Frequency range limits for 2.5/5/10GBASE-T1

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Introduction

- Current draft specifies different freq limits for IL and RL
  - IL: 5MHz-3GHz
  - RL: 5MHz-5.5GHz

- Discussed in Spokane that using different limits is inconsistent
  - Smooth RL behavior up to 5.5GHz will implicitly disallow IL suck-outs between 3-5.5GHz too

- Reason for larger RL freq range is to bound echo due to unavoidable signal content beyond Nyquist
  - also mentioned by: Farjadrad_3ch_01b_1117.pdf

- Currently no differentiated frequency limits for 2.5/5/10Gbps
  - Although everybody probably assumes they will scale

Current situation

	BaudRate	fnyq	Insertion Loss (IL)		Return Loss (RL)		IL-ratios		RL-ratios
			fmin	fmax	fmin	fmax	fnyq/fmin	fmax/fnyq	fmax/fnyq
	[MBd]	[MHz]	[MHz]	[MHz]	[MHz]	[MHz]	[1]	[1]	[1]
2.5GBASE-T1	1406.25	703.125	5	3000	5	5500	140.63	4.27	7.82
5GBASE-T1	2812.5	1406.25	5	3000	5	5500	281.25	2.13	3.91
10GBASE-T1	5625	2812.5	5	3000	5	5500	562.50	1.07	1.96

- Fmax for IL & RL are different

- Fmax/Fnyq ratio almost unity for 10Gbps

- Fmax/Fnyq ratio >2 for 2.5Gbps and 5Gbps

- Fmin at 5MHz

Legacy BASE-T standards

	BaudRate [MBd]	fnyq [MHz]	Insertion Loss (IL)		Return Loss (RL)		IL-ratios		RL-ratios
			fmin [MHz]	fmax [MHz]	fmin [MHz]	fmax [MHz]	fnyq/fmin	fmax/fnyq	fmax/fnyq
100BASE-T1	66.67	33.33	1	66	1	66	33.33	1.98	1.98
1000BASE-T1	750	375	1	600	1	600	375	1.60	1.60
100BASE-TX	125	62.5	1	100	1	100	62.5	1.60	1.60
1000BASE-T	125	62.5	1	100	1	100	62.5	1.60	1.60
10GBASE-T	800	400	1	500	1	500	400	1.25	1.25

▸ IL and RL are always specified with same freq limits
  – Also makes sense from characterization perspective

▸ Fmin is always at 1MHz

▸ Fmax/Fnyq ratio significantly larger than unity

Conclusions (underpinned by legacy)

- It makes sense to specify IL and RL limits for the same frequency ranges

- In order to achieve sufficient excess BW the frequency range for IL needs to be extended
  - This does't imply tighter specs, but extending the freq range over which it is specified, probably with a fairly tolerant limit line
  - Tangible proposal in Bangkok

- Seems useful to consider setting Fmin at 1MHz
  - Even though the limit in the lowest frequency range might be relaxed, it seems useful to have IL and RL behavior bounded down to a reasonably measurable frequency

Frequency range proposal

	BaudRate	fnyq	Insertion Loss (IL)		Return Loss (RL)		IL-ratios		RL-ratios
			fmin	fmax	fmin	fmax	fnyq/fmin	fmax/fnyq	fmax/fnyq
	[MBd]	[MHz]	[MHz]	[MHz]	[MHz]	[MHz]			
2.5GBASE-T1	1406.25	703.125	1	1000	1	1000	703.13	1.42	1.42
5GBASE-T1	2812.5	1406.25	1	2000	1	2000	1406.25	1.42	1.42
10GBASE-T1	5625	2812.5	1	4000	1	4000	2812.50	1.42	1.42
2.5GBASE-T1	1406.25	703.125	1	900	1	900	703.13	1.28	1.28
5GBASE-T1	2812.5	1406.25	1	1800	1	1800	1406.25	1.28	1.28
10GBASE-T1	5625	2812.5	1	3600	1	3600	2812.50	1.28	1.28

▸ Fmax is scaling with data rate

▸ Fmin down to 1MHz for all rates

▸ Fmax/Fnyq ratio >25%
  – If 1/2/4GHz doesn't impose a practical problem is might be best to take that extra margin

denBesten/3ch1/AdHoc