Low-latency Schemes for 50GE

Phil Sun, Credo

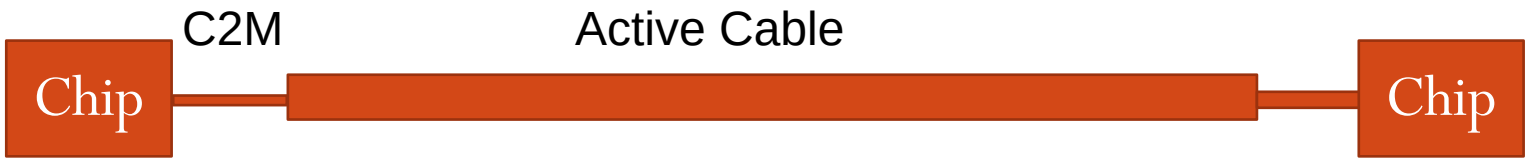
Introduction

- **In January interim meeting, the importance and possible solutions of 50GE low-latency link have been discussed in multiple presentations:**
  - [1] 50G, 100G & 200G SERVER CONNECTIVITY
  - [2] Breakout applications and impacts on objectives for 50/200G Ethernet
  - [3] No-FEC Link for 50GE

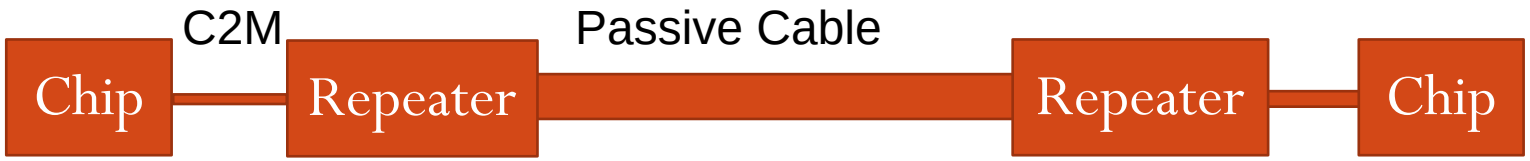
- **The presentation is to clarify/demonstrate two possible schemes:**
  - No-FEC C2M and C2C
  - Lower-latency FEC

No-FEC C2M and C2C

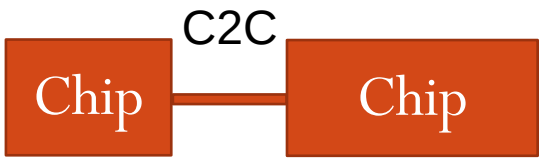
- What does this mean?
  - BER is lower than 1e-12, so no FEC is needed for the whole link.
- What does it look like?
  - With active cables:



  - With repeaters:



  - Short-reach chip to chip:



No-FEC C2M and C2C

- What to be defined?
  - BER target: 1e-12 without FEC.
  - Insertion loss: 6dB to10dB @ 12.89 GHz. The reach needs to meet application needs while easy enough to enable low BER.

- Considerations:
  - Very low latency as no FEC is involved!
  - FEC Power can be saved.
  - Flexibility to add external customized FEC without having KP4 FEC latency penalty.
  - Repeaters or active cables are required for copper cable link.
  - Impact on current PMD needs to be analyzed.

Lower-latency FEC

- KR4 and KP4 FEC frame latency is more than 100ns. A typical decoder may require another 70ns to100ns decoding latency.

- If FEC latency needs to be less than 100ns [1], a lower-latency FEC is needed.

- RS(272,257,t=7,m=10) may be a good candidate:
  - Same primitive field and generator polynomials as KP4/KR4 FEC.
  - Same clock rate as KP4 FEC.
  - Compatible with transcoding and AM schemes used for KP4 FEC.
  - Most of the logic can be shared with KP4/KR4 FEC.
  - 1 more FEC modes, but manageable.
  - Another candidate that can be easily added is RS(264,257,t=3,m=10). But RS(272,257) performance is much better.

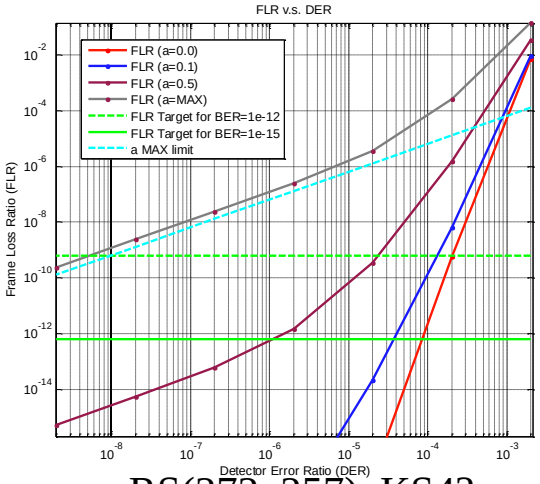
FEC Performance on Electrical Link

- This analysis assumes precoding is used, or error propagation rate can be limited to 0.5 for low-latency channels.
- Latency is a trade off of complexity.

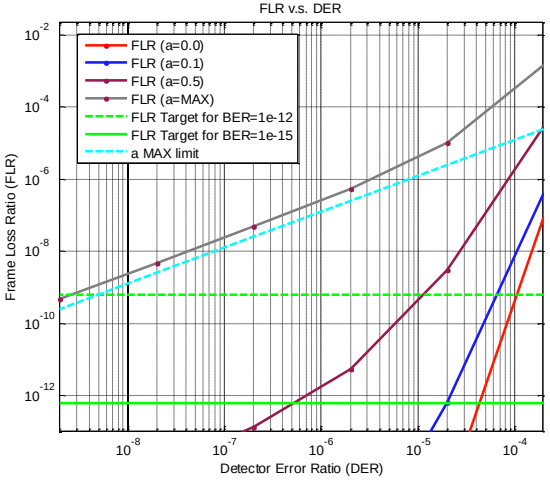
FEC	DER for 1e-12 BER "a"=0.5	DER for 1e-12 BER with precoding	Latency
RS(544,514), KP4	3.1e-4	2.0e-4	198ns
RS(528,514), KR4	1.1e-5	9.0e-6	169ns
RS(272,257), KS4?	2.4e-5	1.8e-5	99ns
RS(264,257)	2.3e-9	5.6e-8	86ns

- In this case, RS(272,257) can tolerate higher than 1e-5 DER (about the same DER target as 802.3bs C2C and 802.3bj KP4) while achieves less than 100ns latency.

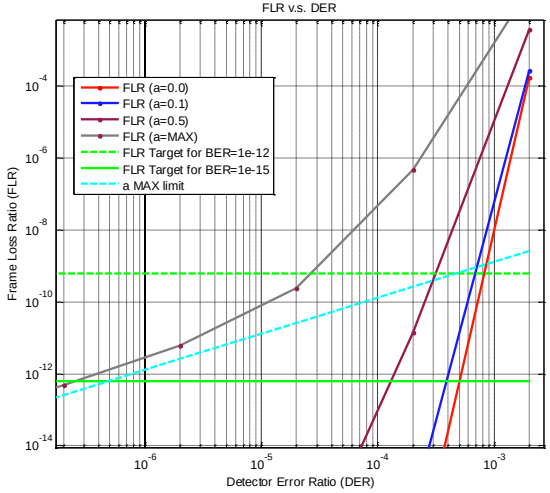
FEC Performance on Electrical Link



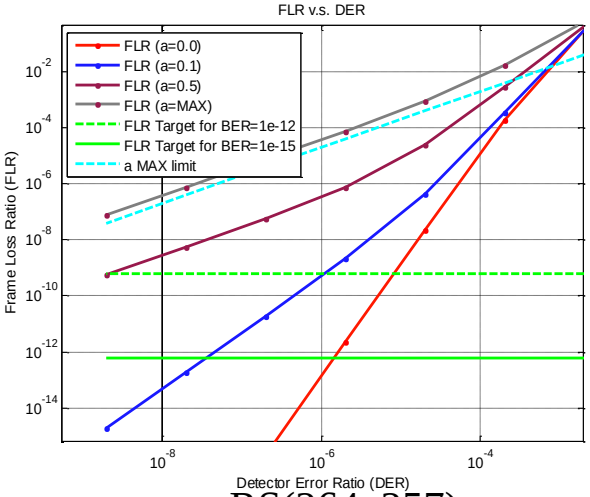
RS(272, 257), KS4?



RS(528, 514), KR4



RS(544, 514), KP4



RS(264, 257)

Conclusions

- **Conclusions:**
  - There are promising approaches for Low-latency link.
    - No-FEC C2M and C2C
      - Lower latency.
    - Lower-latency FEC
      - Easy to be added.

Thanks!