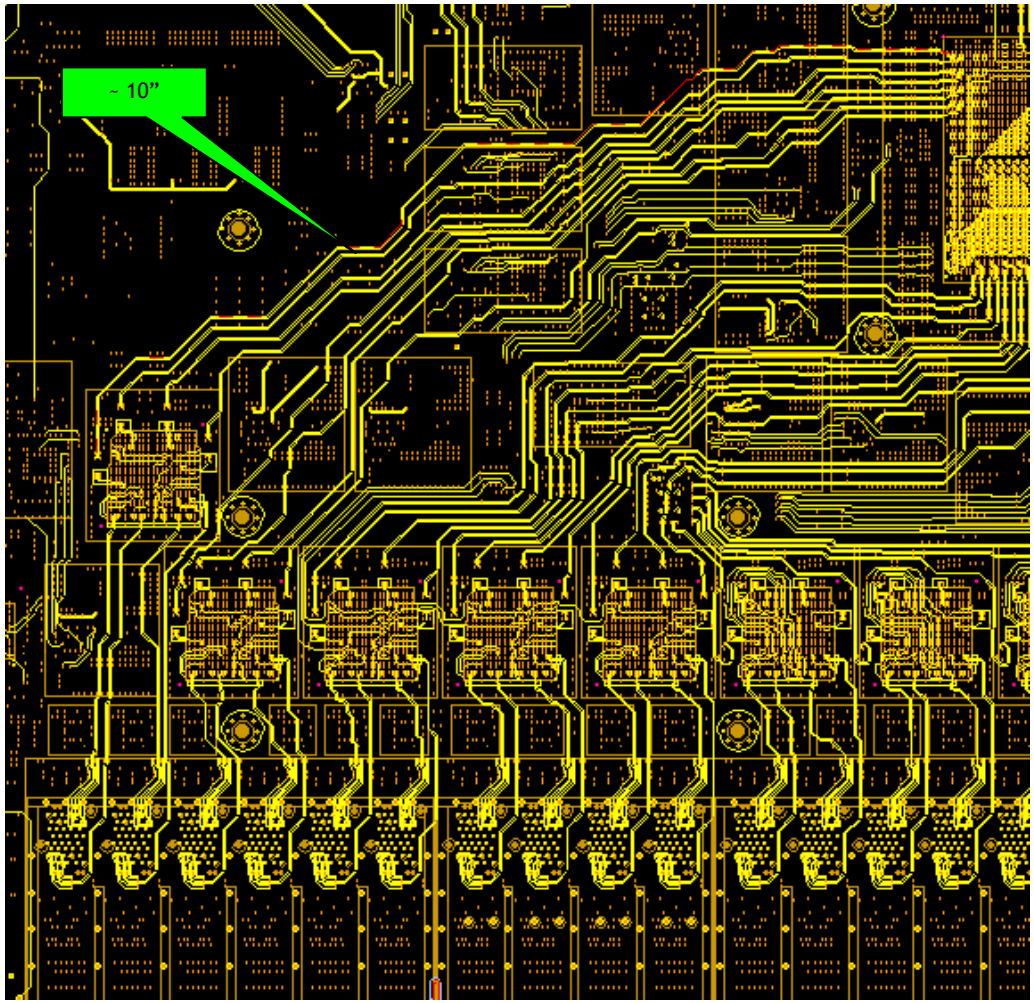
- Chip-to-Chip channel – multi-board (1 connector)



Example Applications (1)

- Chip-to-Chip channel - single board

Alcatel-Lucent Channel

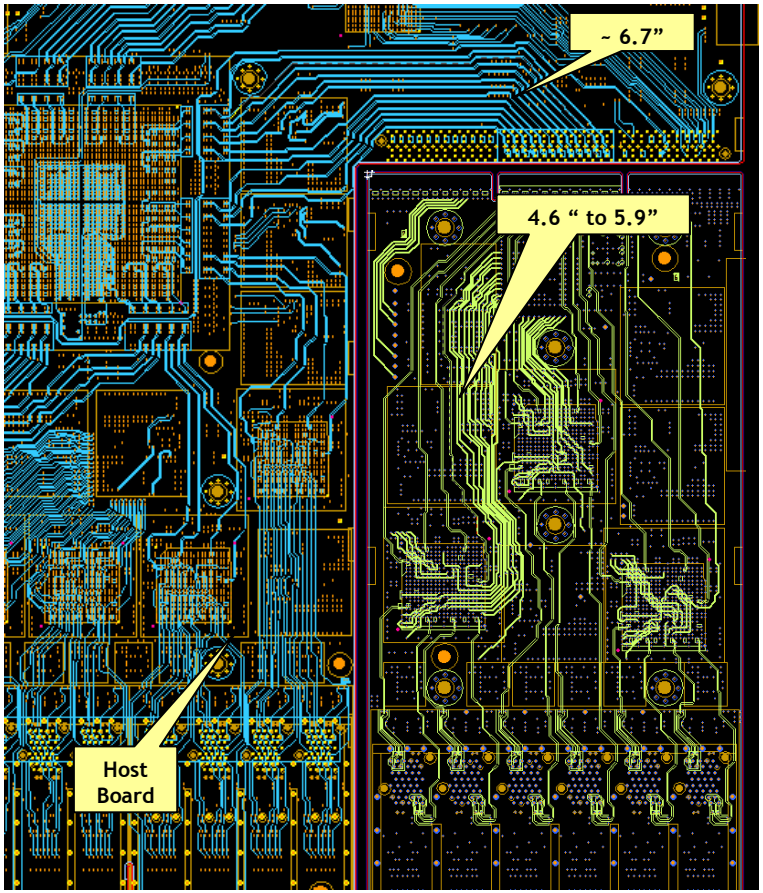


cisco Alcatel·Lucent

Example Applications (3)

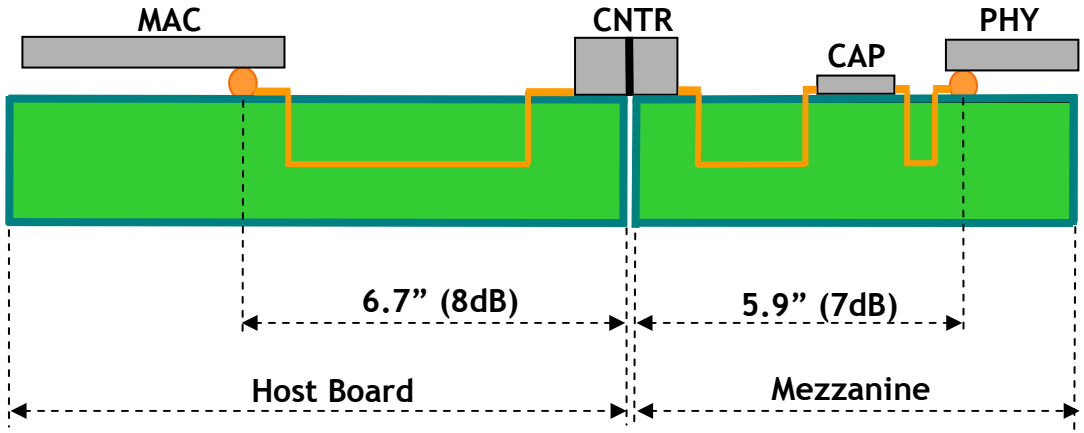
- Chip-to-Chip channel - multi-board (1 connector)

Alcatel-Lucent Channel



If we assume…

- Megtron 4, stripline (IL ~1.2dB/in *)
- De-coupling cap in channel
- Top-of-the-line connector



Host Board (dB)	Mezzanine (dB)	Connector Loss (dB)	6 vias (dB)	Total Channel Loss (dB)
8	7	1	3	19

Notice: A typical nominal case shows well over 15dB!

* Source: P802.3bj CFI_01_1110.pdf

cisco Alcatel·Lucent

Keep 15dB as an objective...

- Forces end-users to utilize alternatives to cover basic applications
  - ie: use of retimers/repeaters, use of more sophisticated/expensive materials
  - Will our solution become economically infeasible?
- End-users likely would have to resource to other port type interfaces
  - 802.3bj: 30dB with error correction disabled (overkill)
  - Other forum standards
  - Are we really meeting broad market potential??
- Users may resort to customized channels
  - Incompatibility from chip-to-chip vendors

Extend chip-to-chip to beyond 15dB…

- End-users will be able to cover a majority of applications
    - Increase broad market potential and use in industry
- Economic feasibility increases
    - System vendors can build useful applications of standard
    - Extended ‘reach’ and minor portion of industry can utilize alternative methods
- Other examples exist in industry
    - ie: OIF CEI-25G-MR (draft)
- Technical feasibility has been proven – let’s look to improvements in method/power from what has been proven.

What are our options? (3)

We **need** to recognize that there needs to be enough loss budget for the channel to be realizable!

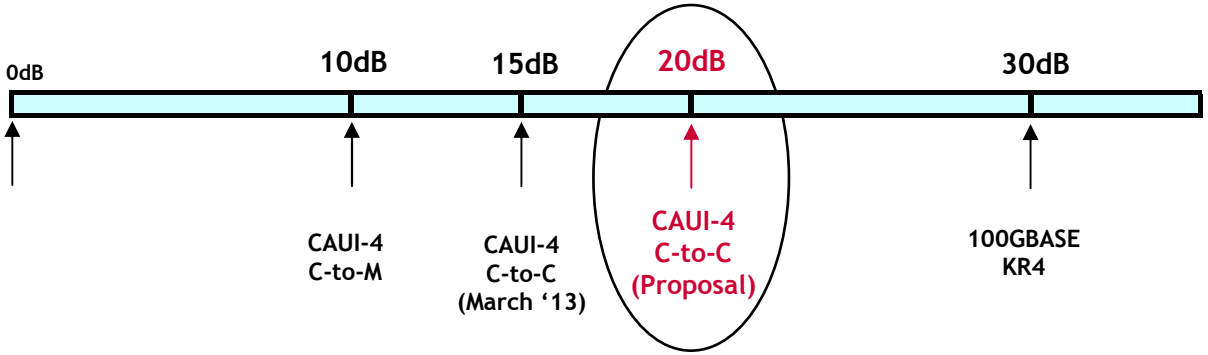
Although PCB technology has improved it must be acknowledged that physical constraints are not also scaling.

- Boards become **more** cluttered, routing flexibility becomes constrained
- Chips become **larger**, routing becomes longer
- Increased speeds **constrain** loss
  - skin effect, surface roughness, manufacturing tolerances, etc.
- …the opposite of extra margin to give away!

Question: How many designs have channels with more than 15dB loss?
Answer: "One is too many." Need to have a minimum number of different chips to implement in a single design.

Insertion Loss (IL) Proposal

- 802.3bm chip-to-module IL: 10dB
- 100GBASE-KR4 IL (no FEC): 30db
- 802.3bm chip-to-chip (previously proposed): 15dB
- Alcatel-Lucent example of a typical application: 19dB



We have demonstrated a *market need and economical reasons* to propose:

Define CAUI-4 chip-to-chip insertion loss of 20dB.

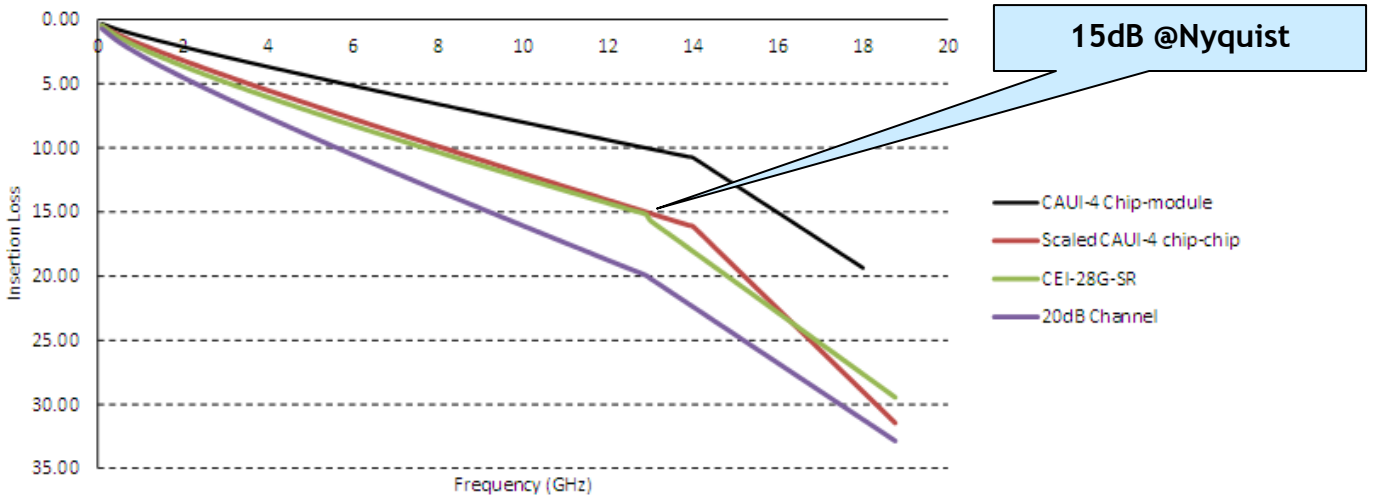
cisco Alcatel·Lucent

Thank you !

Backup Slide - 802.3bm CAUI-4 Chip-to-Chip PHY Interface

Source: latchman_02_0313_optx - Slide 7

CAUI-4 chip to chip informative channel characteristics



- Insertion Loss = 1.614 (0.075 + .537f^(0.5) + 0.566f) 0.01<=f<14
  1.614 (-18+2f) 14<=f<18.75
- Or insertion loss increase depending on simulation results with Ali's & Mike's channel (http://www.ieee802.org/3/bm/public/jan13/li_01_0113_optx.pdf)
- Return loss = TBD

cisco Alcatel·Lucent

www.alcatel-lucent.com

www.cisco.com