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# **IEEE 802.3 Electrical Backplane/ Twinax Cu Cable SG Objectives**

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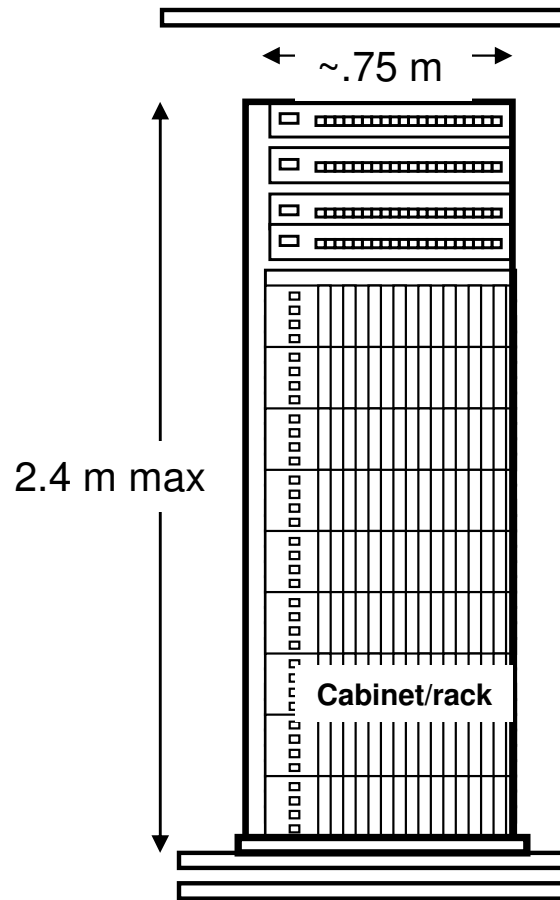
# Presentation

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- **Media reach; topology and applications**
- **Twinaxial cable assembly transmission characteristics**
  - **802.3ba Integrated crosstalk noise – QSFP**
  - **Noise basis for 100G Cu**

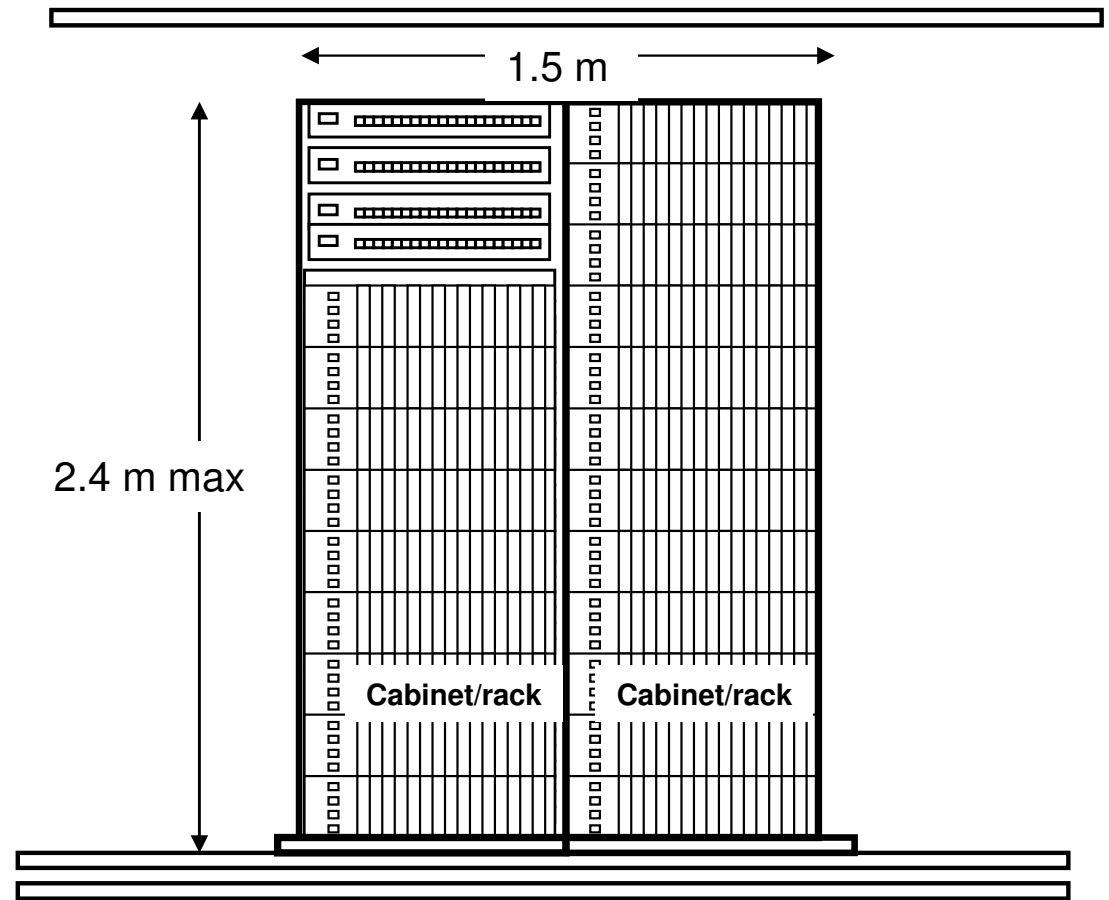
# Media reach

Intra-rack configurations



- at least 3m addresses majority of configurations

Inter-rack configurations



- 3 to 7m addresses a meaningful portion of configurations

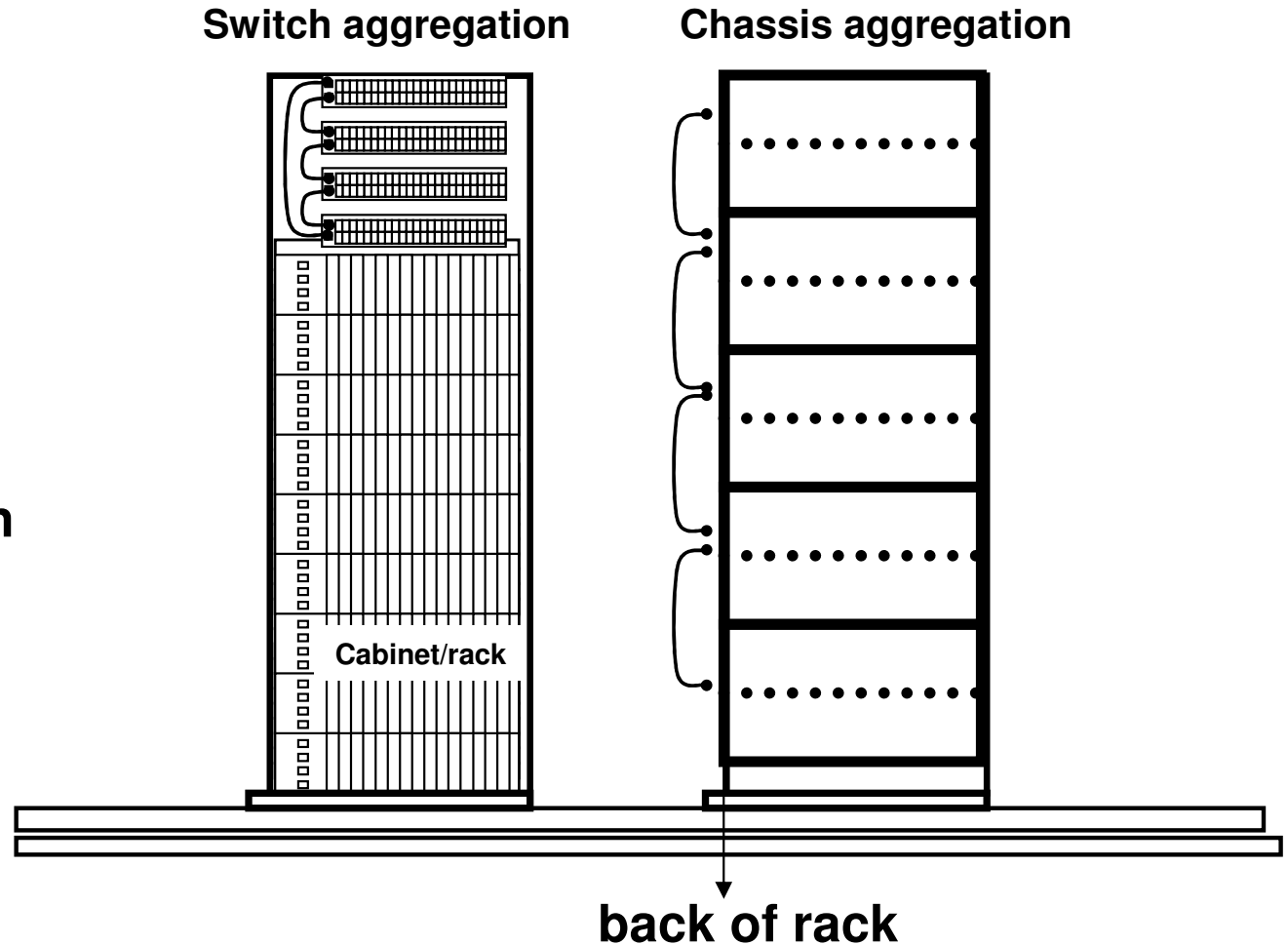
# Media reach intra-rack applications

## Switch aggregation

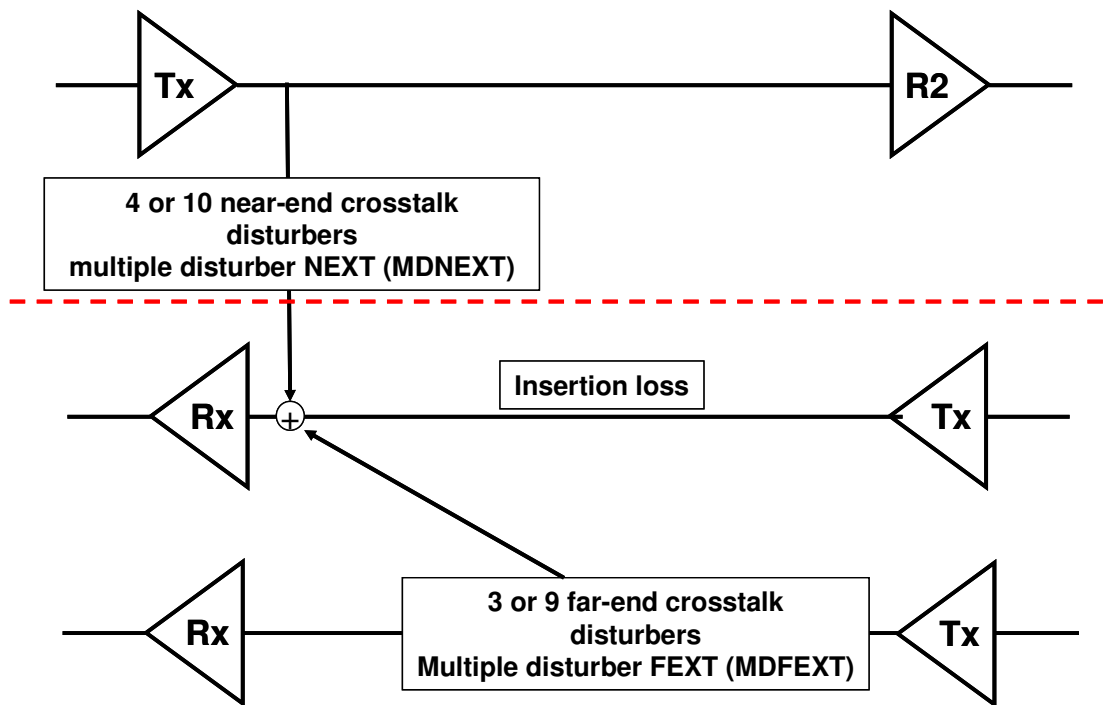
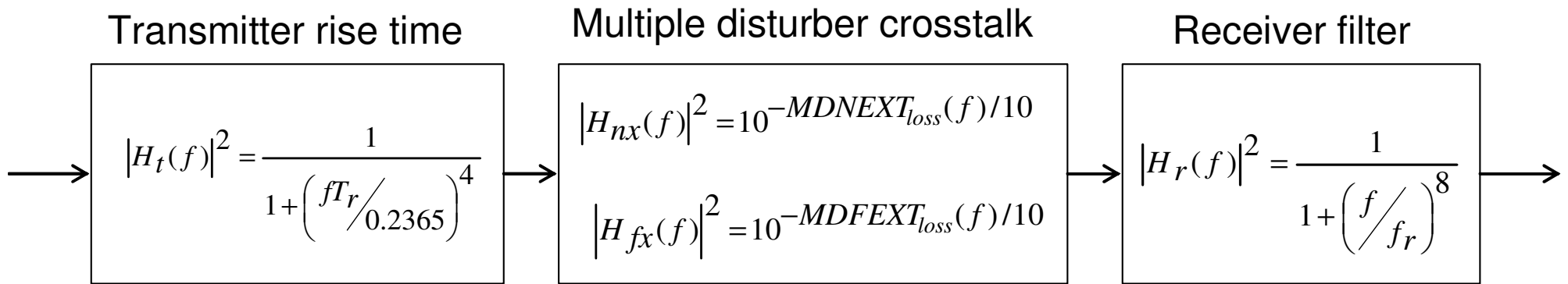
- Cost optimized
  - At least 3 meters addresses majority of configurations

## Blade/chassis aggregation /backplane extender

- Cost optimized
  - At least 3 meters addresses majority of configurations



# Integrated Crosstalk Noise



$$MDFEXT_{loss}(f) = -10 \log_{10} \left( \sum_{i=1}^{i=3 \text{ or } 9} 10^{-FEXT_{indiv}(f)/10} \right)$$

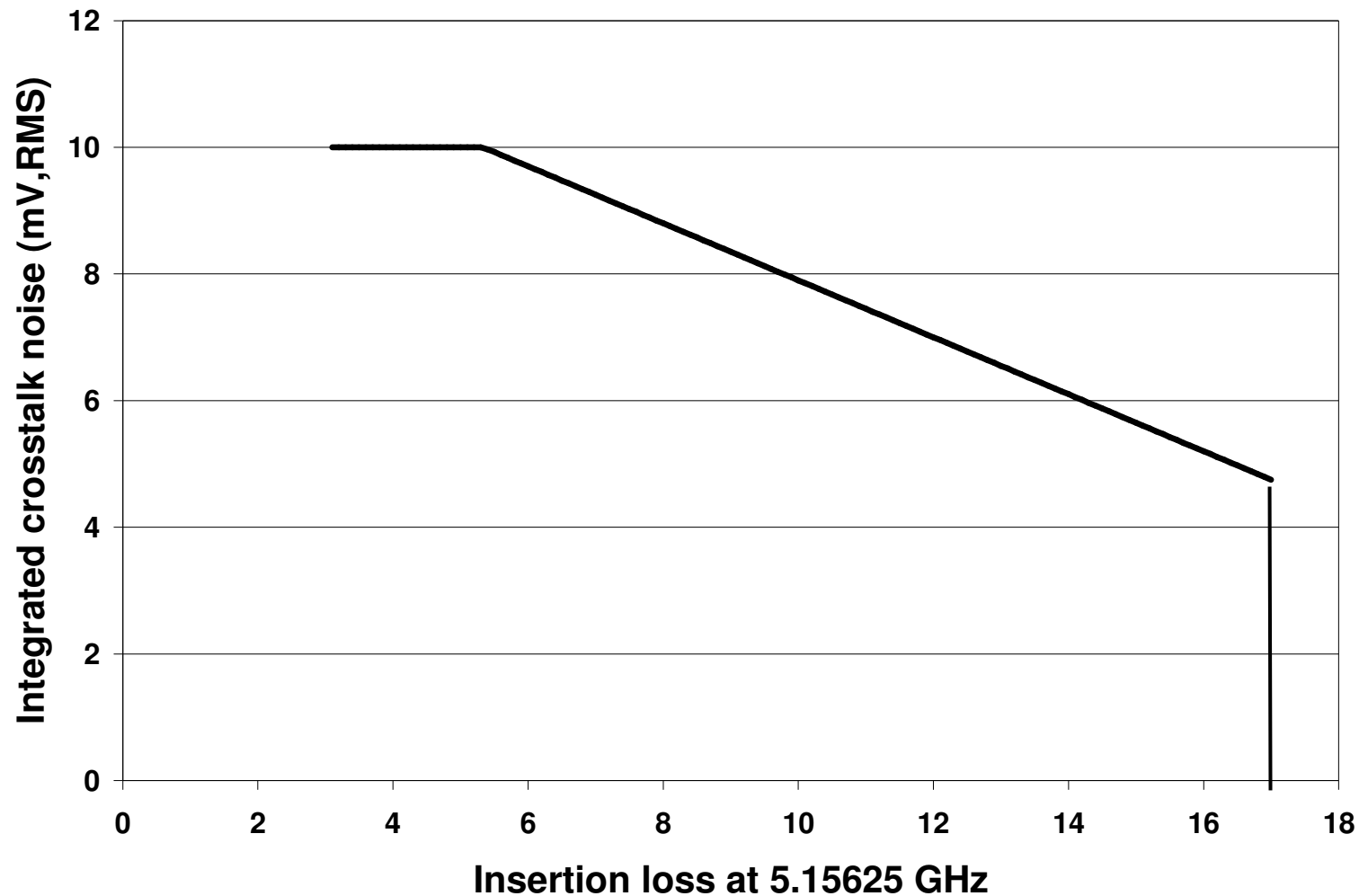
$$MDNEXT_{loss}(f) = -10 \log_{10} \left( \sum_{i=1}^{i=4 \text{ or } 10} 10^{-NEXT_{indiv}(f)/10} \right)$$

Where:

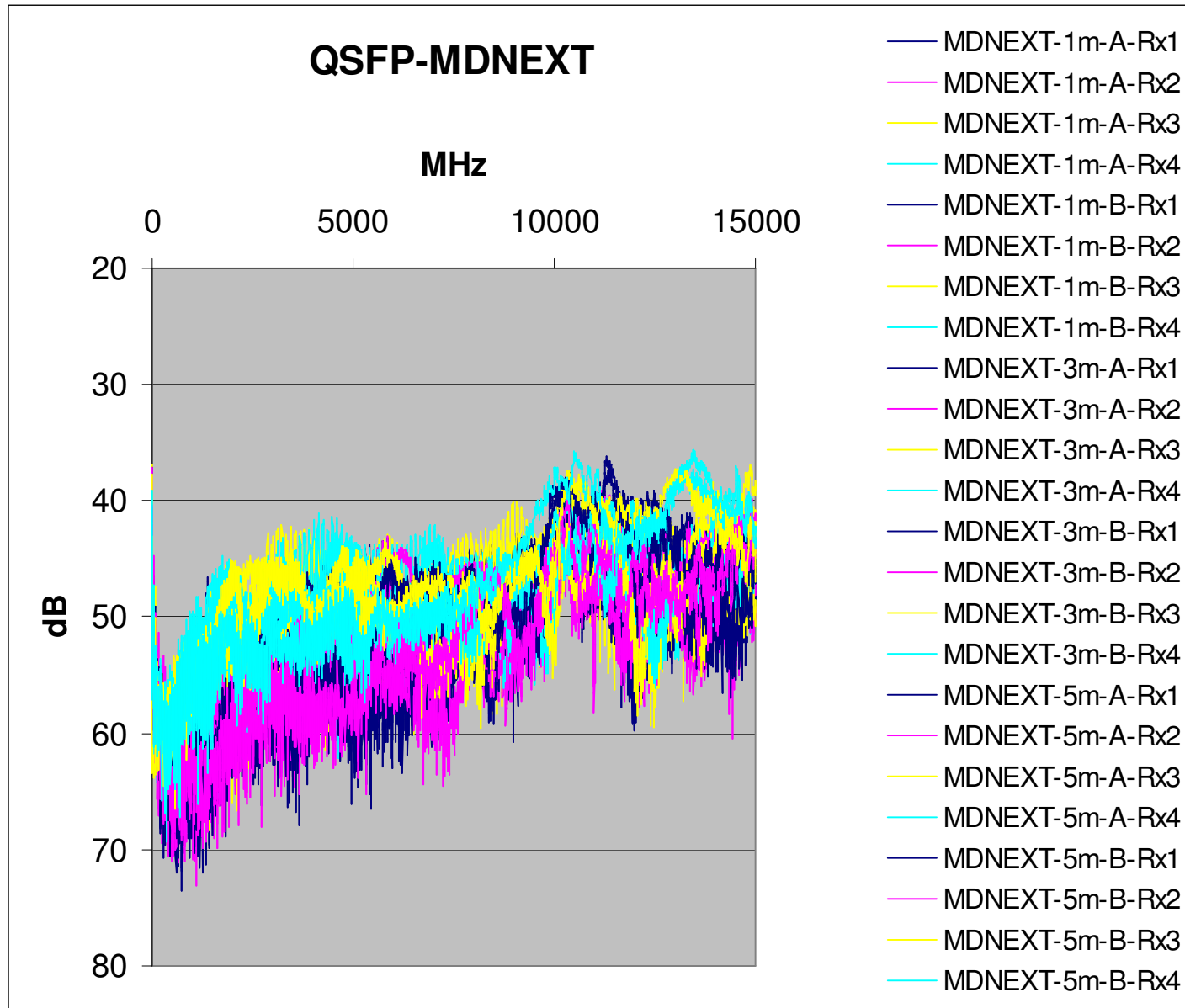
$f_r$  is the 3 dB reference receiver bandwidth  
 $T_r$  is the 20% to 80% transmitter rise and fall times  
 $f$  is the frequency in MHz

# 802.3ba Integrated Crosstalk Noise

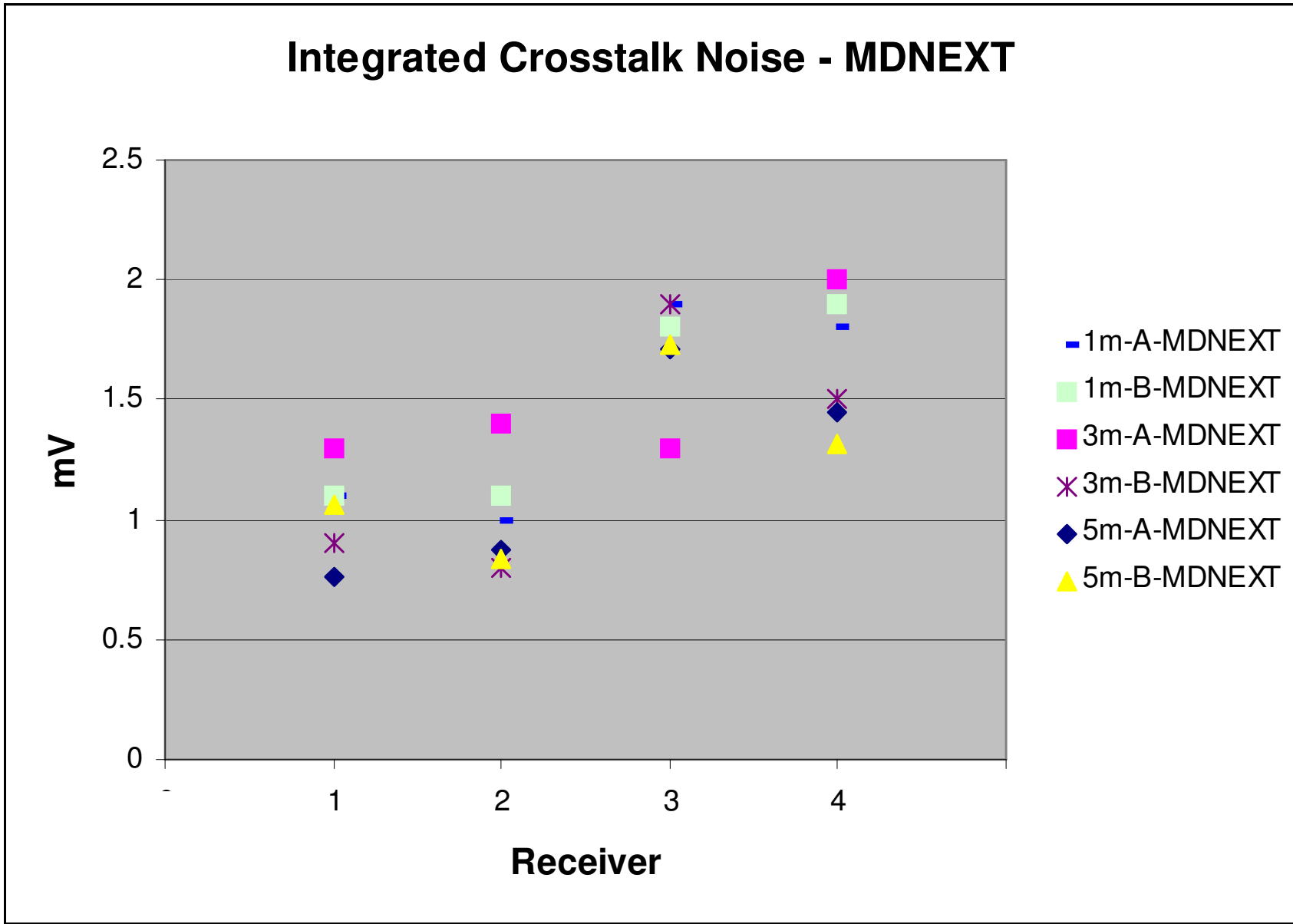
$$\sigma_{x,ca} \leq \begin{cases} 10 & 3 \leq IL \leq 5.3 \\ 12.4 - 0.45IL & 5.3 < IL \leq 17.04 \end{cases}$$



# QSFP- Cable assembly - MDNEX

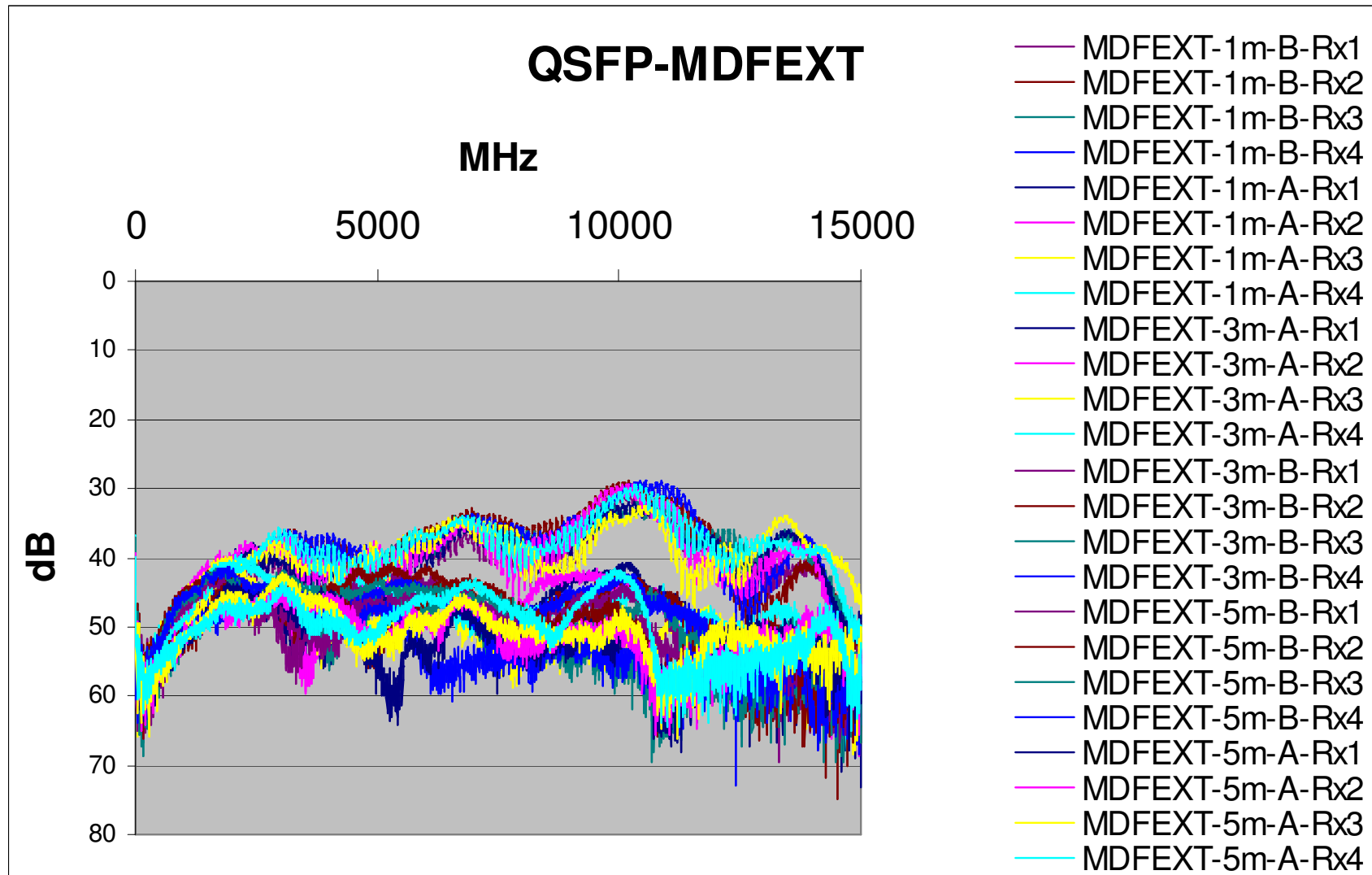


# QSFP- Cable assembly - MDNEXT

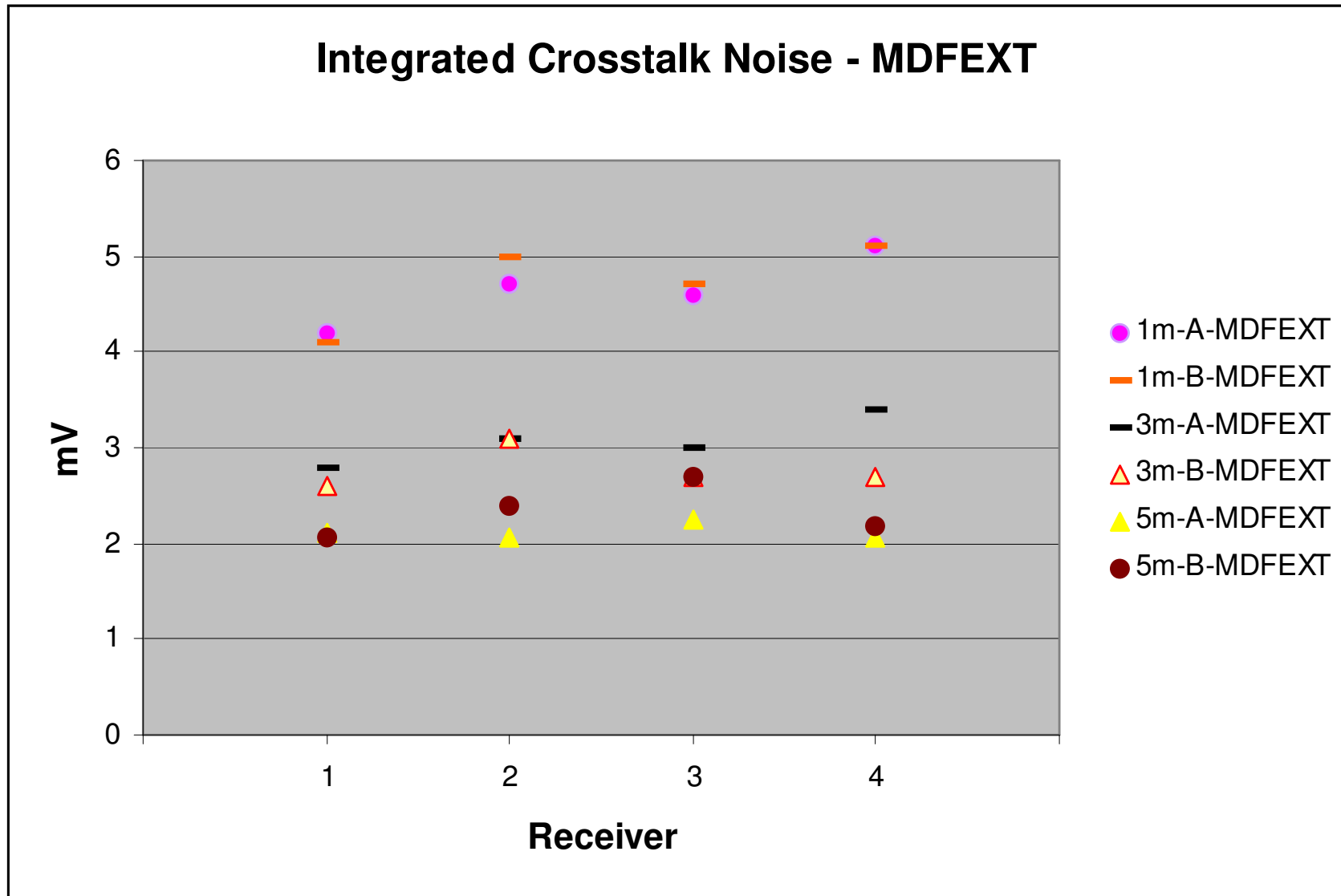




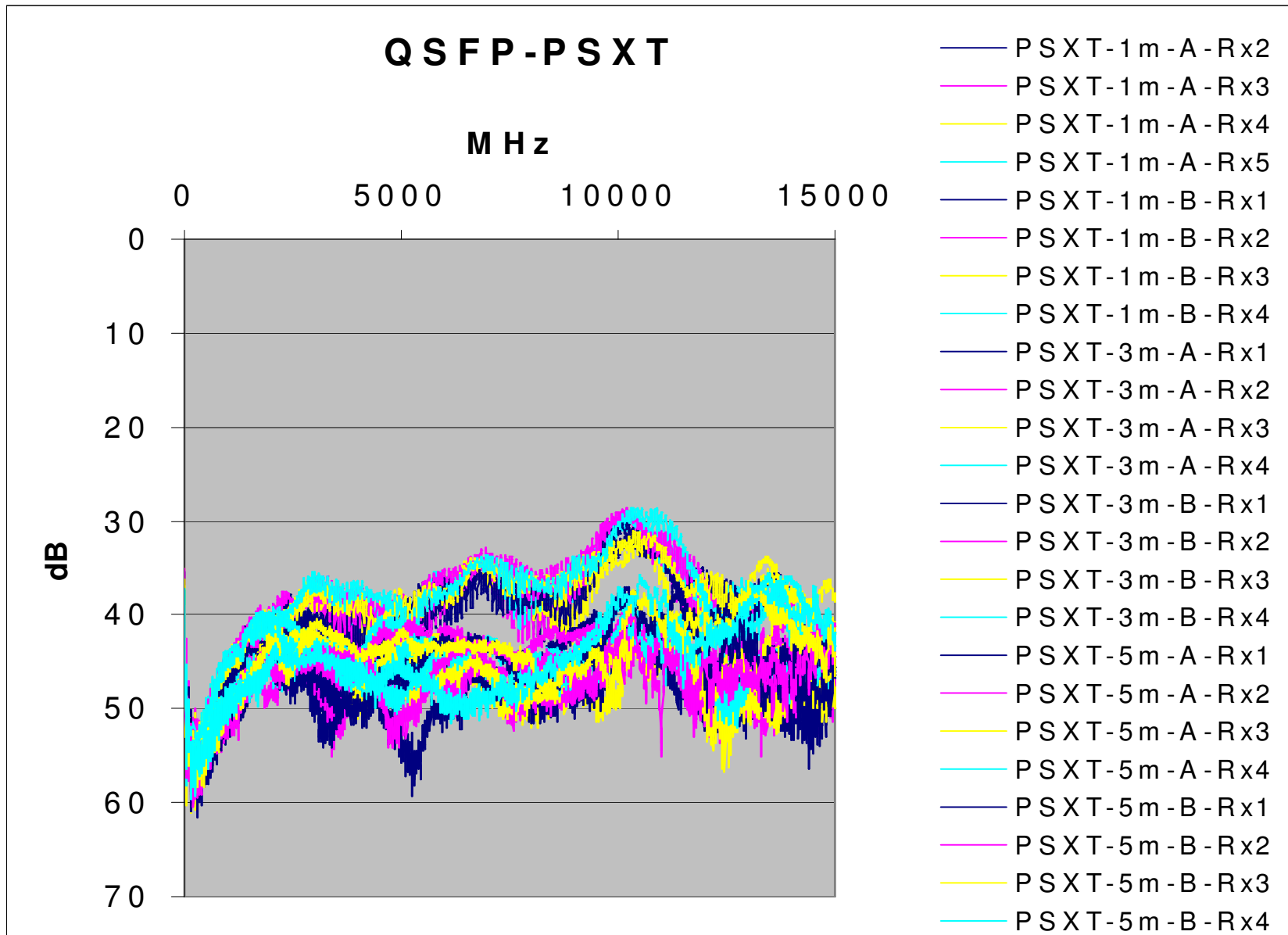
# QSFP- Cable assembly - MDFEXT



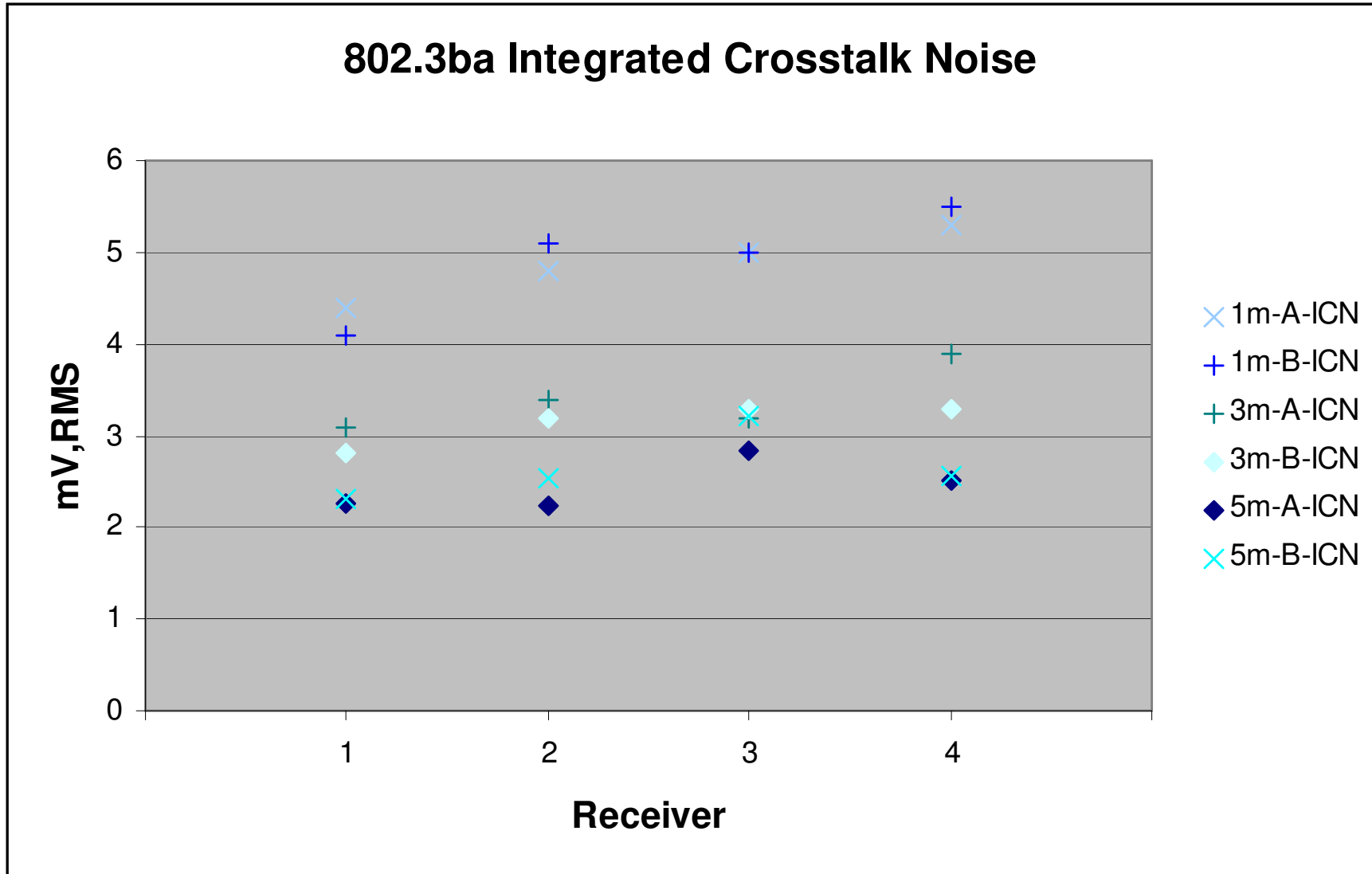
# QSFP- Cable assembly - MDFEXT



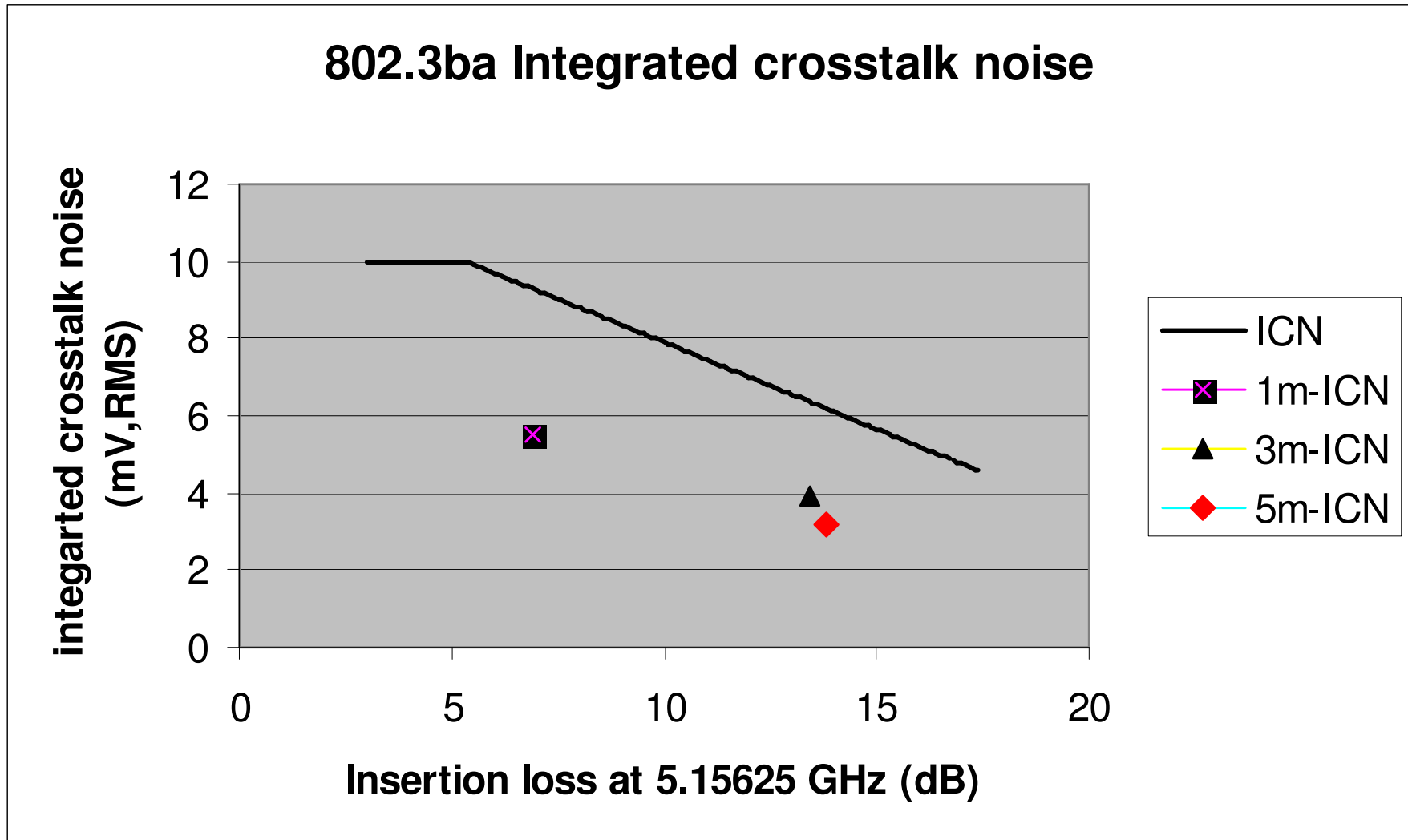
# QSFP- Cable assembly - PSXT



# QSFP- Cable assembly - ICN

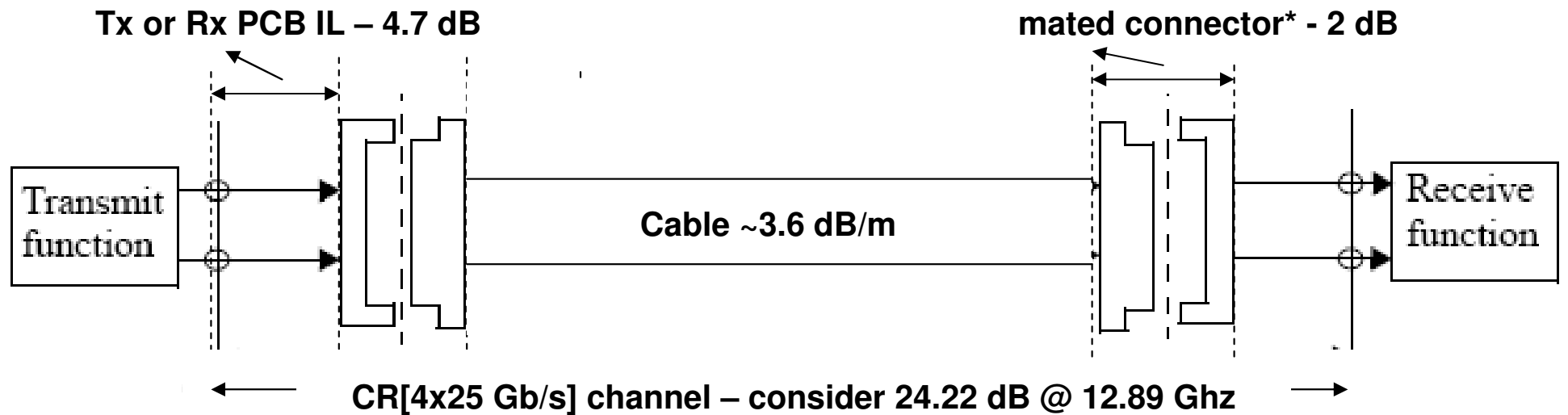


# QSFP- Cable assembly - ICN



1 m-30 AWG, 3m-30 AWG, 5m-26 AWG

# Channel insertion loss - 12.89 GHz – 3 m assembly



\*mated connector loss including paddle card and wire termination

$$2 \times 4.70 \text{ dB (PCB)} + 2 \times 2 \text{ dB mated connector} + 10.82 \text{ dB cable} = 24.22 \text{ dB}$$

# 100GbE Electrical Backplane / Cu Cabling Call-For-Interest

## Loss budget examples

	40GBASE-CR4 signal integrity		"Next generation" signal integrity	
Uncoded rate, Gb/s	10.0	25.0	25.0	25.0
Line code	NRZ	4-PAM	4-PAM	NRZ
Signaling rate, GBd	10.3125	12.8913	12.8913	25.7813
SNR for BER $\leq 10^{-12}$ , dB [1]	17.0	26.6	26.6	17.0
Cable length, m	7	7	7	3
Host TX PCB (4") [2], dB	3.50	4.33	2.54	4.70
TX Connector, dB	2.07	2.31 [3]	1.41 [4]	2.00
Bulk cable, dB	13.30	16.42	13.68 [5]	10.82
RX Connector, dB	2.07	2.31 [3]	1.41 [4]	2.00
Host RX PCB (4"), dB	3.50	4.33	2.54	4.70
<b>Total insertion loss, dB</b>	<b>24.44</b>	<b>29.70</b>	<b>21.58</b>	<b>24.22</b>

[1] Assumes fixed transmitter peak-to-peak differential output voltage.

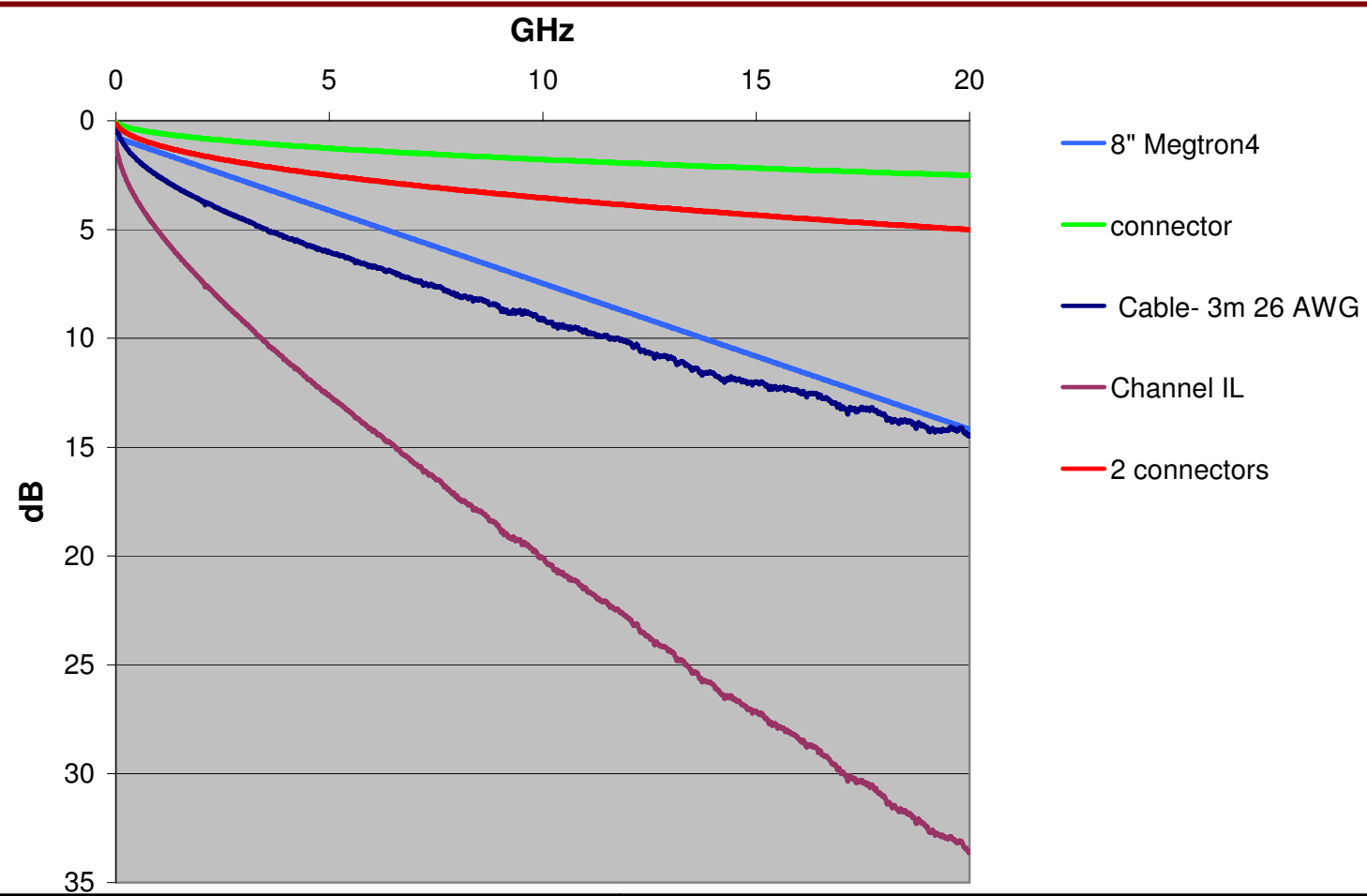
[2] Losses are defined at the fundamental frequency for the cited signaling rate.

[3] Derived as  $2.07 \times \sqrt{6.4453/5.1563}$

[4] Derived as  $2.00 \times \sqrt{6.4453/12.8913}$

[5] Derived as  $(7/3) \times 7.06 \times 0.83$  where 0.83 is the reduction in loss for 24AWG cabling relative to 26AWG

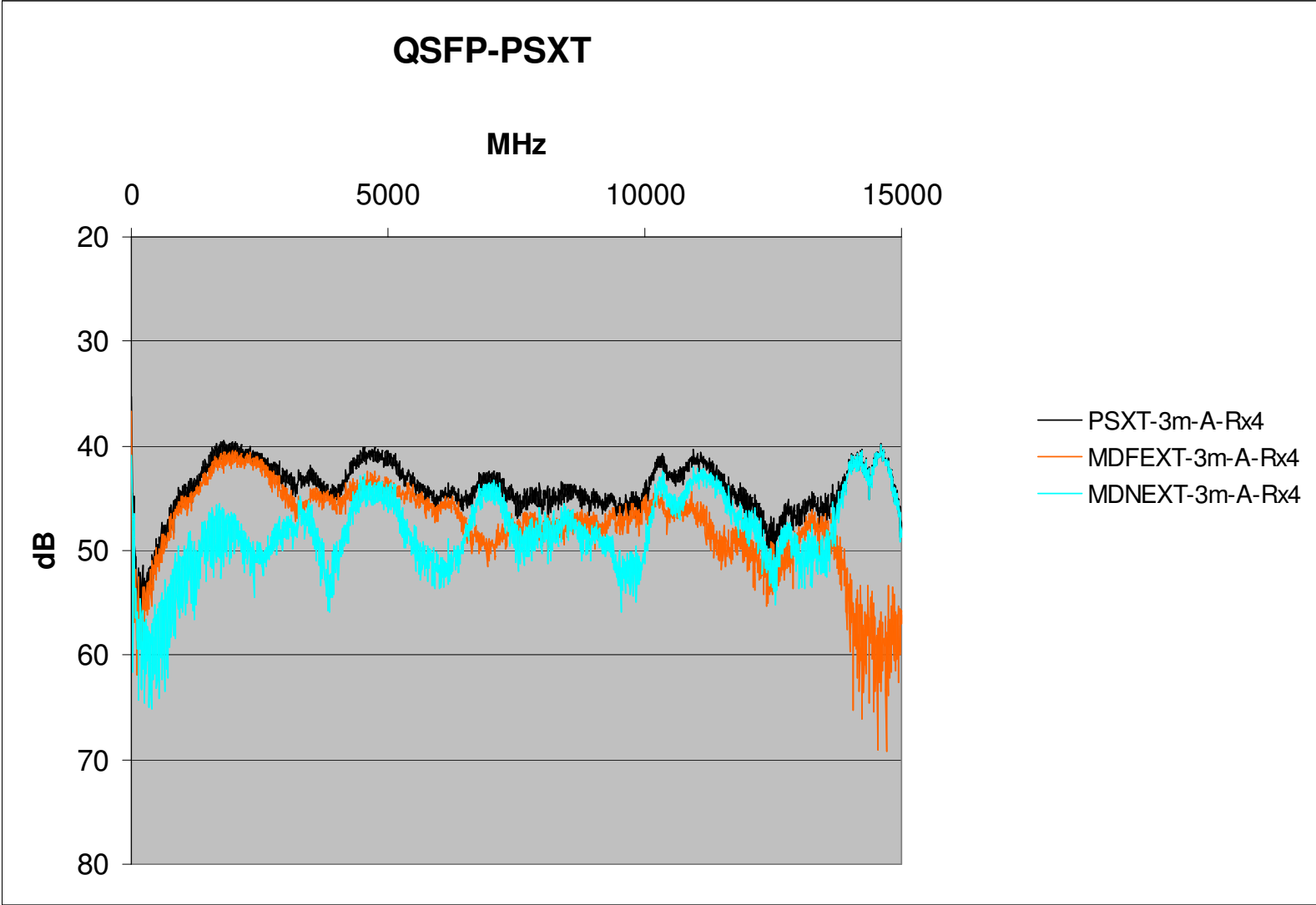
# Channel loss implementation 24.22 dB @ 12.89 GHz



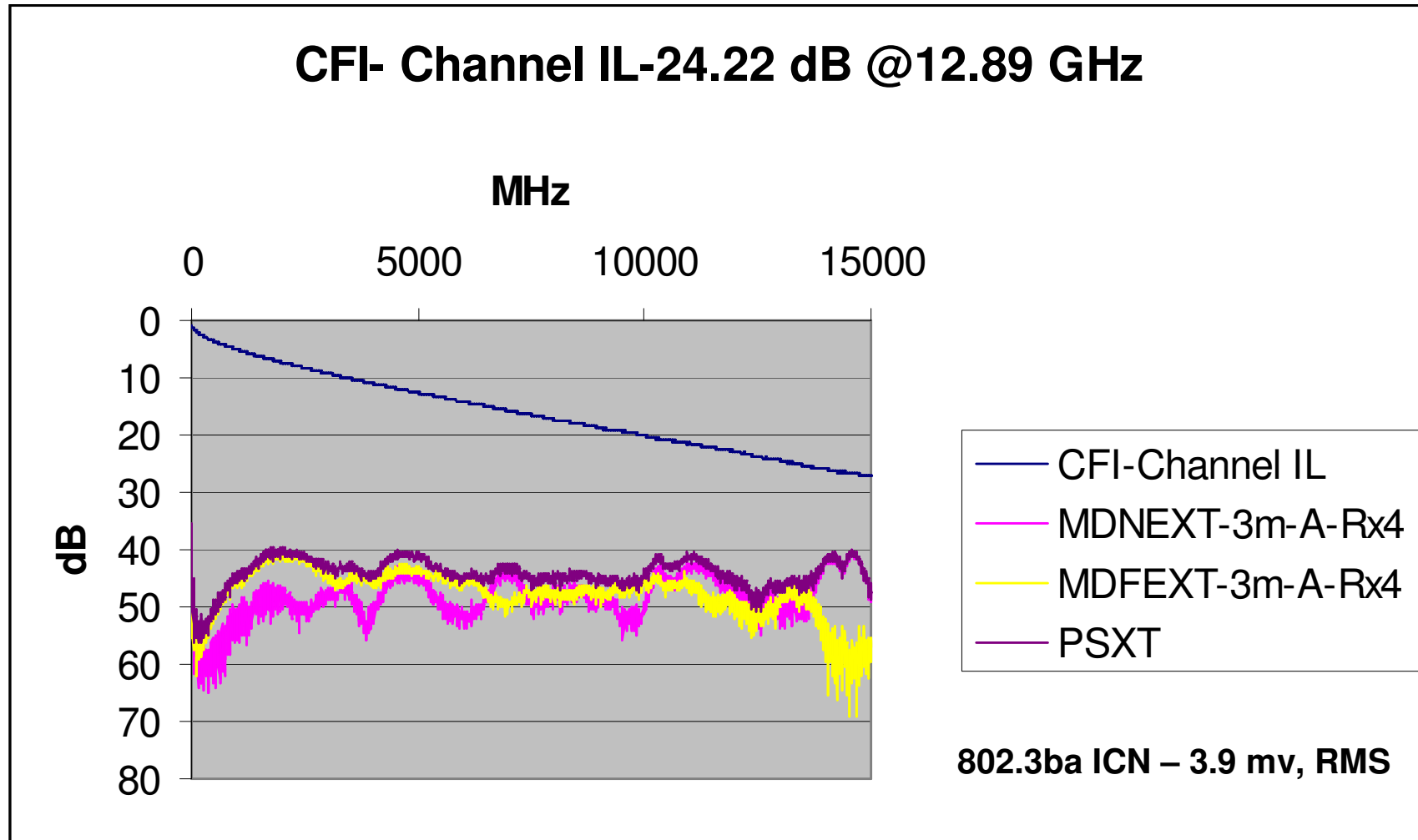
Channel components	Total 24.22 dB @ 12.89
Tx PCB-4" from Megtron4 measurements (1.175 dB/in)	$OIF2010.132.01.pdf = 4 * (0.0838 * fGHz + 0.0944) = 4.7 \text{ dB}$
Connector loss including paddle card termination	$0.558 * \sqrt{fGHz} = 2 \text{ dB}$
Cable 3 m 26 AWG measured (~3.6 dB/m)	10.82 dB
Connector loss including paddle card termination	$0.558 * \sqrt{fGHz} = 2 \text{ dB}$
Rx PCB-4" from Megtron4 measurements (1.175 dB/in)	$OIF2010.132.01.pdf = 4 * (0.0838 * fGHz + 0.0944) = 4.7 \text{ dB}$



# QSFP- Cable assembly – ICN – 3.9 mv, RMS

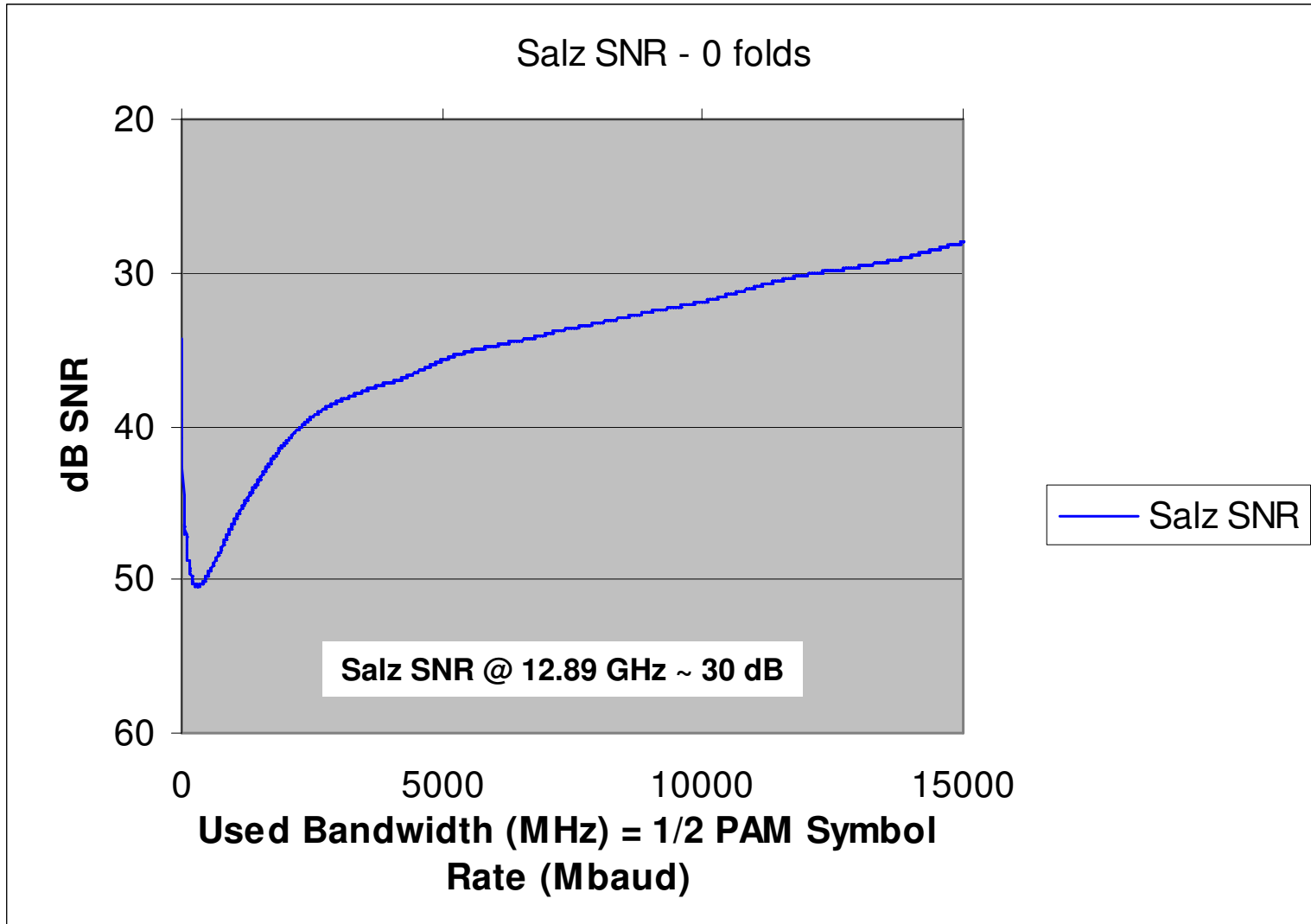


# Channel IL - QSFP- Cable assembly ICN



- CFI Channel IL from slide 14-16
- MDNEXT, MDFEXT, PSXT from slide 17

# Salz SNR



## •Impairments

- QSFP Cable assembly PSXT (slide 18)
- CFI Channel IL (slide 18)

# Summary

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- **Illustrations of Intra-rack applications in support of at least 3m media reach objective...**
- **QSFP cable assembly measurements as basis for considering noise impairments beyond those currently specified in 802.3ba while maintaining ICN methodology. Results in support of demonstrating technical feasibility.**
- **Work in progress....**