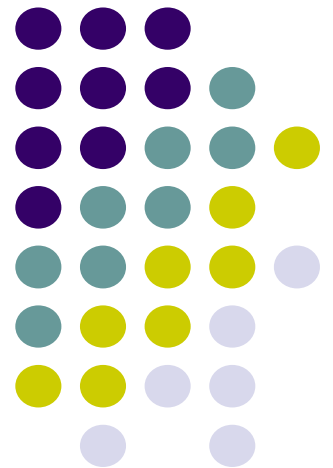


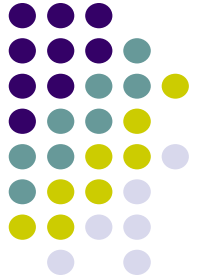
Performance of N=4 THPs with Power Backoff

IEEE P802.3an Task Force
San Antonio, Nov' 04

Glenn Golden
Jose Tellado

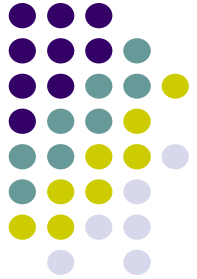
Teranetics





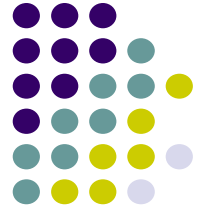
Overview

- TF has approved:
 - Fixed THP after start-up
 - Select 1 out of N THP filters
- Design and performance of N=4 THP IIRs
- Design and performance of N=4 THP FIRs
- Robustness to Channel IL distortion
- Power Backoff proposal



Common Assumptions

- Modulation rate: 800 MHz
- Channel Model: Measured Channel data limited to Model 3 at 100m (Olindo Savi, Siemon, 6/26/04, at /an/public/channel_models/index.html)
 - IL scaled by length for lengths < 100m
 - ANEXT set at 100m worst case
- Residual Impairments:
 - -140 dBm/Hz AWGN
 - Models AWGN plus residual Echo, NEXT, FEXT, analog, ...

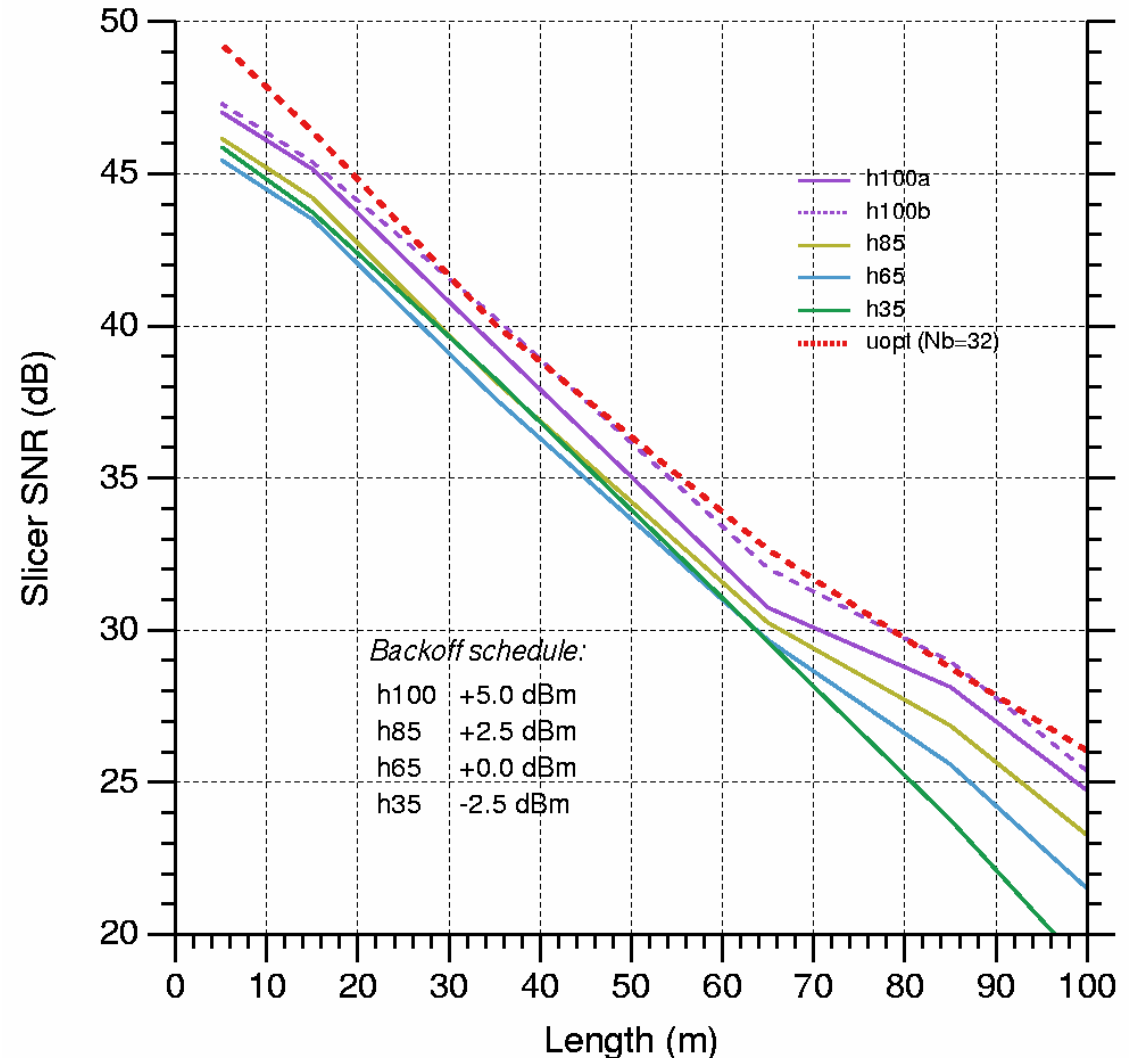


Fixed IIR THP with Power Backoff

thp_nov802/expt4b1: Model 4I3A

Fs = 800 Msym/s, N0 = -140 dBm/Hz, Nf = 128

- Four IIR ARMA(2,3) THP optimized for
 - 100m, Ptx = 5 dBm
 - 85m, Ptx = 2.5 dBm
 - 65m, Ptx = 0 dBm
 - 35m, Ptx = -2.5 dBm
- IIR Filters have been shared with most PHY vendors
 - $h_{100a}(D) = (1 - D^2) / (1 - 64/32D + 42/32D^2 - 9/32D^3)$
 - $h_{85}(D) = (1 - D^2) / (1 - 15/8D + 9/8D^2 - 7/32D^3)$
 - $h_{65}(D) = (1 - D^2) / (1 - 13/8D + 21/32D^2)$
 - $h_{35}(D) = (1 - D^2) / (1 - 9/8D - 5/32D^2 + 21/64D^3)$
- ARMA(3,6) at 100m has even better performance (h100b)



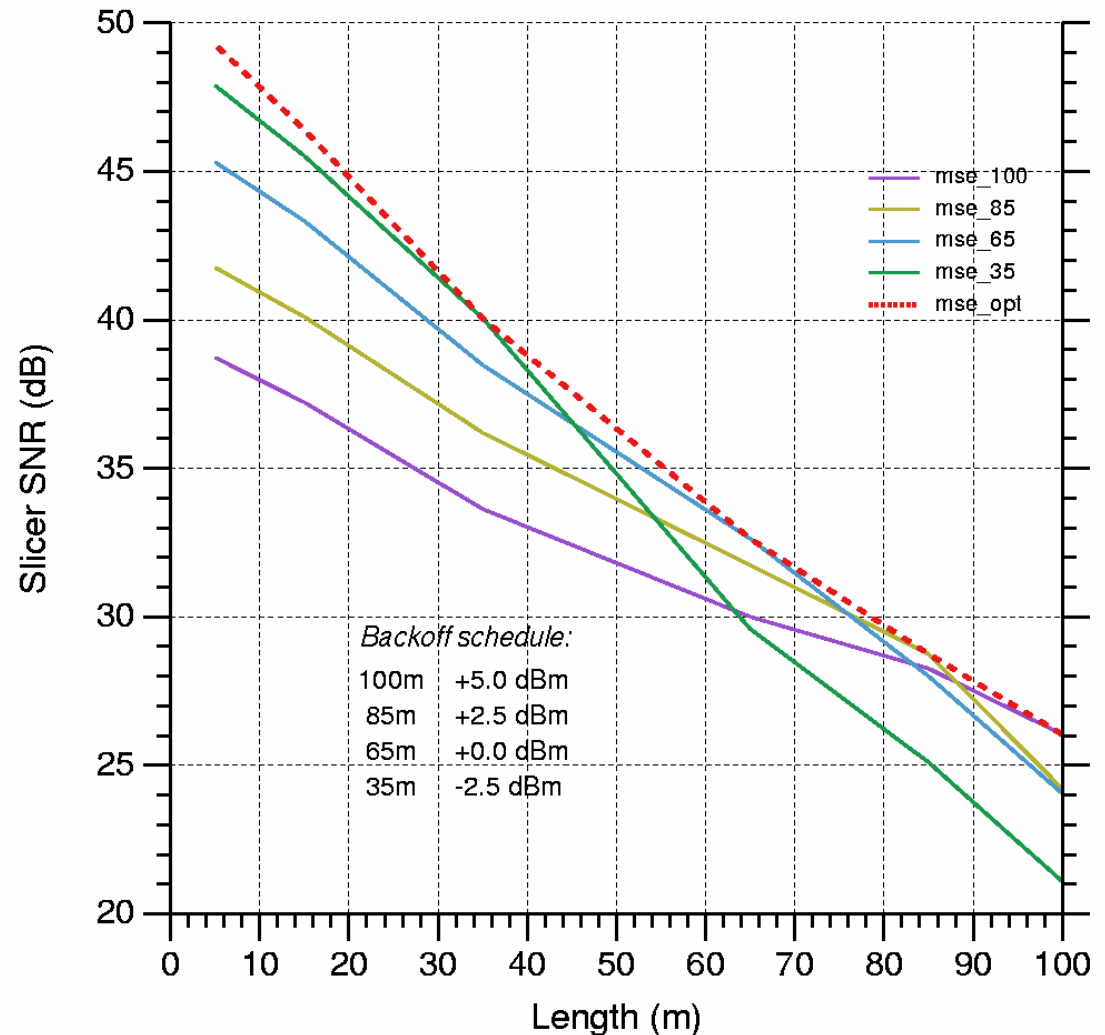


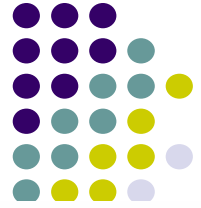
Fixed FIR THP with Power Backoff

thp-nov802/expt3c: Model 4I3A

$F_s = 800 \text{ Msym/s}$, $N_0 = -140 \text{ dBm/Hz}$, $N_f = 128$, $N_b = 32$

- 4 FIR THP optimized for
 - 100m, $P_{tx} = 5 \text{ dBm}$
 - 85m, $P_{tx} = 2.5 \text{ dBm}$
 - 65m, $P_{tx} = 0 \text{ dBm}$
 - 35m, $P_{tx} = -2.5 \text{ dBm}$

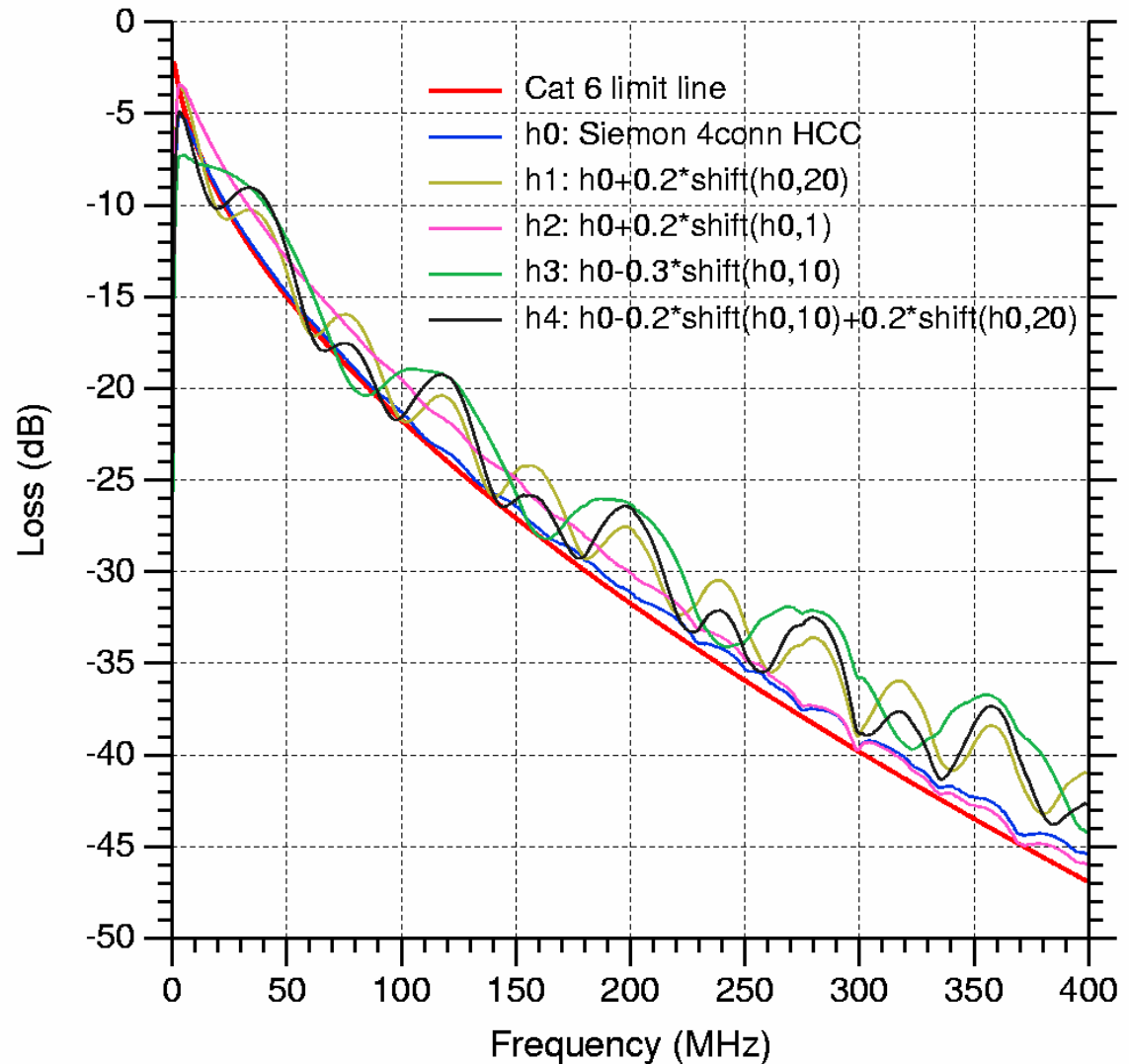


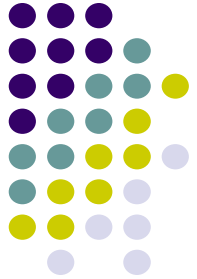


Fixed THP w/ PBO and Channel Distortion

thp_nov802/expt5a

- IIR THP optimized for 100m at 5dBm
- 4 channel cases with IL distortion
 - SNR(h0) = 25.4 dB
 - SNR(h1) = 26.2 dB
 - SNR(h2) = 26.1 dB
 - SNR(h3) = 27.2 dB
 - SNR(h4) = 26.1 dB





Proposal Summary

- N=4 selectable THP filters provide reasonable equalizer SNR performance from 0 to 100m
 - Can be implemented as either IIR or FIR
- Shorter lengths have larger equalizer SNR margin, thus enabling power backoff
- Recommendation: Five Power backoff settings, one associated with each of four fixed THP filters plus bypass THP
 - $P_{tx} = 5$ dBm for 100m THP
 - $P_{tx} = 2.5$ dBm for 85m THP
 - $P_{tx} = 0$ dBm for 65m THP
 - $P_{tx} = -2.5$ dBm for 35m THP
 - $P_{tx} = -5$ dBm for bypass THP