

# Relative Power of new channel data

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# Introduction

- Last Relative Power Consumption Analyses has been done in November 2013
- After the Dallas meeting important improvements have been presented within the Channel Ad Hoc
  - Cabling Channels with improved IL
  - Improved MDI including magnetics
- How are we doing on Relative Power today ?
- Power Consumption is still a concern : 4.X W to be reduced to 3.5W

# Relative Power Model

- Earlier contributions from Bliss and Grimmwood have introduced the concept of Relative Power
- Nexans reconstructed the Relative Power Model using given formulars and applied calculations to concatenation of new datasets
- Modelling done by Jonathan Nevett (Nexans) & Dave Hess (CordData)

## A Simple model of Relative Power

- Power is proportional to  $BW$ 
  - Analog currents are typically proportional to  $BW$ , while voltages remain constant
  - Number of digital computations (if they parallelize well) are typically proportional to  $BW$
- Power to achieve noise Power Spectral Density  $N_o$  doubles with every 6dB reduction of noise
  - Analog currents must typically be doubled to reduce noise and distortion by 6dB, while voltages remain constant
  - E.g., increasing ADC Effective Number of Bits by +1bit (6db) doubles the power
  - DSP costs probably don't scale in this manner, as 'one extra LSB' of significance lowers the DSP noises by 6dB. Thus, this model typically overstates the DSP power at high SNRs (at low Baud rates)
  - Denoting  $N_o$  in dBm/Hz units, then
- Equivalent to reference [G. Zimmerman, "Channel Parameters and PHY Complexity at 40G", TIA TR-42.7-2011-10-085]

$$Power \propto BW * 2^{-No/6.02}$$

IEEE 802.3 NextGenBASE-T Sept 2012 Geneva

Bliss\_01\_0912.pdf

## Return Loss Relative Power Model

- Define a new power model that reflects the relative power consumption due to echo cancellation:

$$P_{RL} \propto BW * 2^{\left(\frac{code\_margin + impl\_margin_{RL} - SNR\_margin_{RL}(BW)}{20 * \log_{10}(2)}\right)}$$

- The term  $(code\_margin + impl\_margin_{RL} - SNR\_margin_{RL}(BW))$  reflects the degree of cancellation required and therefore relates to the dynamic range requirement.
- For a fixed bandwidth, a change in  $SNR\_margin_{RL}$  results in the following percentage change in  $P_{RL}$ :

$$\Delta P_{RL} \% = 100 * [2^{(-\Delta SNR\_margin_{RL}/6.02)} - 1]$$

- As an example, with a 3 dB increase in  $SNR\_margin_{RL}$ , the echo canceller power decreases by 29%.

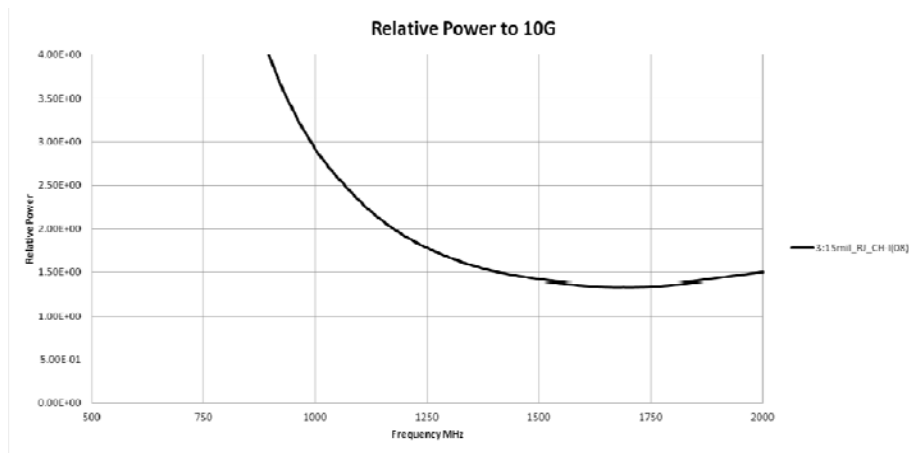
IEEE 802.3 NGBASE-1 Study Group Jan 2013

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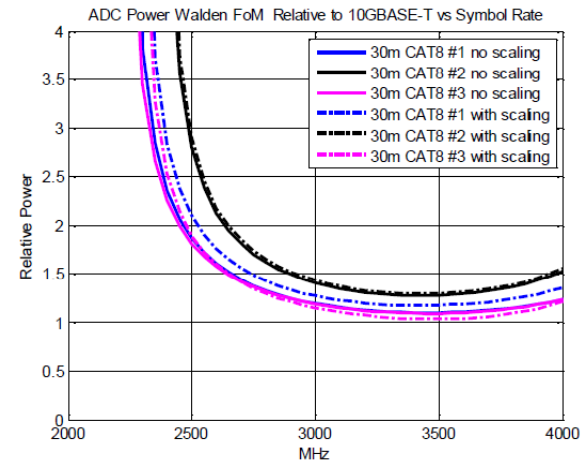
grimmwood\_01\_0113\_NGBT.pdf

# Sanity Check 1

- Simulated Case 1 using 8in/15mil PCB and ICM2 and Cat8 long channel
- Using the Cancellation Assumptions of 50dB for RL and 40dB for NEXT the results from previous work could be roughly matched



## ADC Relative Power, ICM 8in/15mil PCB trace, 30m Cat8

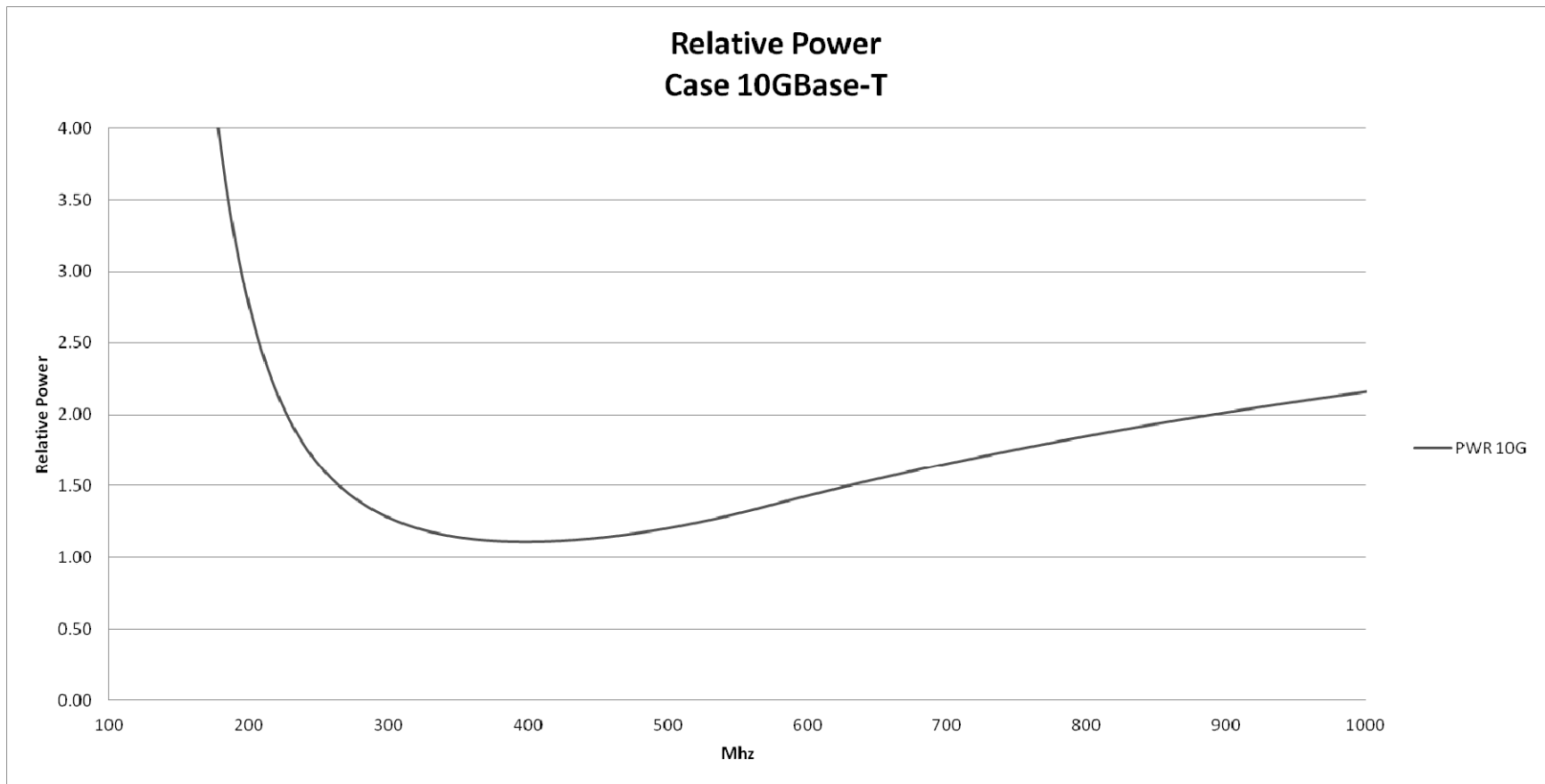


**Note:**  
The arithmetic mean insertion loss from all four pairs used to compute the SNR and dynamic range.

IEEE P802.3bq November 2013

# Sanity Check 2 : Example 10G

- Rel Power Model shows ~ 400MHz as best choice

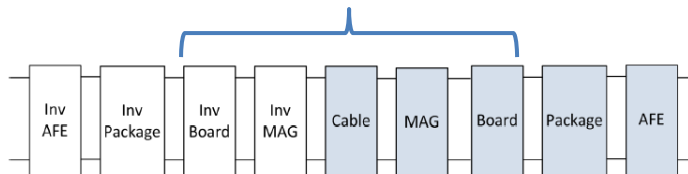


# 16-port Phy Models

Following Data from Channel Ad Hoc was used :

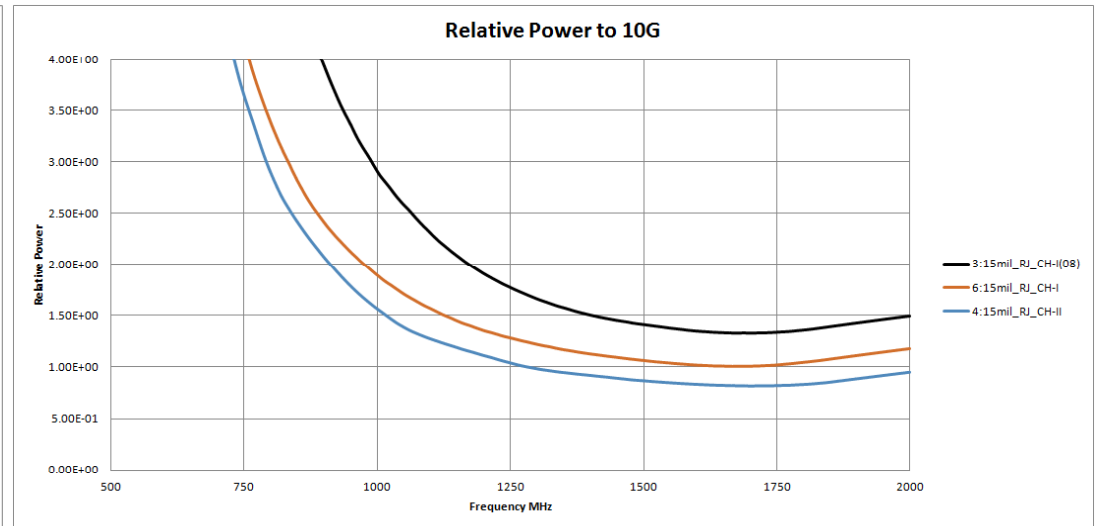
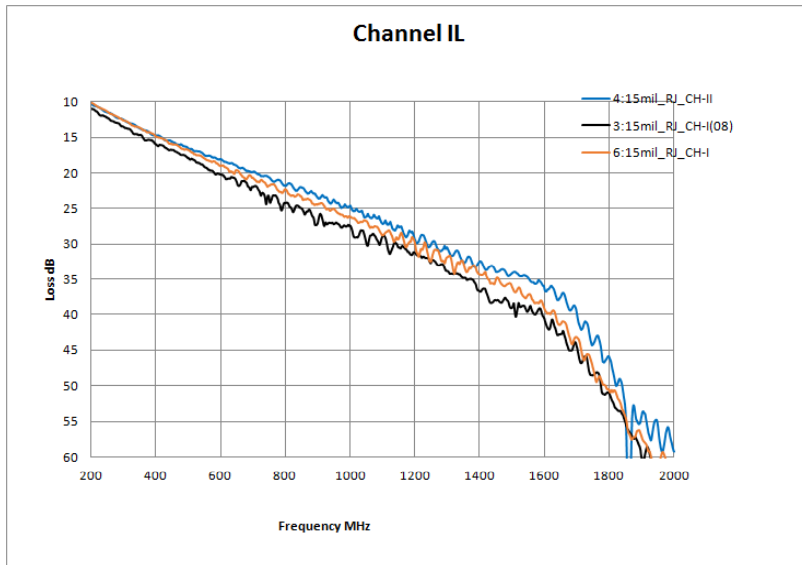
	Filename	Shortnames	Reasoning
• Board	• 100ohms_8in_15mils_iso	: 15mil	• <i>Test Model/Match previous work</i>
	• stackup2_2in_30mils_isolation_2GHz	: 25mil	• <i>Medium Case</i>
• MDI	• <a href="#">BellCM2.S16P.zip</a>	: RJ	• <i>RJ45 based MDI</i>
	• <a href="#">Bel ICM ARJ45 1.zip</a>	: ARJ	• <i>Improved MDI</i>
• Cabling	• <a href="#">long_channel 3-24-3.s16p.rar</a>	: CH-I(08)	• <i>Test Model/Match previous work</i>
	• <a href="#">11513 3-24-3 long_channel.zip</a>	: CH-I	• <i>Better IL &amp; Case for Cat8.1 / CH-I</i>
	• <a href="#">Nexans Channel 3-24-3 no MDI.zip</a>	: CH-II	• <i>Better IL (AWG22) &amp; Case for Cat.8.2 / CH-II</i>
• Full Cases	: Concatenation of 5 x S16P Files		

## PHY-to-PHY Channel



# Impact of Improved Cabling IL

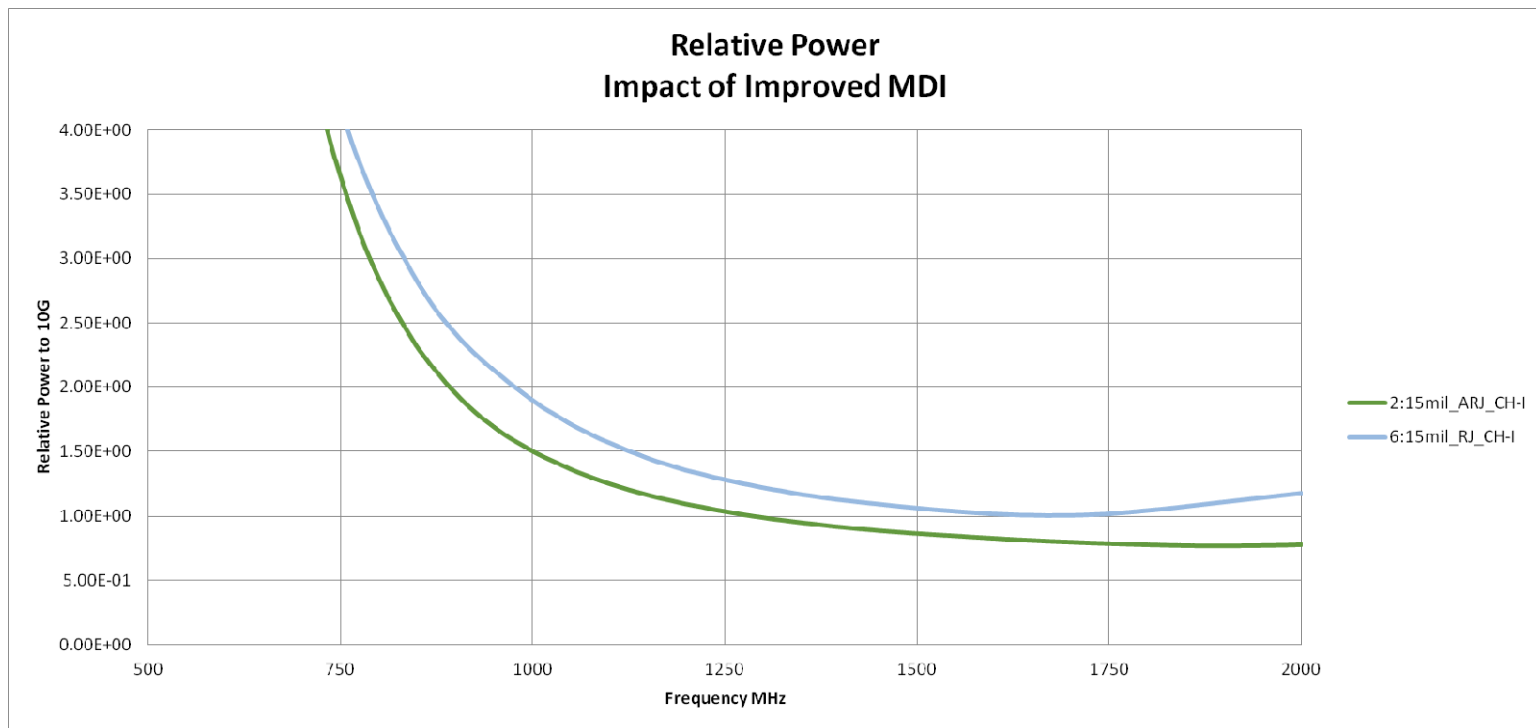
- Compared to November 2013 2 new long channels have been presented, mainly showing reduced insertion loss
- Both result in a significant reduction of Rel Power between



Case	$P_{rel}$
3	1.35
6	1.02
4	0.83

# Impact of Improved MDI(1)

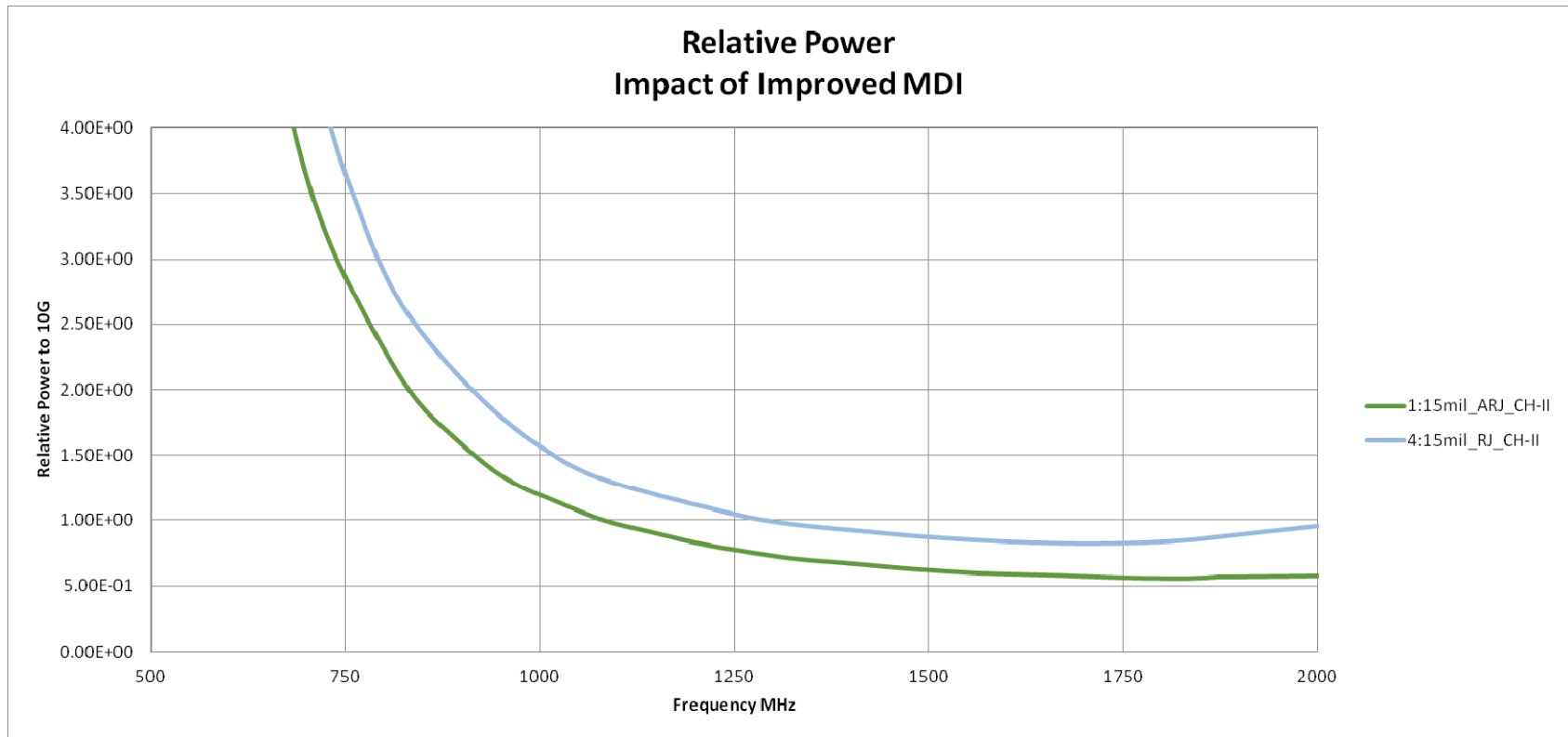
- February 2014 data for second MDI with Magnetics based on Non RJ45 has been presented



Case	P <sub>rel</sub>
6	1.02
2	0.83

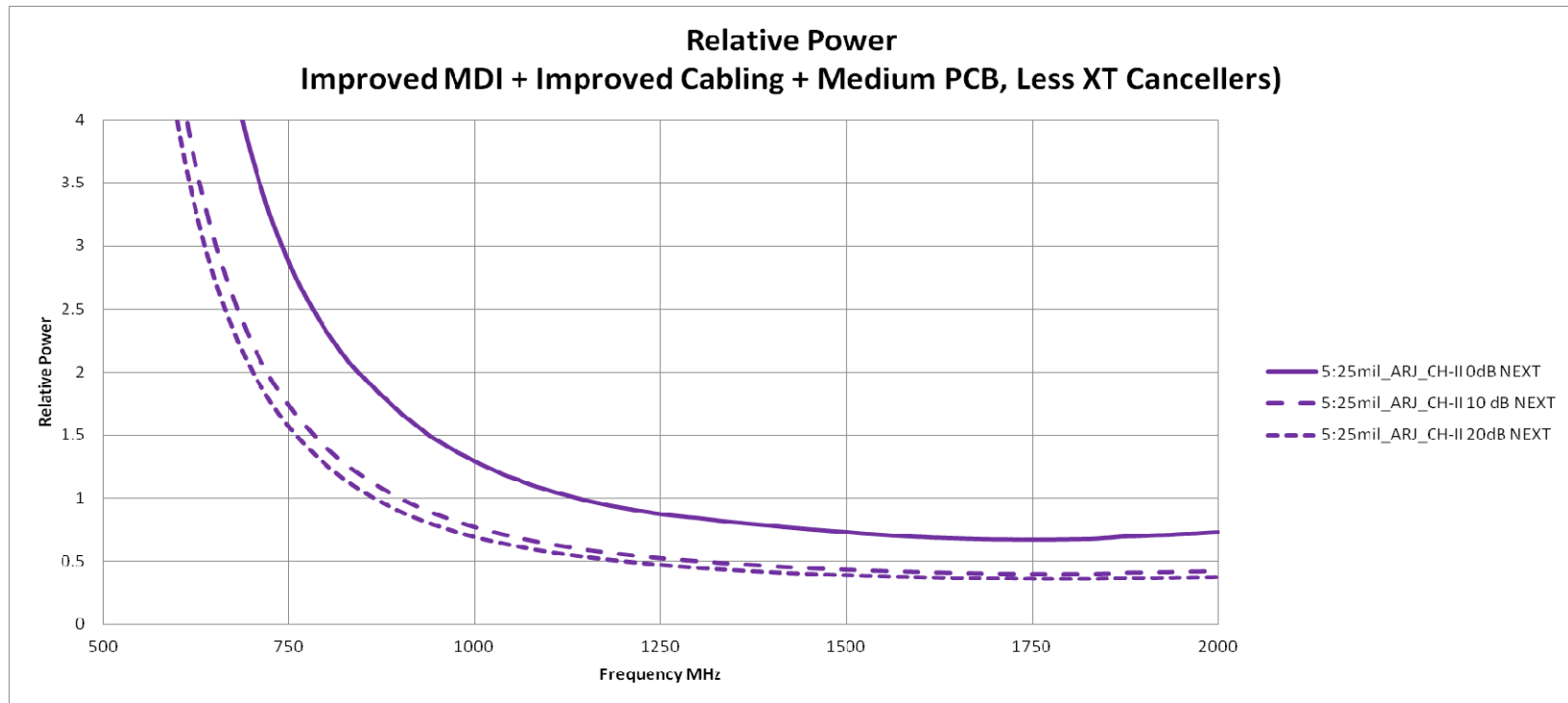


# Impact of Improved MDI(2)



Case	P <sub>rel</sub>
4	0.83
1	0.59

# Case for No Next Cancellation



- With no Next Cancellation still  $P_{rel}=0.69$  can be achieved
- Use of some Cancellation suggests additional savings but might be offset by cost of implementing and operating cancellers

Case	$P_{rel}$
5 + No Cancellation	0.69
5 + 10dB Cancellation	0.42
5 + 20 dB Cancellation	0.37

# Conclusion

- Better Relative Cost compared to 10GBASE-T seems reachable
  - $P_{rel}$  0.83 Power can be achieved by CH-I / improved MDI with NEXT-Cancellation similar to 10GBase-T
  - $P_{rel}$  of 0.69 can be achieved with CH-II cabling / improved MDI and No NEXT Cancellation
  - Lowest Relative Power Option is CH-II with Medium Grade PCB and some Xt Cancellation ( $P_{rel} = 0,37$ )
- Due to high variation in Channel Performance, Phy Designers should use different channel cases to find best power options
- Input required related to Cost Trade Off for Use of Next Cancellation