

C2C return loss and test fixture

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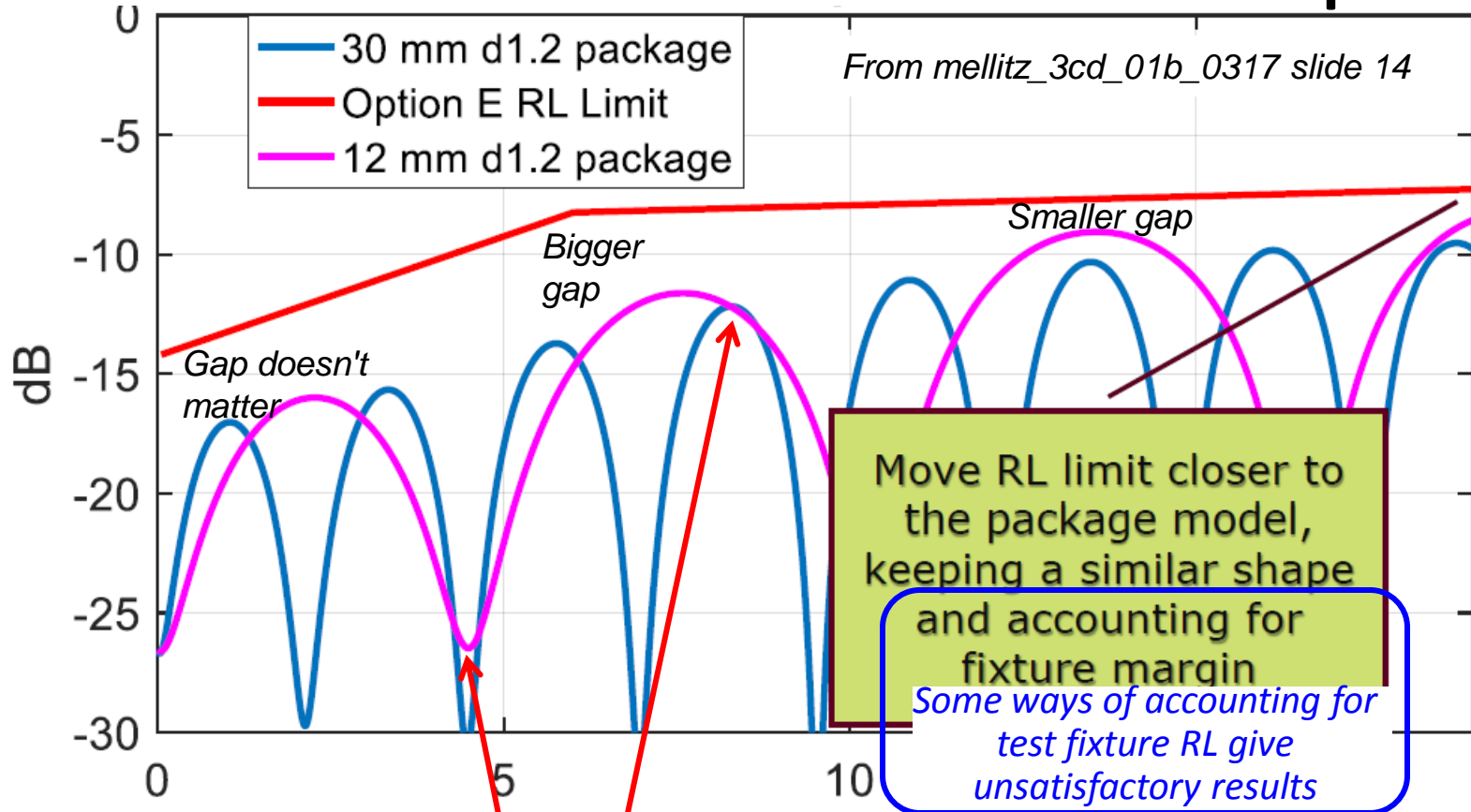
Mellanox

Some related issues with C2C spec

1. 400GAUI-8 C2C needs a channel RL spec to complement the RL spec it has (Clause 137 has a channel RL spec already)
2. 400GAUI-8 C2C test fixture RL is not compatible with tightened RL spec
3. 400GAUI-8 C2C RL is too tight at low frequencies

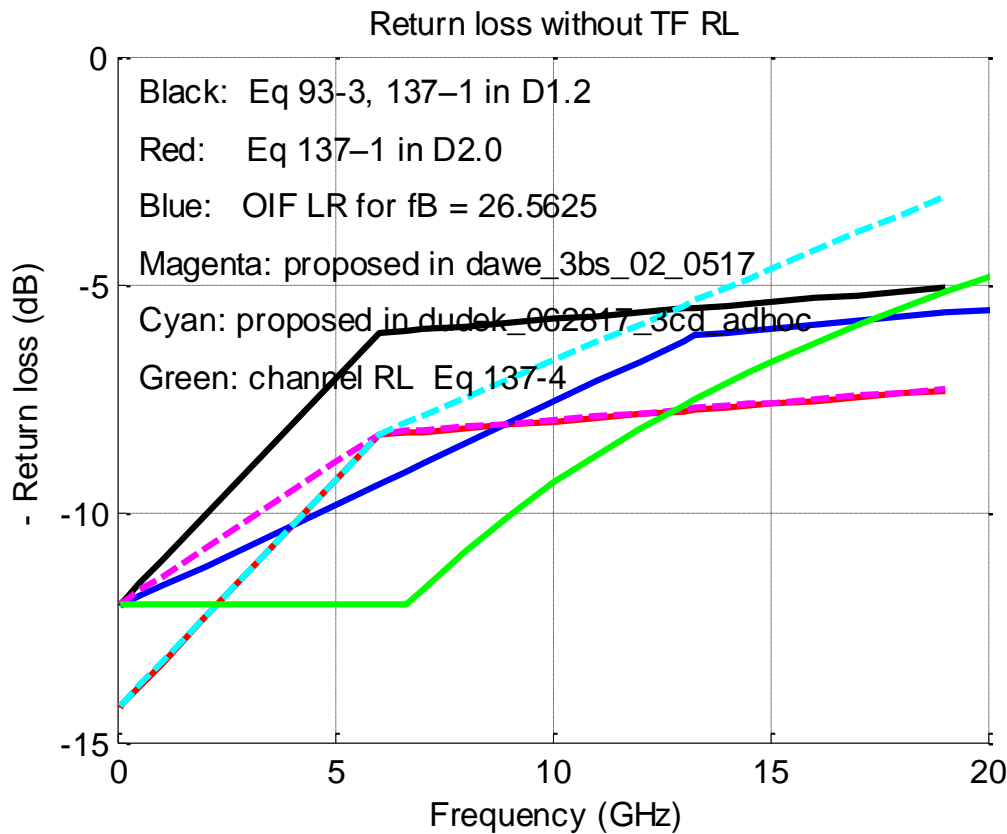
1. C2C needs a channel RL spec
 3. C2C RL is too tight at low frequencies
- For much the same reason we have a Tx return loss spec – to control echoes between e.g. Tx and channel that cause ISI that COM does not know about
 - See `dawe_3bs_02_0517` for some initial calculations on this
 - It turns out that the end-to-end reflections are insignificant in comparison; except for channels with minimal loss, the channel insertion loss, which appears twice in an echo path, makes them much smaller than end-to-channel reflections.
At very low frequencies they could have equal spectral density, but few hertz, and in practice at very low frequencies the channel RL is much better than -12 dB
 - For practical RL limits, it seems that the 5-15 GHz range is the important area

1. C2C needs a channel RL spec



- A channel reflection at this frequency degrades that channel's long-package COM
 - as it should
- A channel reflection at this frequency is pretty much ignored by COM
 - gap in the spec
- We could add more COM package lengths, but...
- A channel RL spec is useful because it treats reflections consistently with frequency

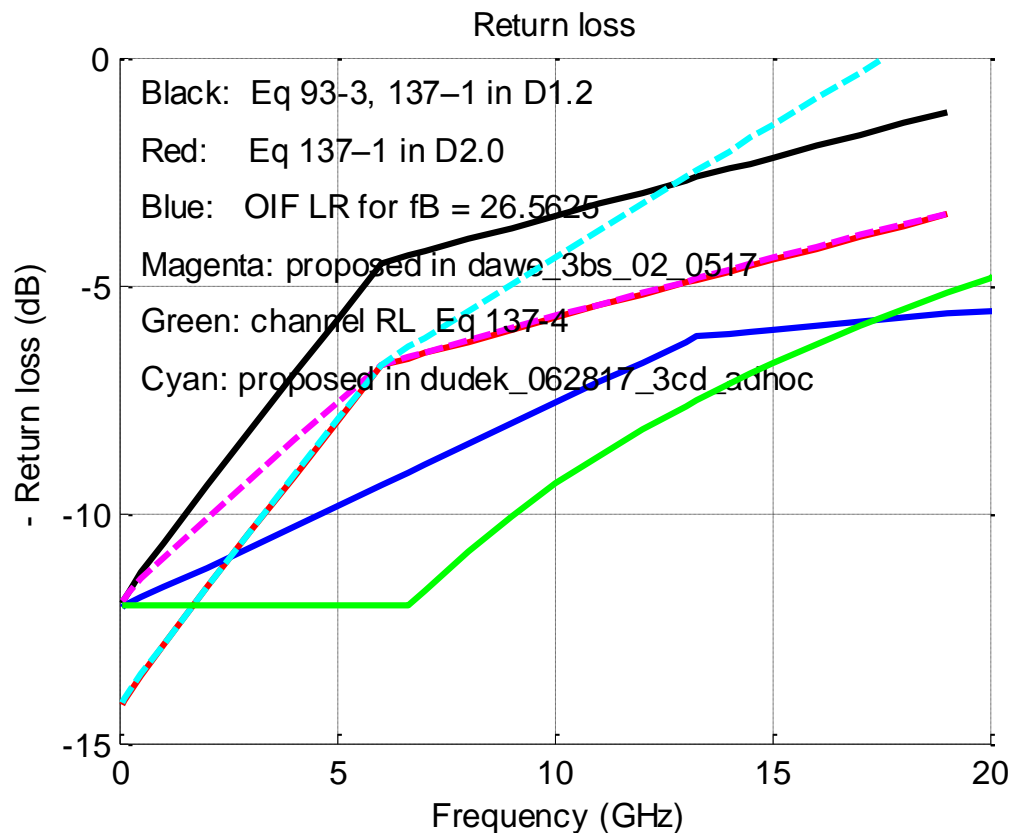
Showing the Clause 137 channel return loss limit



Nominal return losses: channel and OIF at IC, others at test fixture

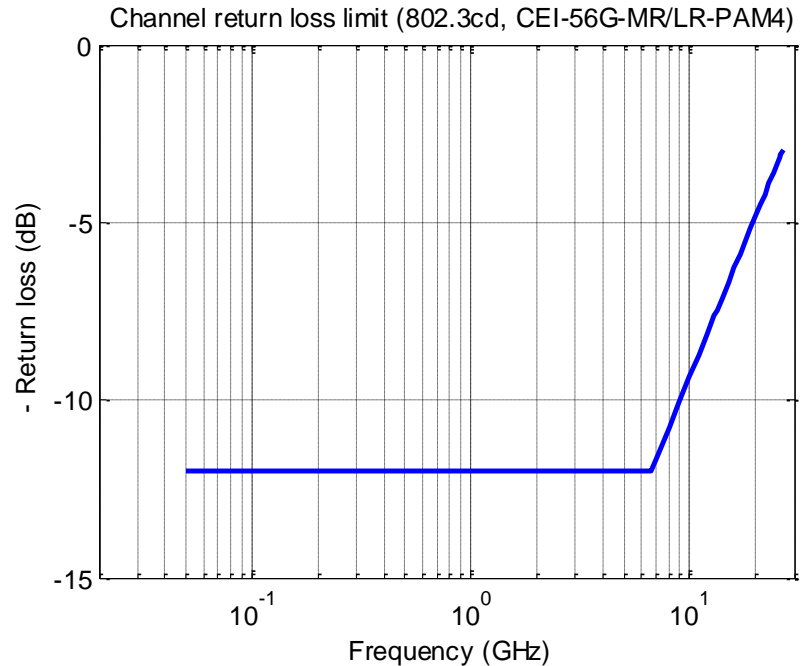
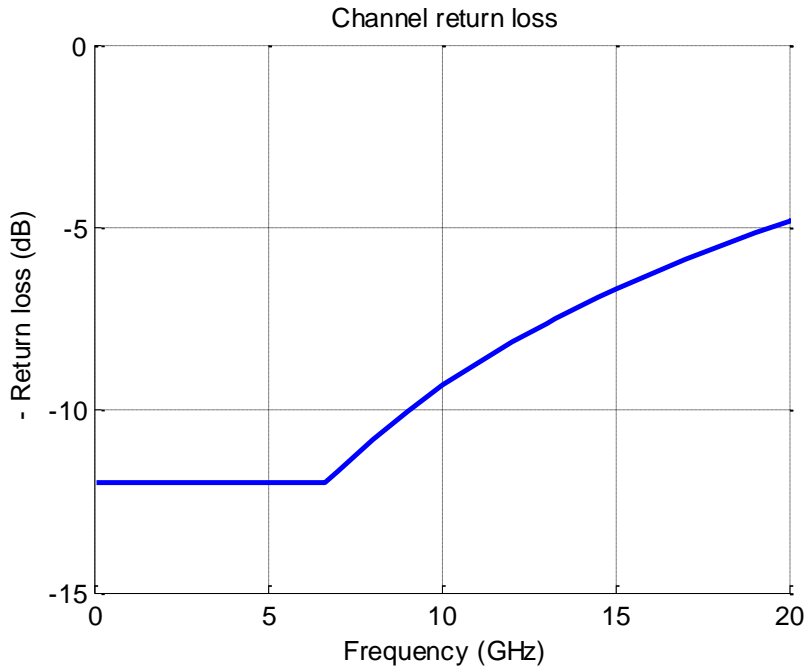
- Channels have lower return loss than this at very low frequencies – but that doesn't mean we need to adjust the spec there
- Should any C2C channel RL spec be the same as Cl. 137 -KRn?
- Should it apply to all channels, or e.g. only if $COM < 4$ or 5 dB?

Adjusting for test fixture IL but not its RL

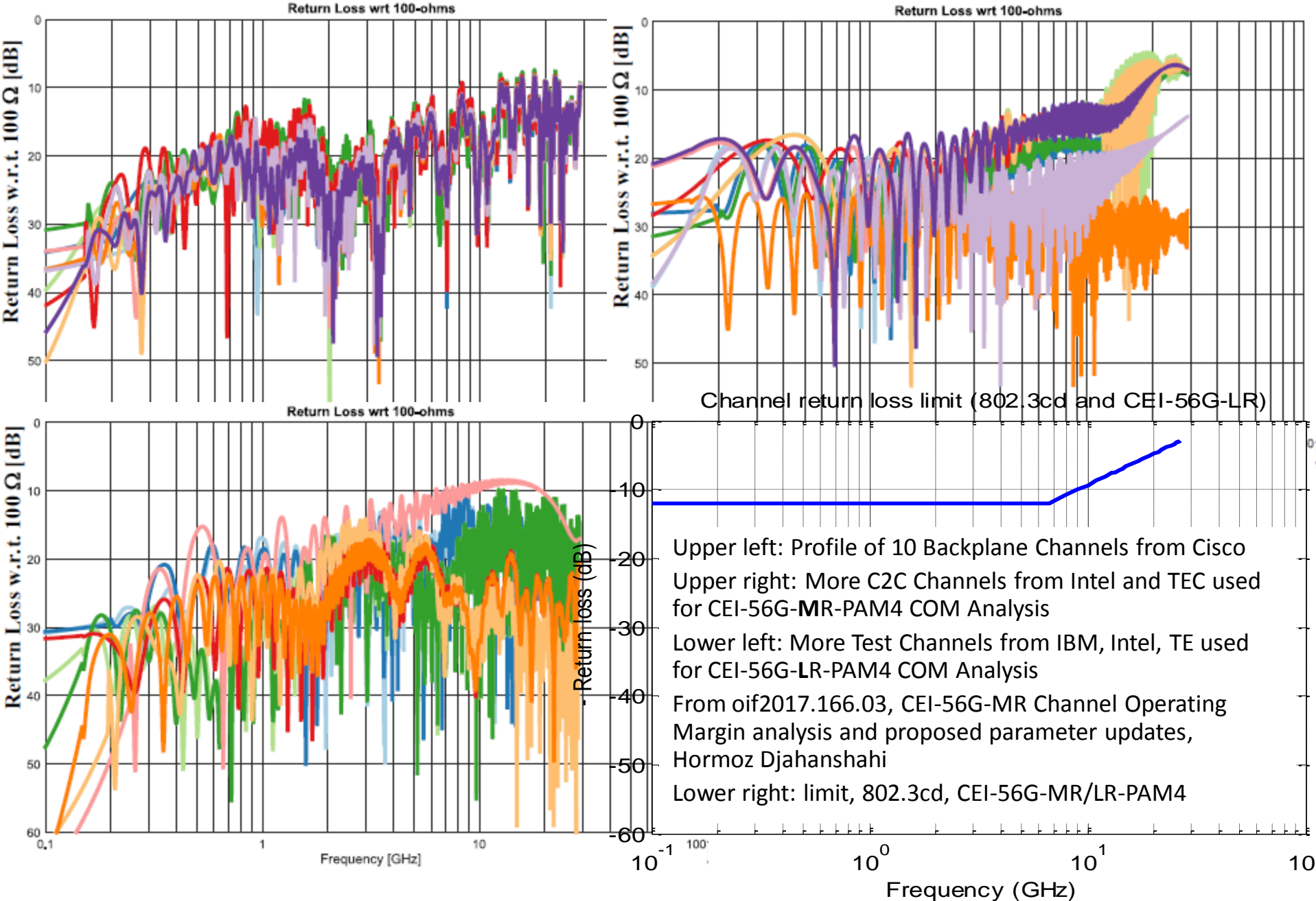


- Compare previous slide
- Red and cyan are too tight at low f
- Cyan is too loose at high f
- Black is too loose at mid f
- Green – compare next two slides

Channel return loss



- Channel return loss (at TP0 or TP5) from 802.3cd Eq. 137-4 and OIF
- CEI-56G-MR-PAM4 Eq 17-3 and LR-PAM4 Eq 21-3 (*but not C2C*)
- *C2C needs a channel RL spec, otherwise the Tx RL spec is not very useful*

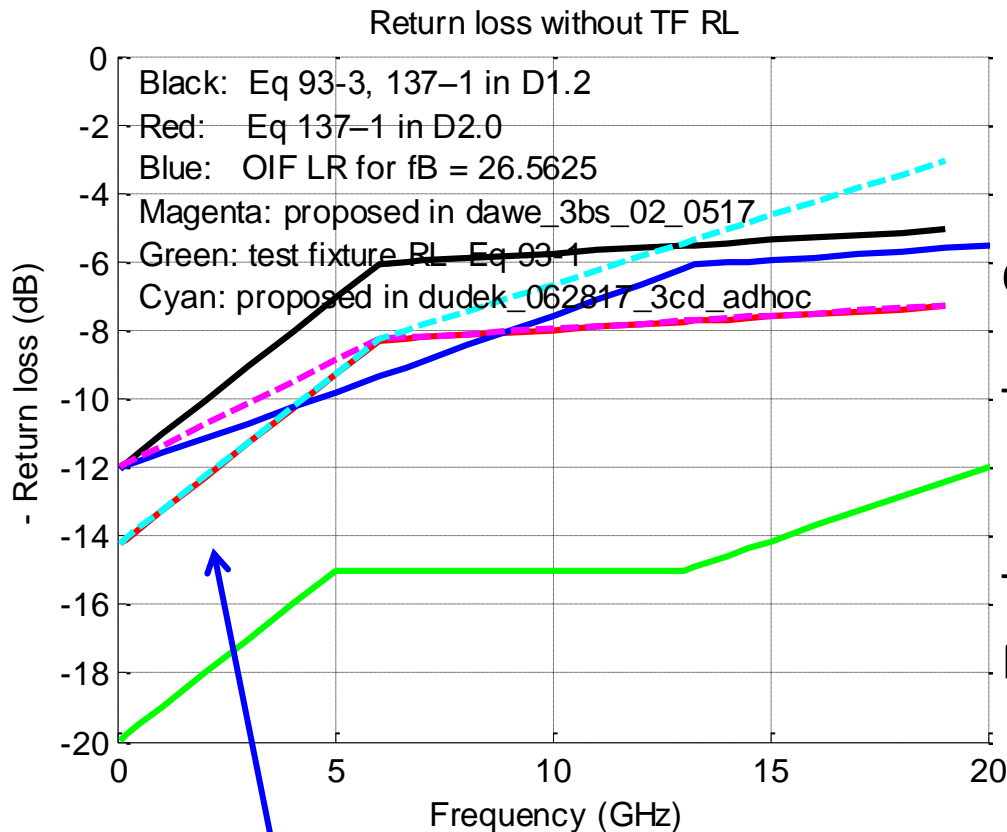


Upper left: Profile of 10 Backplane Channels from Cisco
 Upper right: More C2C Channels from Intel and TEC used for CEI-56G-MR-PAM4 COM Analysis
 Lower left: More Test Channels from IBM, Intel, TE used for CEI-56G-LR-PAM4 COM Analysis
 From oif2017.166.03, CEI-56G-MR Channel Operating Margin analysis and proposed parameter updates, Hormoz Djahanshahi
 Lower right: limit, 802.3cd, CEI-56G-MR/LR-PAM4

Test points and test fixtures

- 802.3bs C2C, 802.3cd -KRn, and OIF CEI-56G-MR-PAM4 and CEI-56G-LR-PAM4 define the channel insertion loss from package ball to package ball (TP0 to TP5)
- Three of them have channel return loss limits, to same test points
- 802.3bs C2C and 802.3cd -KRn specify return loss of transmitter or receiver as observed through a test fixture: at TP0a and Tp5a
 - This test fixture has specified insertion and return loss
 - It is not the same as a C2M compliance board

2. Backplane/C2C test fixture RL



The gap between spec RL and TF RL is too small

If the apparent RL is given by the red line, and the test fixture has allowed reflections per green line, the IC on the test fixture has to be **much** better than intended

Changing from black to red made this issue worse

The problem is worst at low frequencies, and for the red and cyan lines

The test fixture also has insertion loss
Per 93.8.1.1, "The effects of differences between the insertion loss of an actual test fixture and the reference **insertion** loss are to be accounted for in the measurements"

De-embed the return loss differences too, or tighten the TF RL spec?