

Intersymbol Interference

Adaptive Decision Feedback Equalization

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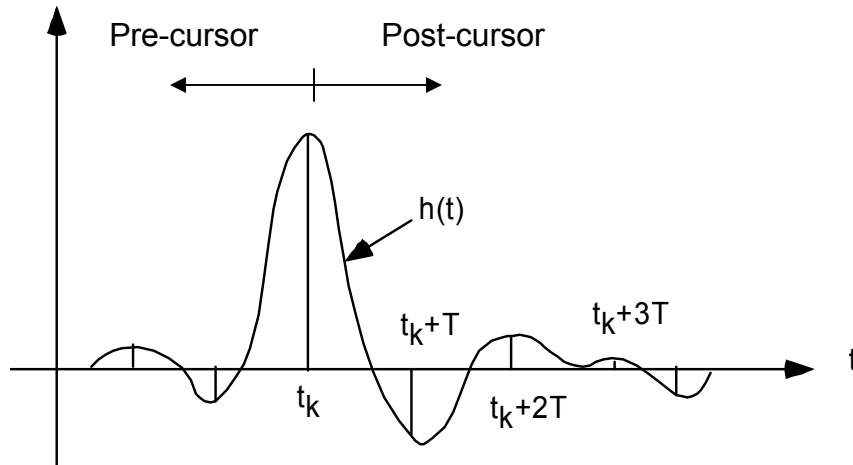
Silicon DSP Corporation

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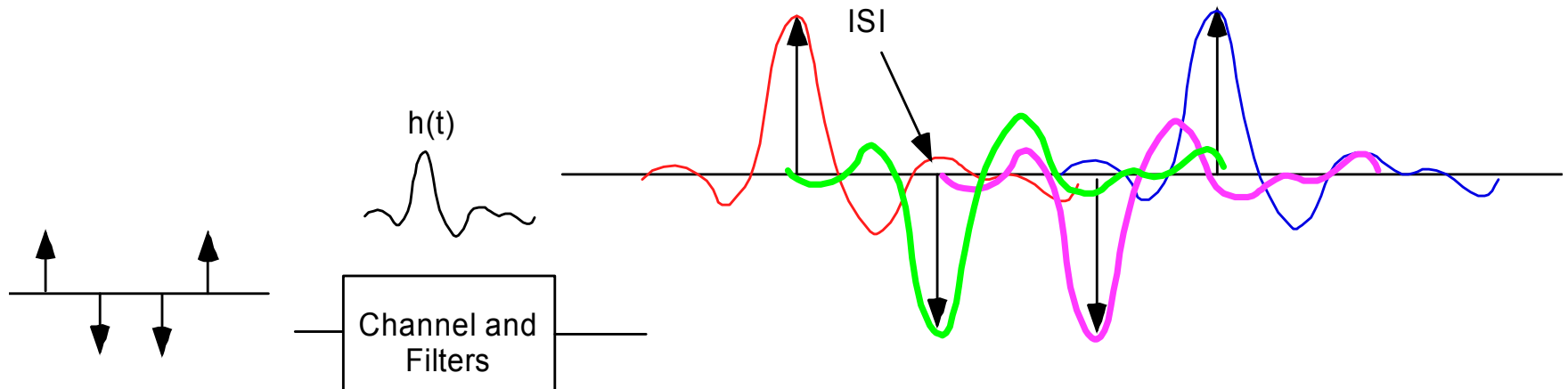
Equalization in Single Carrier and OFDM Communication Systems

Falconer, D. and Ariyavisitakul, S. L., *.Frequency Domain Equalization for 2.11 GHz Fixed Broad-band Wireless systems,*. Tutorial, presented during Session #11 of IEEE 802.16 in Ottawa, Canada, Jan. 22, 2001.

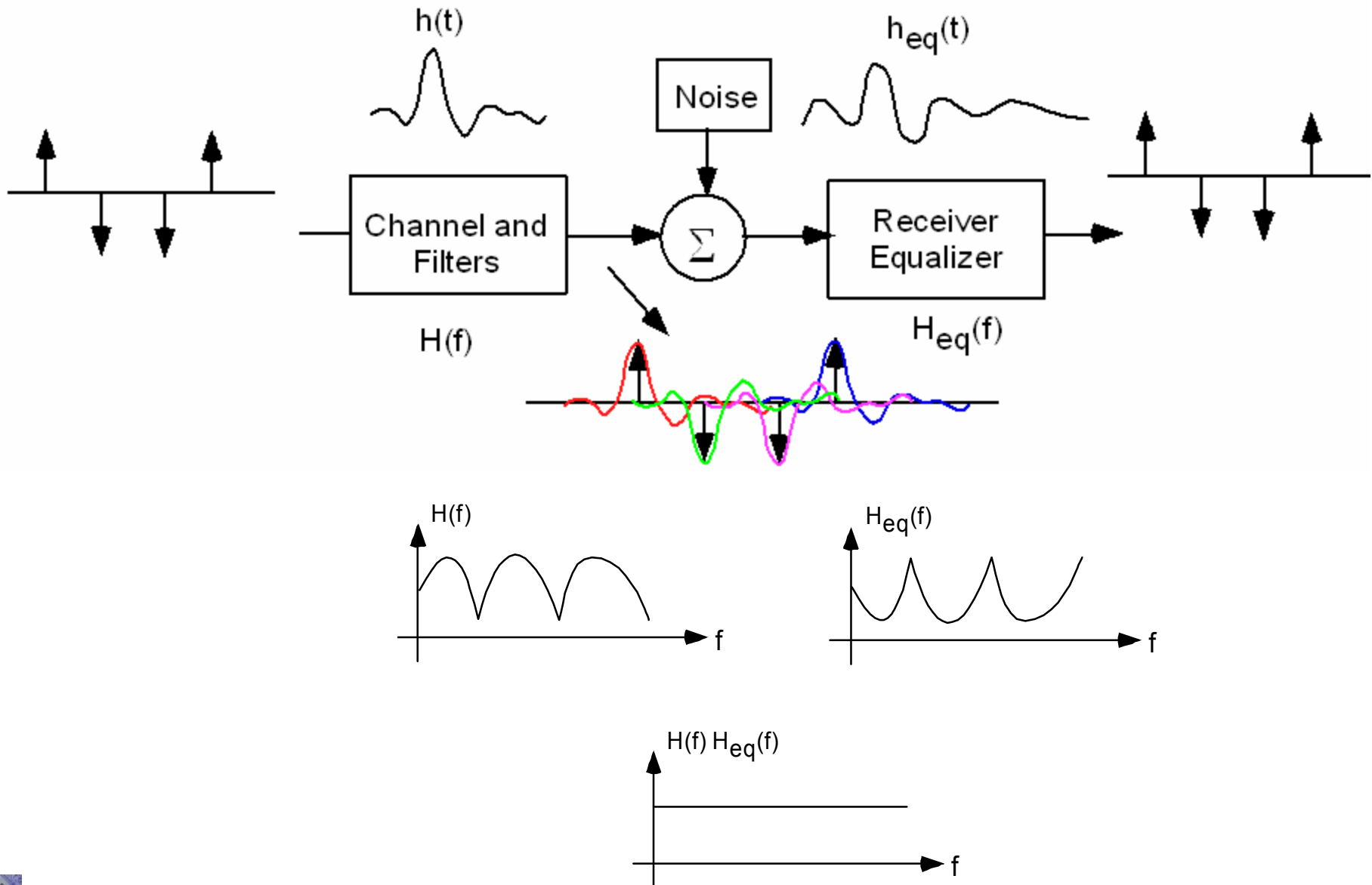
Intersymbol Interference (ISI) in Fading Multipath Channel



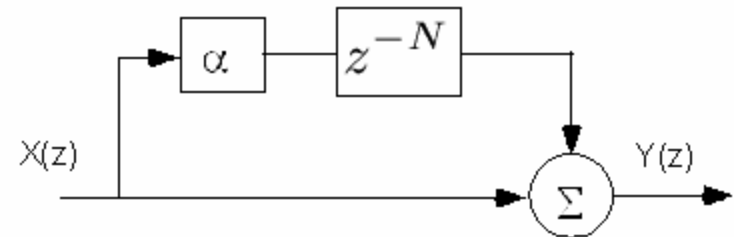
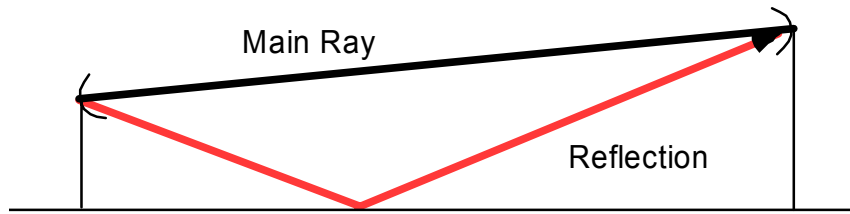
Channel Impulse Response



Equalizer



Deep Fades and Impulse Response



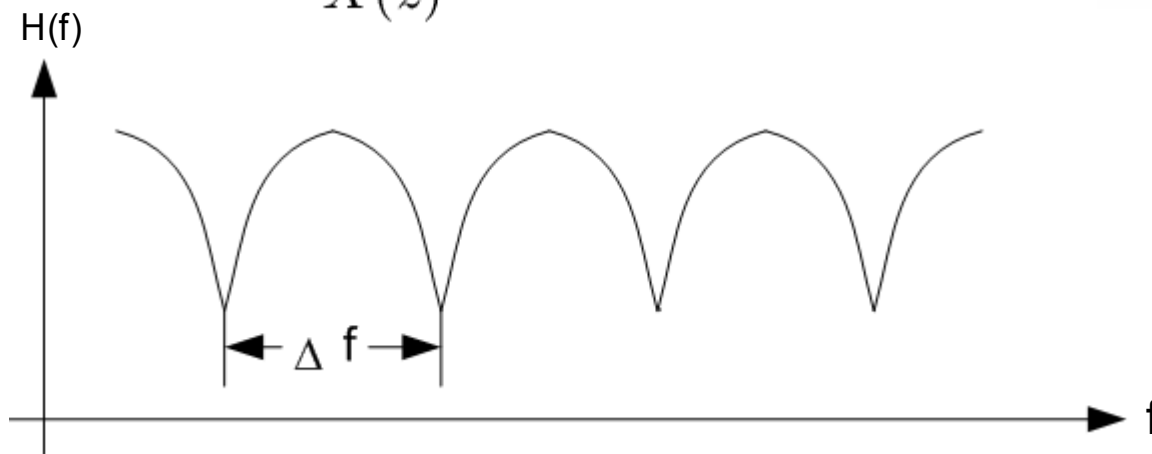
$$s(t) = \delta(t) + \alpha\delta(t - \tau_d)$$

$$Y(z) = X(z) + \alpha z^{-N} X(z)$$

$$H(z) = \frac{Y(z)}{X(z)} = 1 + \alpha z^{-N}$$

Discrete Time Model

$$\tau_d = N \frac{1}{f_s} = N\Delta t$$

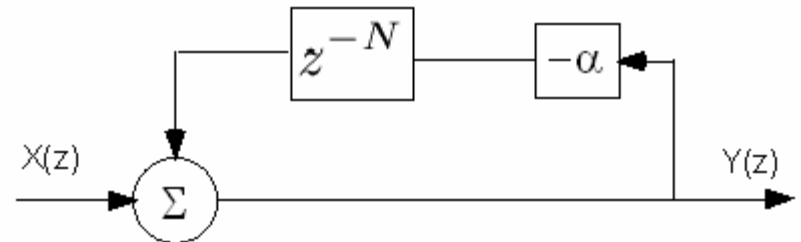


Inverse Channel Multipath Fading

$$Y(z) = X(z) - \alpha z^{-N} Y(z)$$

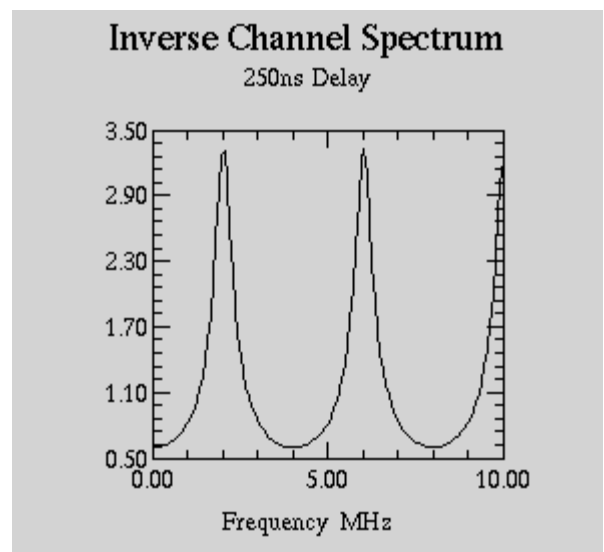
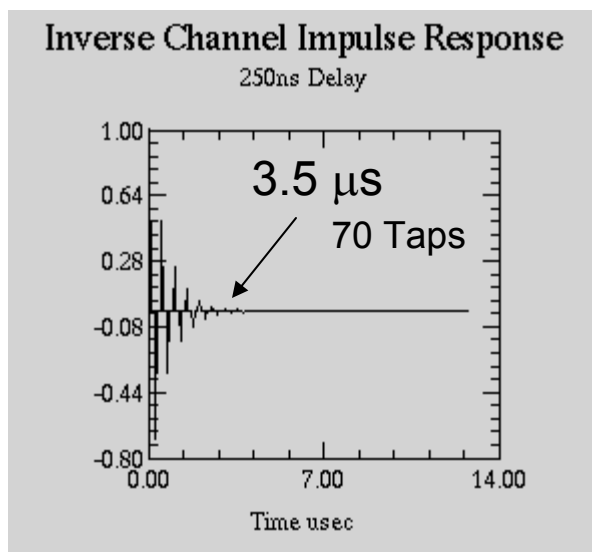
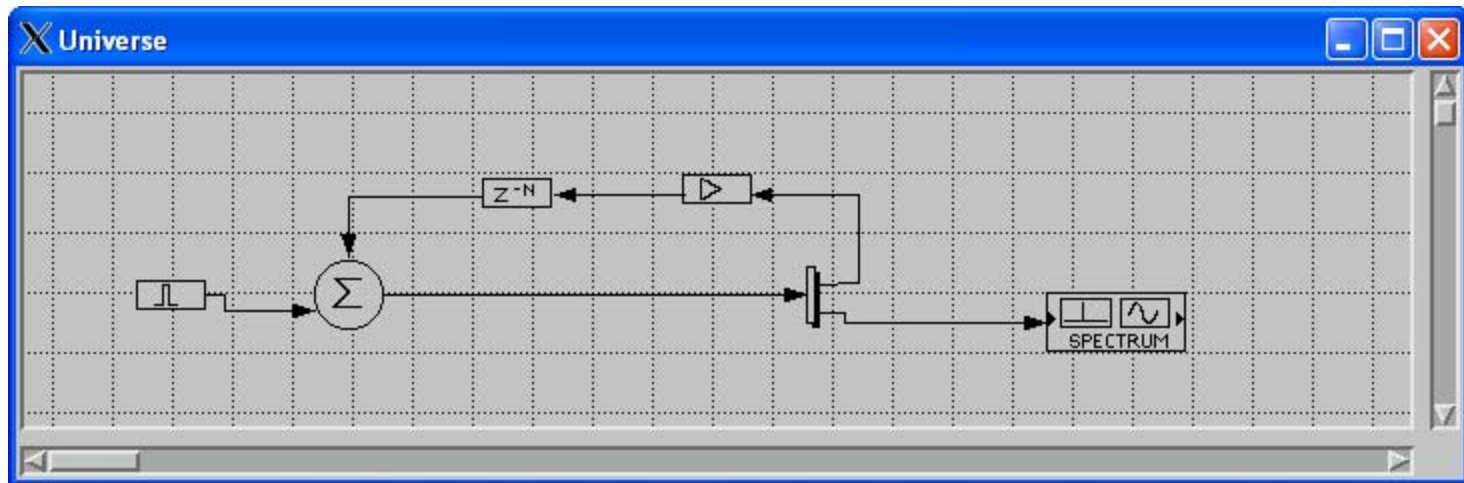
$$Y(z) + \alpha z^{-N} Y(z) = X(z)$$

$$Eq(z) = \frac{Y(z)}{X(z)} = \frac{1}{1 + \alpha z^{-N}}$$



$$H(z)Eq(z) = (1 + \alpha z^{-N}) \frac{1}{1 + \alpha z^{-N}} = 1$$

Inverse Channel Impulse Response



$$\tau_d = 250ns$$

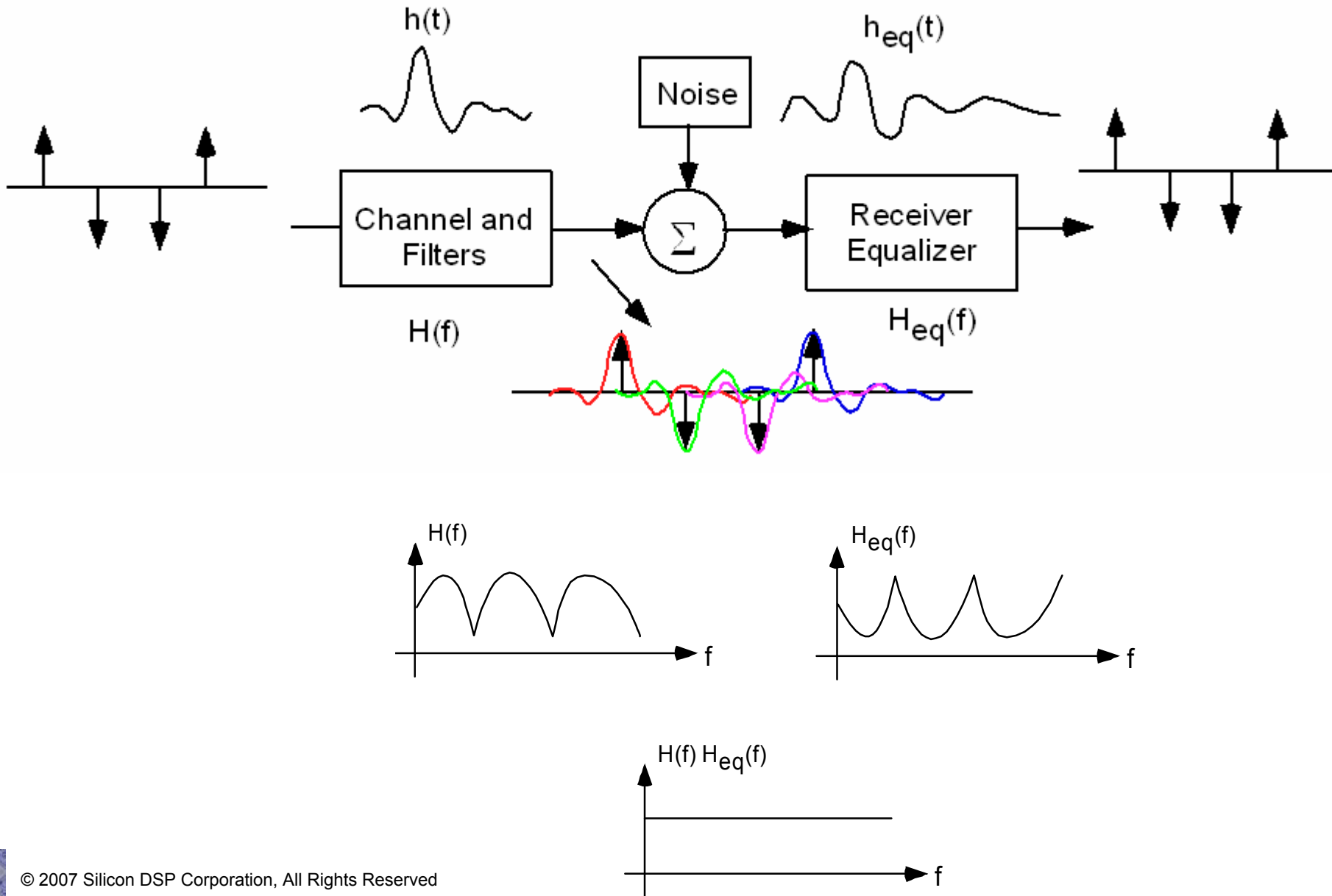
$$f_s = 20 MHz$$

$$\tau_d = N \frac{1}{f_s} = N \Delta t$$

$$N = \frac{\tau_d}{\Delta t} = \frac{250ns}{50ns} = 5$$



Equalizer



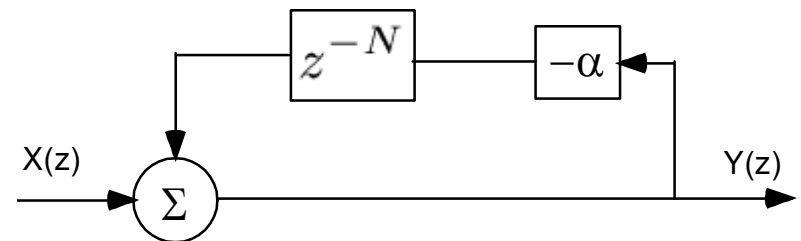
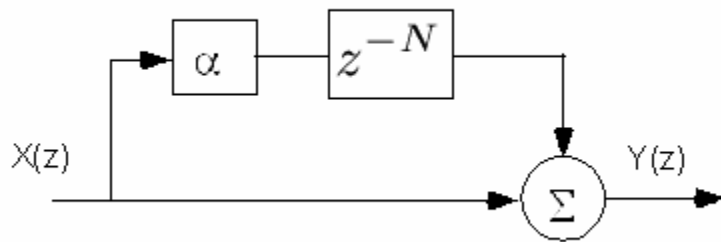
Multipath Implications

- Multipath Deep Fades Lead to Long Impulse Response
- Many Taps Required to Model Impulse Response in Equalizer
- High Complexity

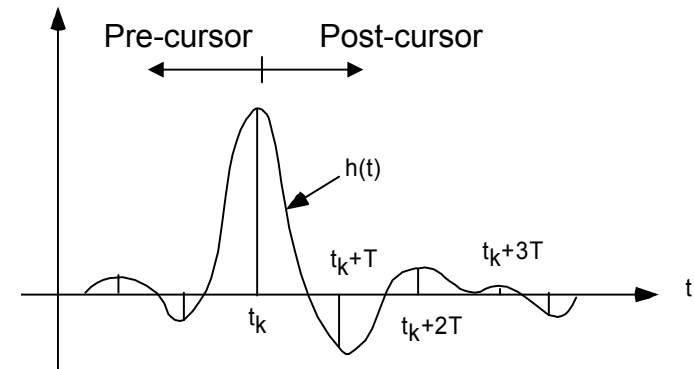
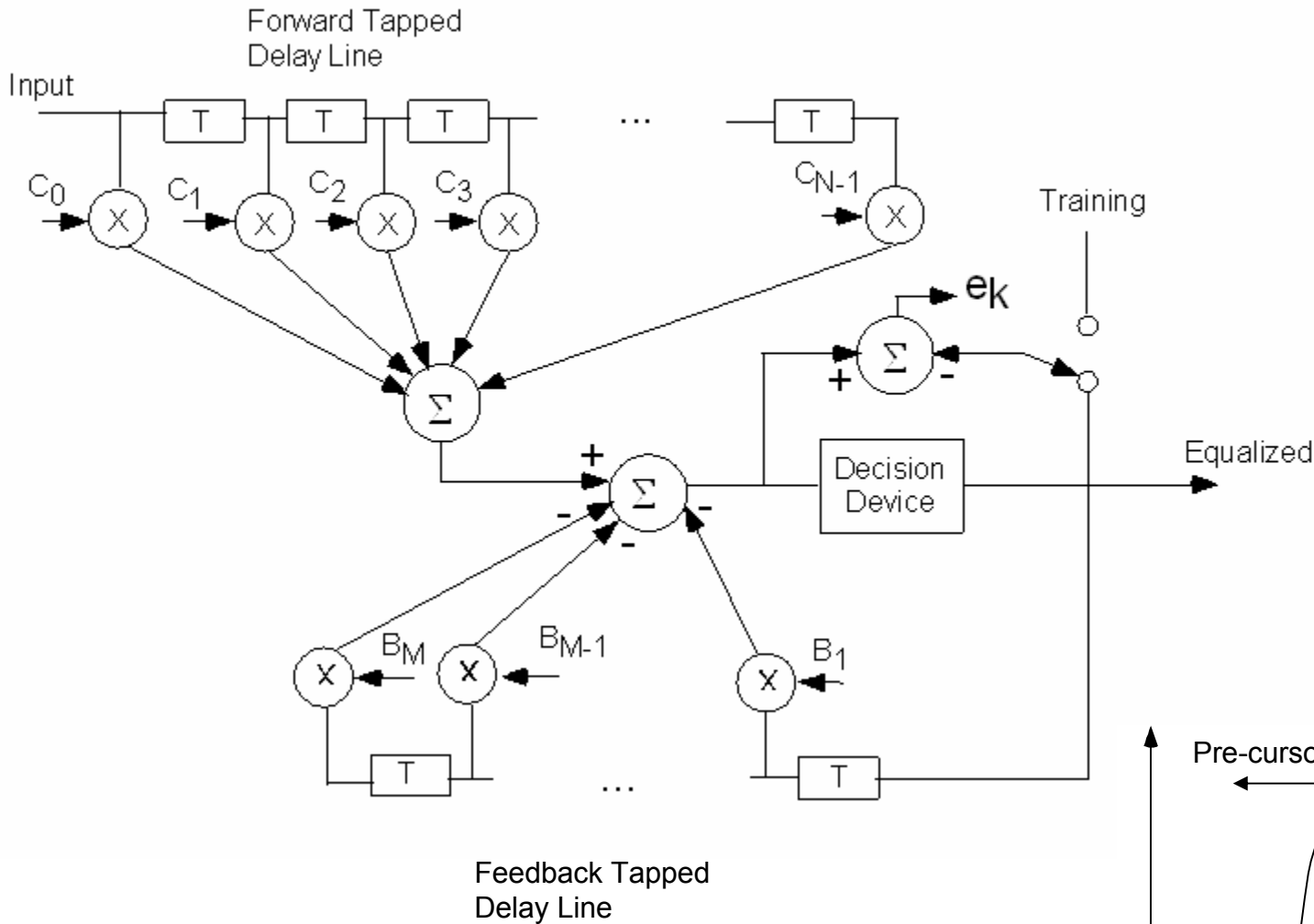


Solution

- Model using Decision Feedback Equalizer
- Include both forward and feedback tapped delay lines
- Reduce complexity



Digital Adaptive Equalizer



Channel Impulse Response



Complex Equalizer

