














Power Backoff

George Zimmerman, Solarflare
Jose Tellado, Teranetics



Supporters

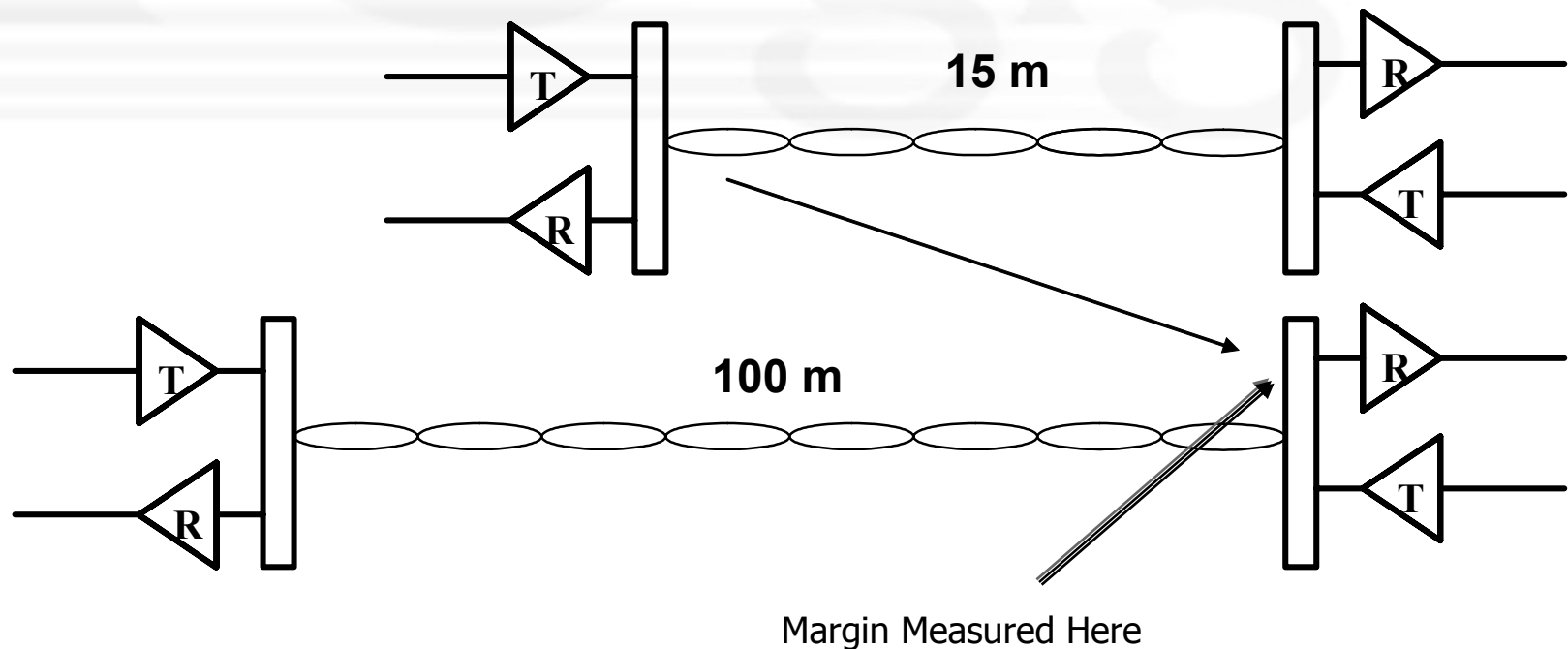
-  Henriecus Koeman, Fluke Networks
-  Chris DiMinico, MC Communications
-  Katsutoshi Seki, NEC Electronics

Overview





-  Model
-  How much power backoff is needed?
-  Proposed power backoff schedule
-  Cat 6a case (100m)
-  Cat 6 case (55m or less)
-  Scaled length channel results
-  Received signal power variation
-  Conclusion

Model

-  Co-located Victim & Disturber
-  Coupling Models as per D1.3



How Much Power Backoff is Needed?

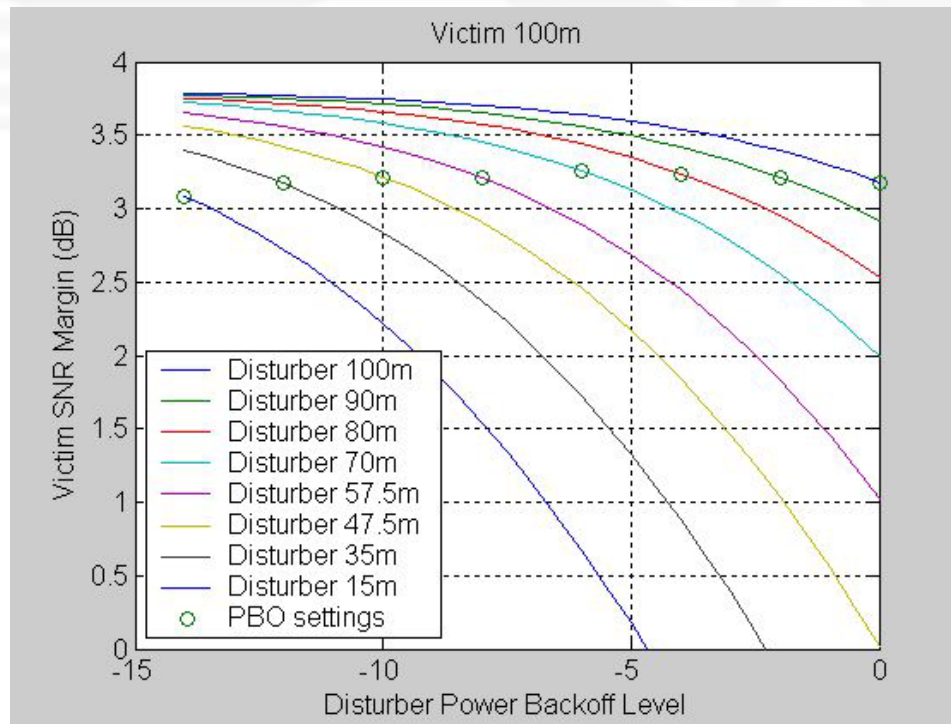
-  Disturbance into a 100m link defines limiting case
-  Co-terminated receivers, Cat 6a cabling
-  Full-power ANEXT into 100m victim receiver
-  Maximum of 14 dB power backoff required

100 meter Cat6e victim receiver		Variable length Cat6e disturber							
Margin (dB)	Power Backoff (dB)								
Disturber Length	0	2	4	6	8	10	12	14	16
10	-3.07	-1.49	-0.03	1.28	2.42	3.36	4.10	4.66	5.06
20	-3.01	-1.41	0.05	1.37	2.50	3.44	4.16	4.71	5.10
30	-1.96	-0.44	0.94	2.14	3.15	3.94	4.55	4.98	5.29
40	-0.61	0.78	2.01	3.03	3.85	4.48	4.93	5.25	5.46
50	0.77	1.98	3.00	3.82	4.45	4.91	5.23	5.45	5.60
60	2.01	3.00	3.81	4.43	4.89	5.22	5.44	5.59	5.69
70	3.02	3.81	4.42	4.88	5.20	5.43	5.58	5.69	5.75
80	3.80	4.40	4.86	5.19	5.42	5.57	5.68	5.75	5.79
90	4.38	4.83	5.16	5.40	5.56	5.67	5.74	5.79	5.82
100	4.80	5.14	5.38	5.55	5.66	5.73	5.78	5.81	5.83

How Much Power Backoff is Needed? (2)

🚗 Independent confirmation

- 🚗 $P_{tx}=4\text{dBm}$, -140dBm/Hz noise to model sum of rx impairments, Model 1 channel model







Proposed Power Backoff Schedule

- 🚚 Controlled by line Insertion Loss only
- 🚚 Don't use SNR – it will vary as disturbers come on!
- 🚚 Approx. 10 m partitions, 3.5 dB IL increments

Length(m)	IL 250 MHz (dB)	Backoff (dB)
0-25	<9.0	14
25-45	9.0-16.2	12
45-55	16.2-19.8	10
55-65	19.8-23.4	8
65-75	23.4-26.9	6
75-85	26.9-30.5	4
85-95	30.5-34.1	2
>95	>34.1	0





Cat 6a Margin Analysis

-  Constant full-power 100m ANEXT (4.2 dBm)
-  ANEXT/AELFEXT independent of length (Cat6a levels)
 -  Green = margin \geq 100m/100m margin
 -  Yellow = within 1 dB of 100m/100m margin

IEEE_nominal_DSQ 100m 1/19/04, nominal TX power = 4.2 dBm, Cat6 aug, all ANEXT at full power

Margin		Victim Length / Victim Power Backoff (dB)									
		10	20	30	40	50	60	70	80	90	100
Disturber PBO	Disturber Length	14	14	12	12	10	8	6	4	2	0
14	10	6.97	10.34	11.53	9.96	9.35	8.57	7.71	6.77	5.75	4.66
	20	7.02	10.39	11.60	10.01	9.40	8.62	7.75	6.81	5.80	4.71
12	30	7.03	10.51	11.51	9.87	9.23	8.45	7.58	6.64	5.63	4.55
	40	7.05	10.70	11.97	10.25	9.62	8.84	7.97	7.03	6.02	4.93
10	50	7.05	10.74	12.07	10.39	9.60	8.81	7.94	7.00	5.99	4.91
8	60	7.05	10.77	12.14	10.50	9.73	8.79	7.92	6.98	5.97	4.89
6	70	7.05	10.78	12.19	10.57	9.82	8.90	7.89	6.95	5.95	4.88
4	80	7.05	10.79	12.22	10.63	9.89	8.98	7.98	6.93	5.93	4.86
2	90	7.05	10.80	12.24	10.66	9.93	9.03	8.04	6.99	5.90	4.83
0	100	7.05	10.81	12.26	10.69	9.96	9.06	8.08	7.04	5.95	4.80




Class E Margin Analysis

-  Constant full-power 55m ANEXT (10 dB PBO)
-  ANEXT/AELFEXT independent of Length (Class E levels)
 -  Green = margin \geq 100m/100m margin
 -  Yellow = within 1 dB of 100m/100m margin

IEEE_nominal_DSQ 55m 1/19/04, nominal TX power = 4.2 dBm, Cat6
 All ANEXT at 10 dB power backoff, ANCAT6 (47 dB at 100 MHz) Levels

Margin		Victim Length / Victim Power Backoff (dB)					
		10	20	30	40	50	55
Disturber PBO	Disturber Length	14	14	12	12	10	10
14	10	6.86	8.45	8.39	5.94	4.93	5.29
	20	7.08	8.61	8.56	6.10	5.09	5.45
12	30	7.13	8.95	8.44	5.92	4.90	5.26
	40	7.20	9.44	9.32	6.57	5.55	5.92
10	50	7.21	9.55	9.52	6.83	5.55	5.91
	55	7.20	9.50	9.43	6.68	5.36	5.60




Scaled Class E Channel Analysis

-  ANEXT/AFEXT Scaled with IL per Draft
-  IL of longer channel used for ANEXT/AFEXT scaling
-  PBO Applied to both ANEXT and AFEXT sources per the disturbing channel length

IEEE_nominal_DSQ Cat6_varlen 2/1/05, nominal TX power = 4.2 dBm, Cat6, using IL Scaled ANEXT/AFEXT per D1.3
 ANEXT/AFEXT scales with maximum channel length (max (v_length, v_afextlength))

Margin		Victim Length / Victim Power Backoff (dB)									
		10	20	30	40	50	60	70	80	90	100
Disturber PBO	Disturber Length	14	14	12	12	10	8	6	4	2	0
14	10	7.00	9.33	9.68	7.52	6.63	6.20	6.60	6.71	6.53	6.06
	20	7.23	9.53	9.91	7.72	6.82	6.40	6.82	6.96	6.79	6.31
12	30	7.17	9.53	9.22	6.88	5.95	5.58	6.18	6.46	6.43	6.05
	40	7.24	10.13	10.33	7.70	6.78	6.48	7.20	7.55	7.50	7.01
10	50	7.08	9.52	9.62	7.02	5.80	5.58	6.56	7.16	7.30	6.95
8	60	7.01	9.29	9.39	6.85	5.69	4.46	5.70	6.57	6.96	6.80
6	70	7.18	10.03	10.47	8.12	7.03	5.84	4.61	5.73	6.41	6.50
4	80	7.30	10.65	11.45	9.31	8.28	7.13	5.92	4.67	5.62	6.01
2	90	7.39	11.16	12.32	10.42	9.45	8.34	7.15	5.90	4.61	5.30
0	100	7.46	11.57	13.08	11.43	10.54	9.46	8.29	7.05	5.75	4.38



Received Signal Power Variation

-  Received Far-end Signal is at MDI
-  Total Power at ADC is for relative variation only, and includes all noise sources, and minimal analog cancellation
-  Received Power variation is minimized (5 to 7 dB)

Victim Line Length	10	20	30	40	50	60	70	80	90	100	Variation (dB)	Min at
Received Far-end signal power	-12.47	-14.79	-14.79	-16.53	-16.06	-15.4	-14.6	-13.69	-12.67	-11.57	4.96	40m
Total Power At ADC (AFEXT from 40m line)	-2	-5.07	-5.93	-8.52	-8.8	-8.7	-8.18	-7.27	-6.03	-4.54	6.8	50m

Conclusion

Recommended Power Backoff Schedule

-  Shown to keep margins balanced across line lengths
-  Shown to keep received power balanced

Length(m)	IL 250 MHz (dB)	Backoff (dB)
0-25	<9.0	14
25-45	9.0-16.2	12
45-55	16.2-19.8	10
55-65	19.8-23.4	8
65-75	23.4-26.9	6
75-85	26.9-30.5	4
85-95	30.5-34.1	2
>95	>34.1	0