

Potential Issues and Solution of Dual FEC option for 100GBASE-KR1/CR1

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Background

1. “Clause 91 FEC” and “Interleaved FEC” dual FEC option is under discussion for 100GBASE-KR1/CR1.
 - “Clause 91 FEC” has very clear scenarios, it must be implemented in the Host ASIC.
 - “Interleaved FEC” is dedicated for multi-tap DFE receiver under the “most difficult channel” which has not been found yet.
2. Necessity of “Interleaved FEC” is questioned for host ASIC.
 - The FEC performance for multi-tap DFE is only a “concern”, but not a proven “issue”.
 - However, the “latency/power” of “Interleaved FEC” is not only a “concern” but a proven “issue”.
3. “Interleaved FEC” is not needed for links with retimer, without any doubt.
 - The links with retimers are not difficult, end-to-end “CL 91 FEC” is more than sufficient.
 - Neither “Interleaved FEC” on the host, nor “FEC termination/conversion” in retimer is necessary.
4. This contribution will explore the dual mode FEC option, to find issues and potential solution for the FEC choice.

Observations and Assumptions

1. Motivation of Dual mode FEC option is to benefit both worlds?
 - Lowest latency with “Clause 91 FEC” for most links don’t have burst error concern (scenarios confirmed).
 - “Interleaved FEC” for some links that want it. (The scenarios, necessity & benefit not been confirmed.)
2. AN (Auto-Negotiation) is applied to negotiate between two operating modes.
 - No change to AN architecture, AN only runs for MDI.
 - No change to LT architecture, LT only runs for MDI.
 - Negotiation happens only between “Host and Host”, “Host and Retimer” or “Retimer to Retimer”.

Observations and Assumptions

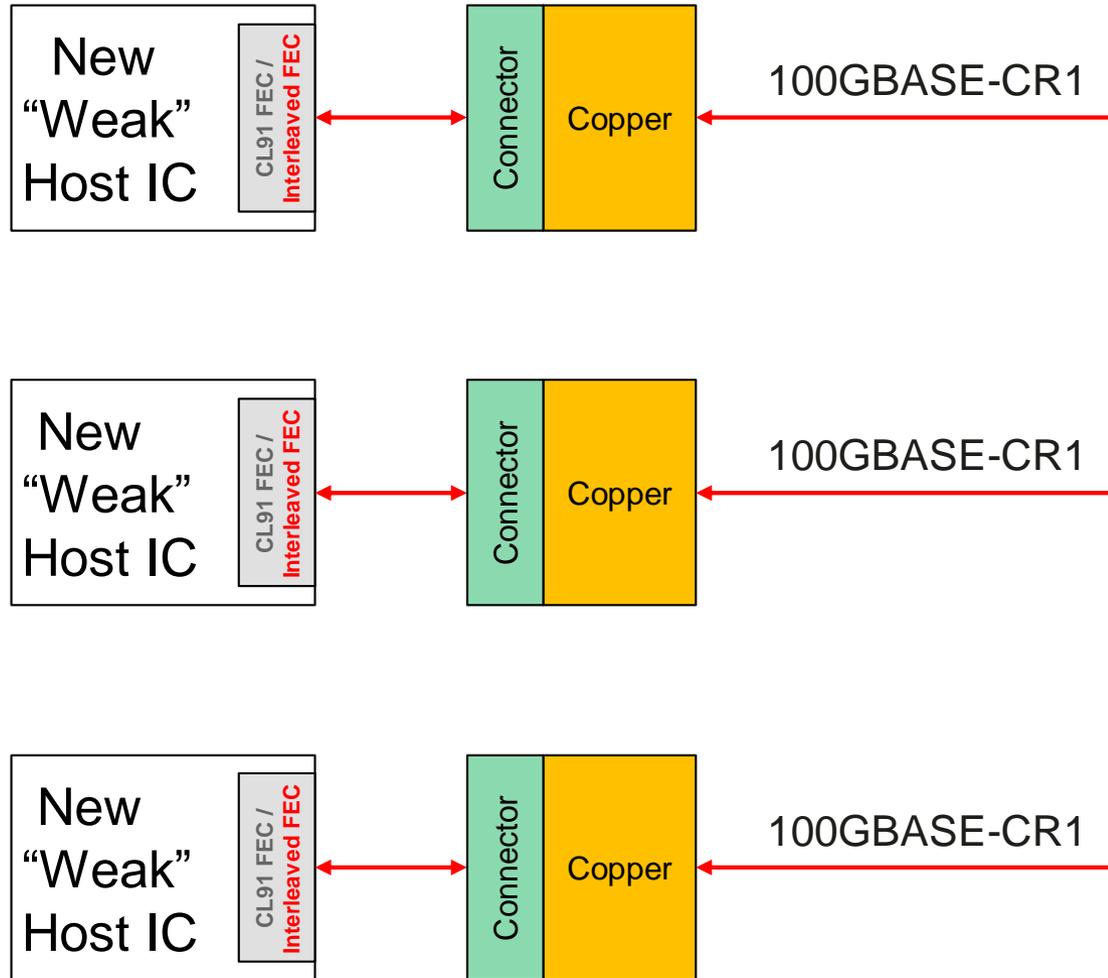
3. “Interleaved FEC” is assumed to be implemented in new host IC.
 - This is not an endorsement of “Interleaved FEC”.
 - At least one realistic “most difficult” channel is required to be provided in order to prove the necessity. (We can even remove “DFE weight Constraints”; but no manual modification of “DFE weights” to make artificial / unphysical channels.)

4. “Transparent Retimer” is preferred. Channels with retimers are covered by end-to-end “Clause 91 FEC”.
 - They are not “difficult” channels for sure.
 - No gain from “Interleaved FEC”, but huge cost in latency and power!

Controversial point: FEC selection

- **“Mandatory Interleaved FEC”**: If **either** side requests the “Interleaved FEC”, use “Interleaved FEC”; otherwise use “Clause 91 FEC”. [gustlin_3ck_01_0719](#)
- **“On-Demand Interleaved FEC”**: If **both** sides request the “Interleaved FEC”, use “Interleaved FEC”; otherwise use “Clause 91 FEC”. [lu_3ck_01_0719](#)

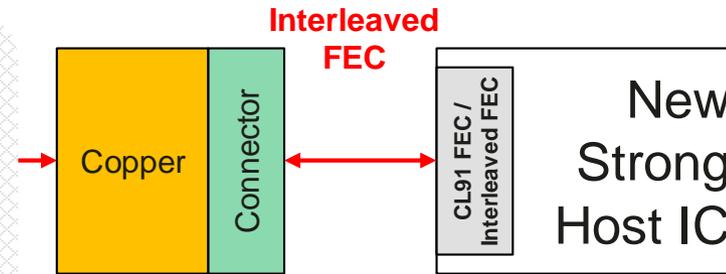
Scenarios and issues of “Mandatory Interleaved FEC”



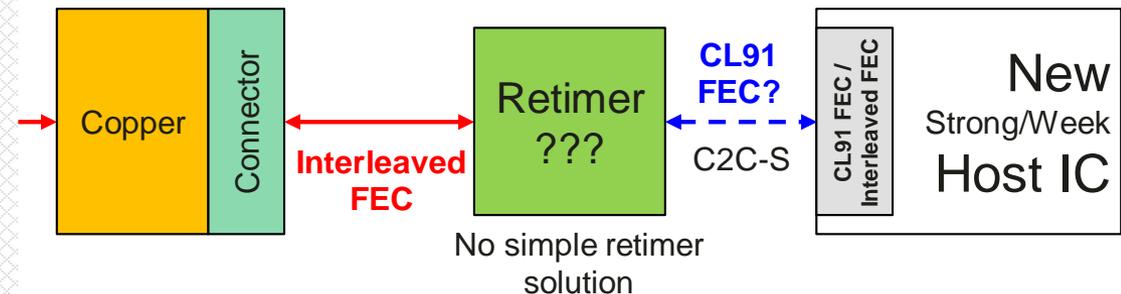
1. A “new” but “weak” host IC has FEC performance concern and requests “Interleaved FEC”.
2. It does not know if it is talking to a Host IC or a Retimer.
3. However, the other side must use “Interleaved FEC”.

Scenarios and issues of “Mandatory Interleaved FEC”

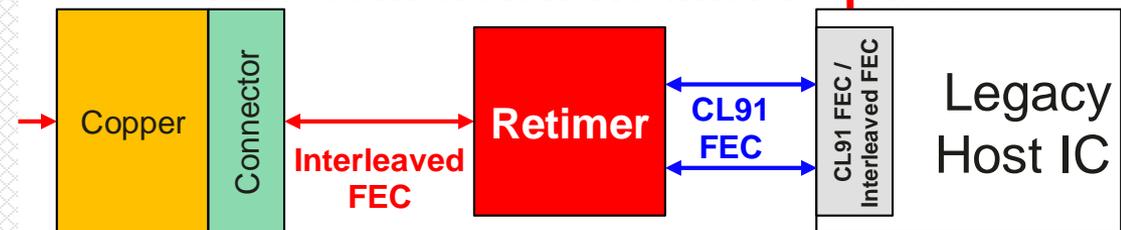
1. The “new” and “strong” host IC does not have any FEC performance concern, but has to response to “Interleaved FEC” request in all the cases, even the channel is not difficult.
2. **For links with retimers, “Interleaved FEC” brings no benefit. Latency and power are paid for nothing.**
3. **Protocol-aware Retimer is enough? Does it work? No simple retimer solution.**
4. The “Legacy Host IC” does not support “Interleaved FEC”. **Mandatory FEC conversion is required in retimer.**



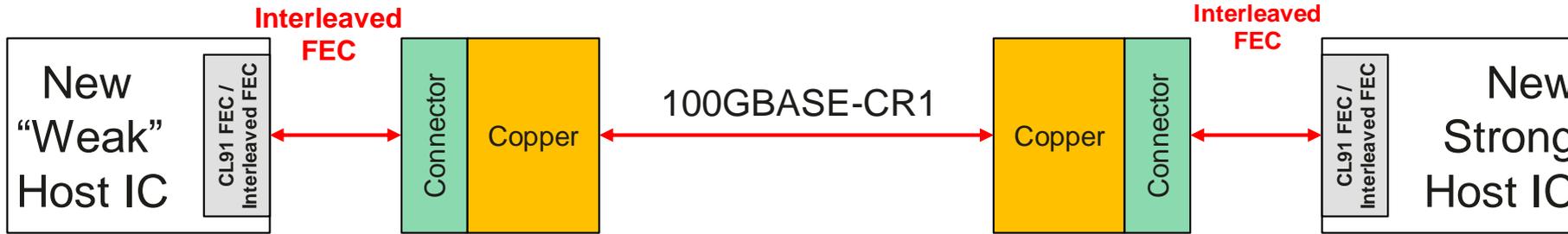
Protocol-aware Retimer is enough? Does it work?



FEC conversion Retimer required

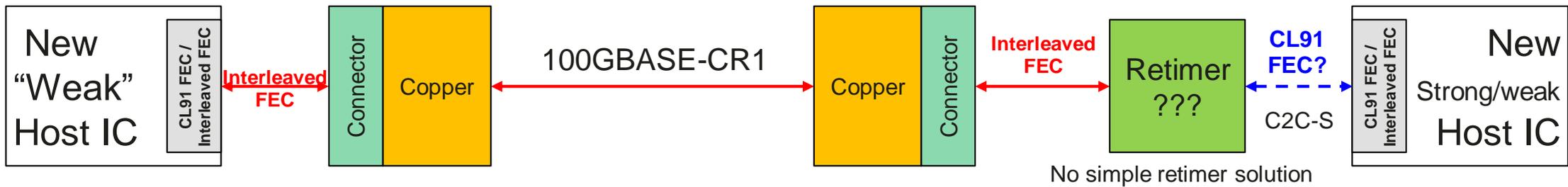


Scenarios and issues of “Mandatory Interleaved FEC”



“Most difficulty channel” has not been found. No benefit for almost all the channels, >50ns latency and power are paid for nothing.

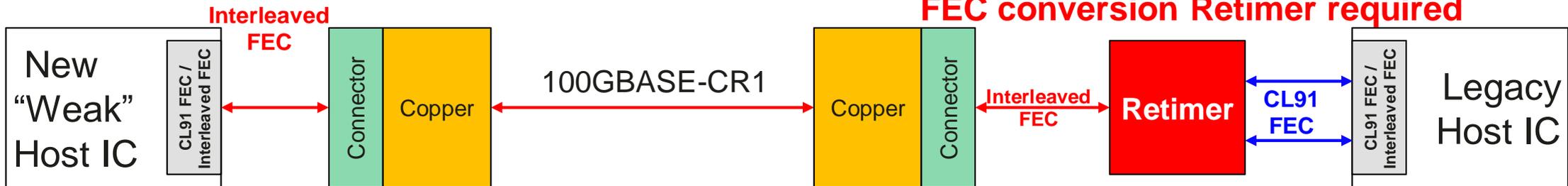
Protocol-aware Retimer is enough? Does it work?



No simple retimer solution

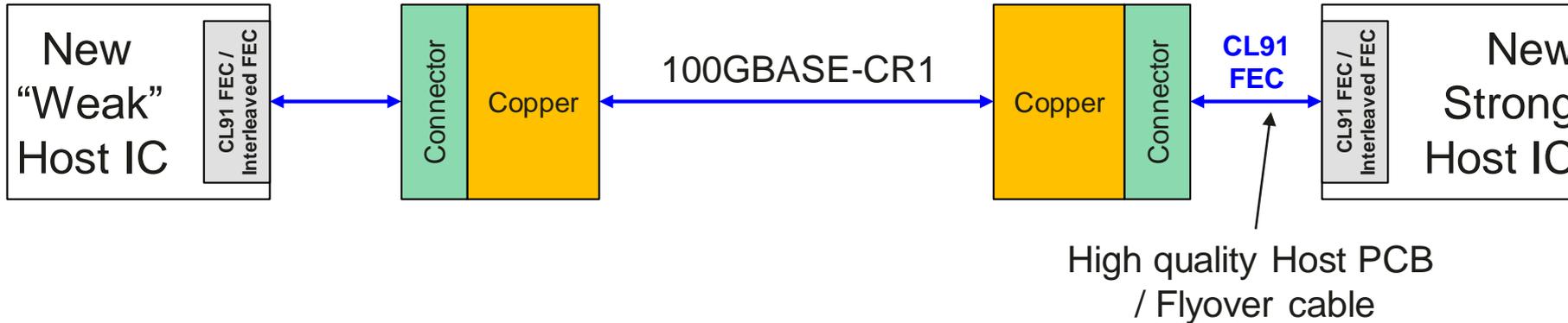
Not difficult at all, No benefit for all the channels, >50ns latency and power are paid for nothing.

FEC conversion Retimer required

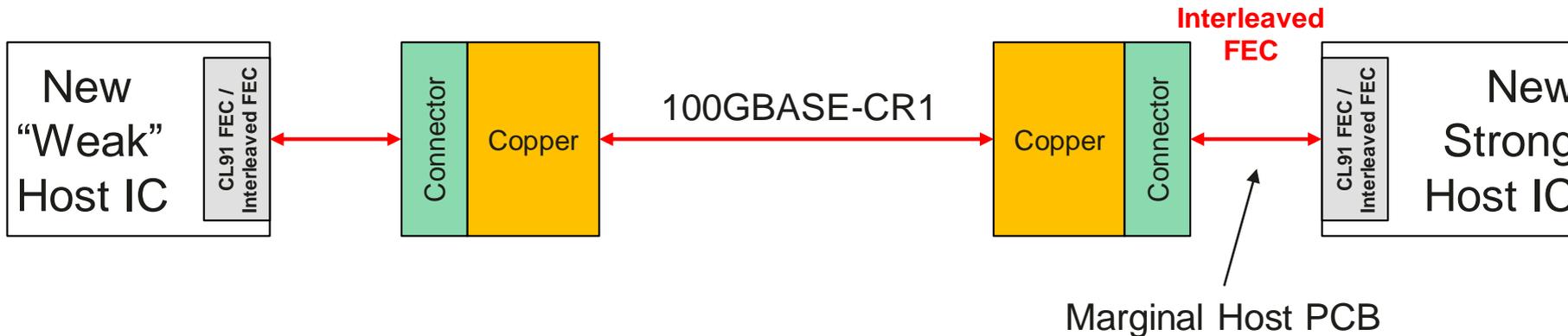


Not difficult at all, No benefit for all the channels, >150ns latency and more power are paid for nothing.

Scenarios of “On-Demand Interleaved FEC”: w/o retimer



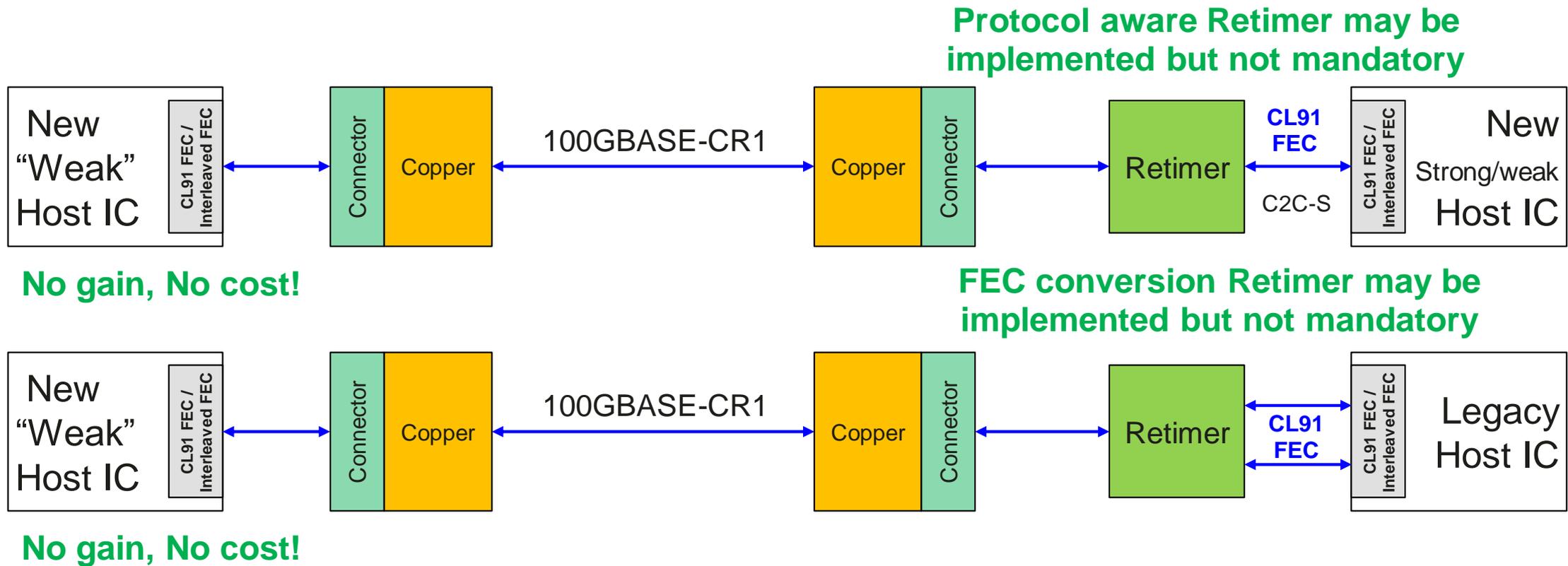
Discard “Interleaved FEC” request, and use CL91 FEC, because this is not a difficult channel.



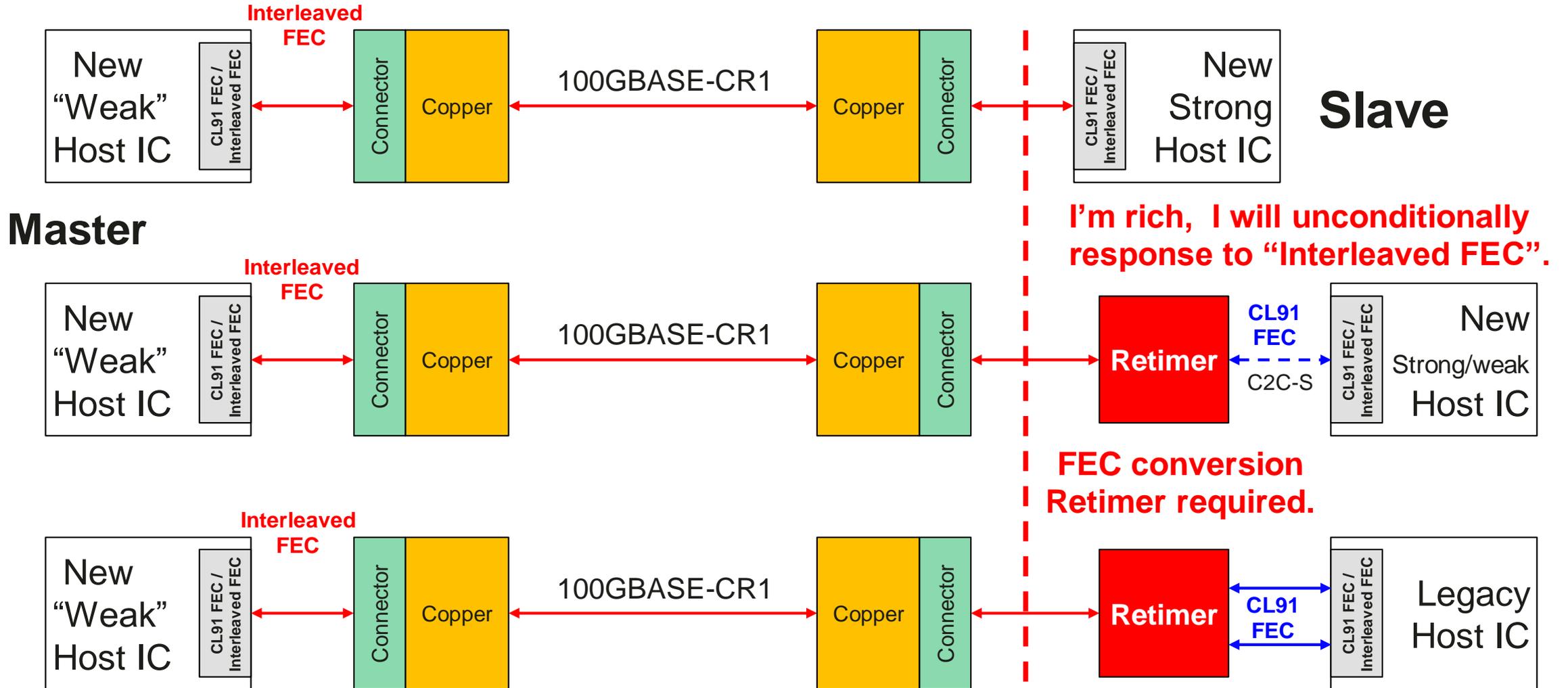
May response to “Interleaved FEC”.

No gain, No cost. “Interleaved FEC” is on when necessary, i.e. both sides request. AN works.

Scenarios of “On-Demand Interleaved FEC”: with retimer



Scenarios of “On-Demand Interleaved FEC”: Always on



Summary

- **“Mandatory Interleaved FEC”**: If **either** side requests the “Interleaved FEC”, use “Interleaved FEC”; otherwise use “Clause 91 FEC”. [gustlin_3ck_01_0719](#)
 - **Protocol-aware Retimer is not enough, no simple retimer solution!**
 - **Requires FEC conversion Retimer (Mandatory).**
 - **Links with retimers are not difficult at all. Why interleaved FEC?**
- **“On-Demand Interleaved FEC”**: If **both** sides request the “Interleaved FEC”, use “Interleaved FEC”; otherwise use “Clause 91 FEC”. [lu_3ck_01_0719](#)
 - **“Interleaved FEC” is used when necessary. No gain, No Cost.**
 - **Simple retimer can be used.**
 - **Benefits for both worlds, low latency and high reliability.**

“On-Demand Interleaved FEC” is recommended to truly benefit both world!

Thank you !

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