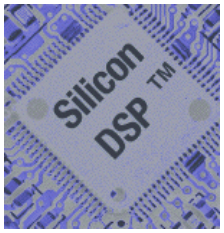
Intersymbol Interference

Adaptive Decision Feedback Equalization

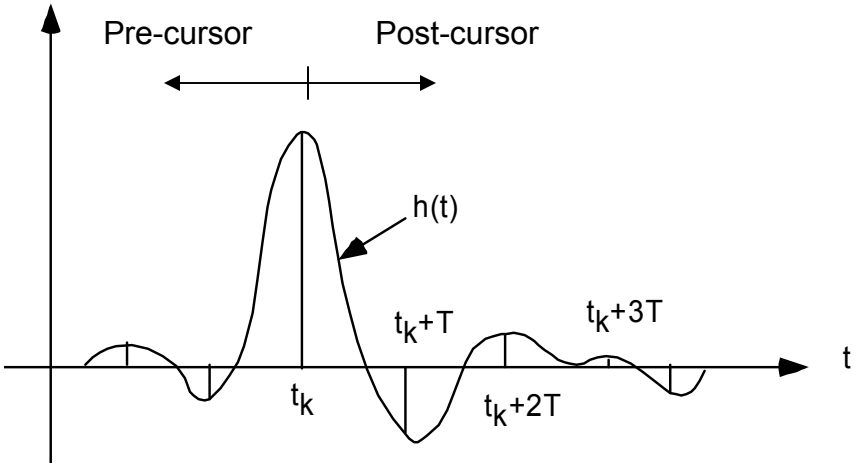


Silicon DSP Corporation

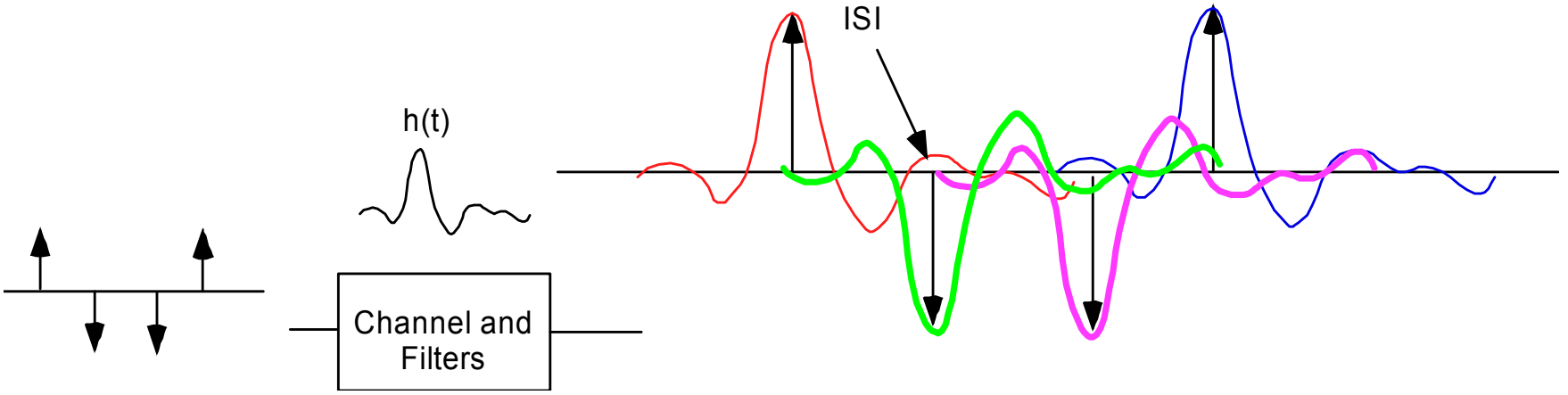
Equalization in Single Carrier and OFDM Communication Systems

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.

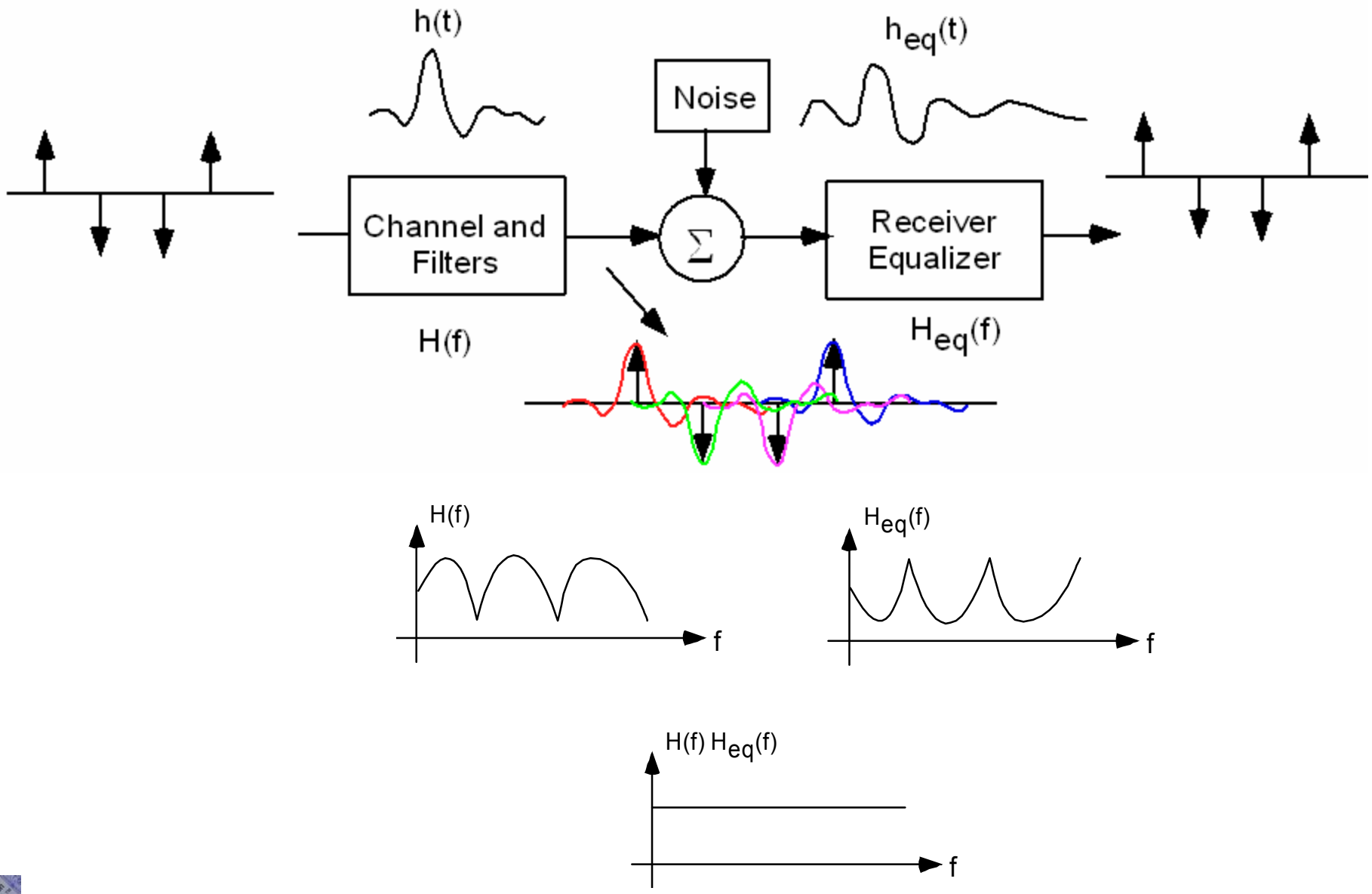
Intersymbol Interference (ISI) in Fading Multipath Channel



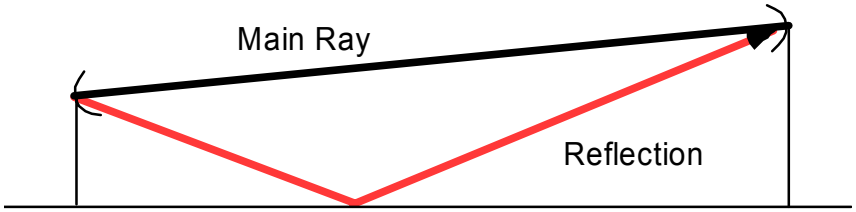
Channel Impulse Response

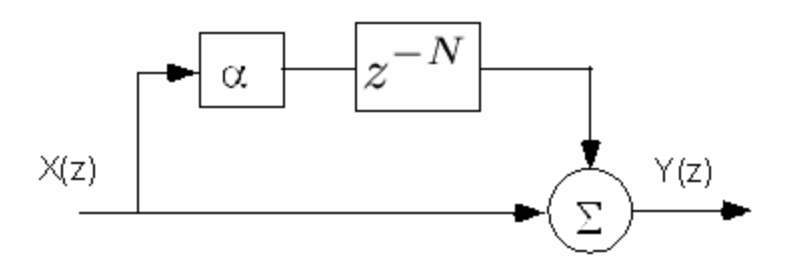


Equalizer



Deep Fades and Impulse Response





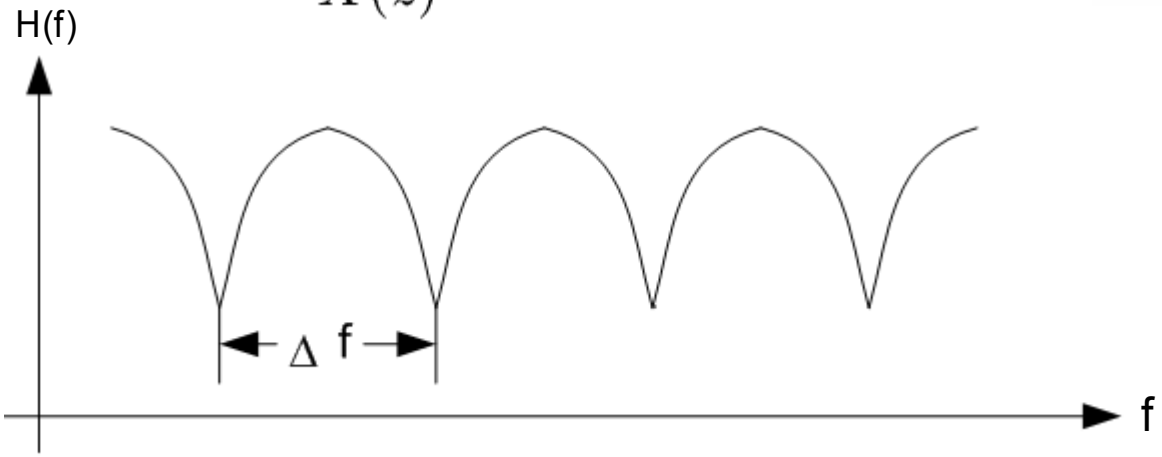
$$s(t) = \delta(t) + \alpha\delta(t - \tau_d)$$

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

Discrete Time Model

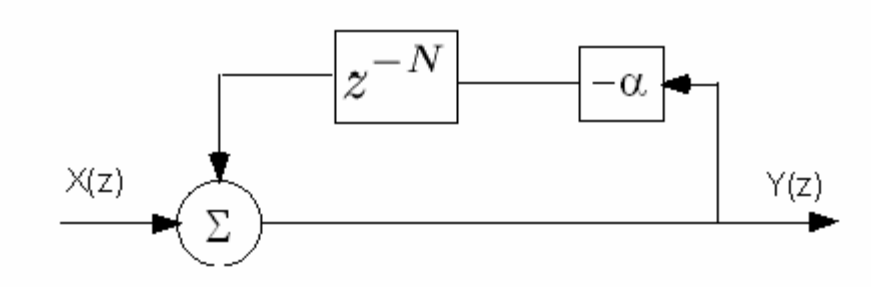
$$H(z) = \frac{Y(z)}{X(z)} = 1 + \alpha z^{-N}$$

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



Inverse Channel
Multipath Fading

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

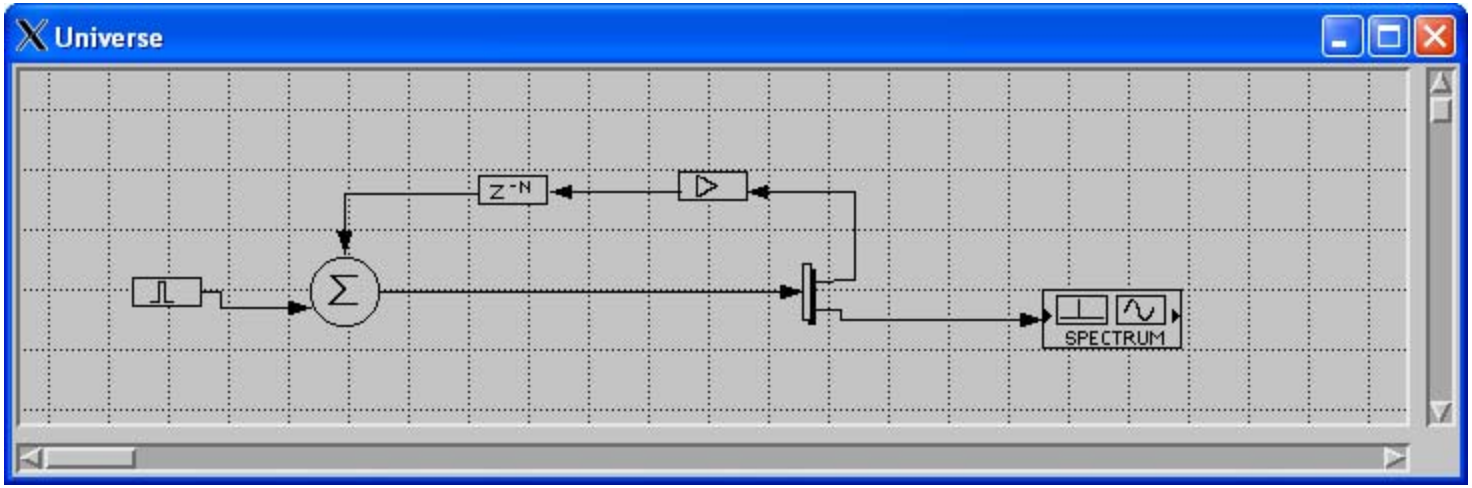


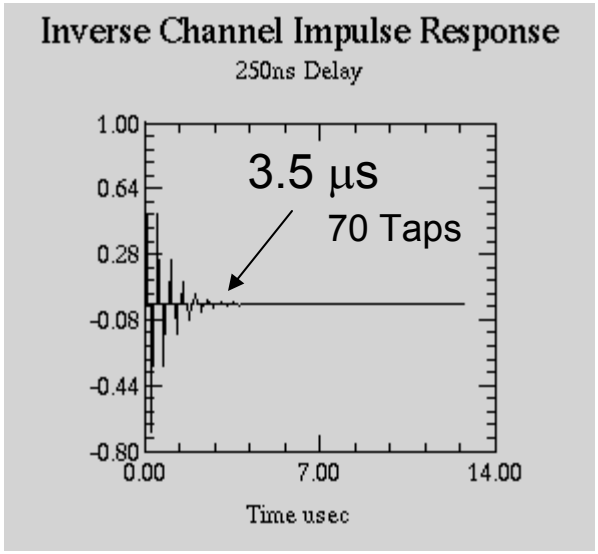
$$Y(z) + \alpha z^{-N} Y(z) = X(z)$$

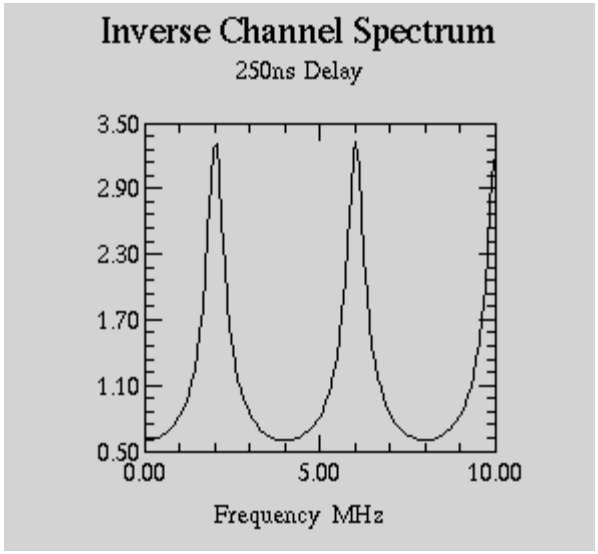
$$Eq(z) = \frac{Y(z)}{X(z)} = \frac{1}{1 + \alpha z^{-N}}$$

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

Inverse Channel Impulse Response





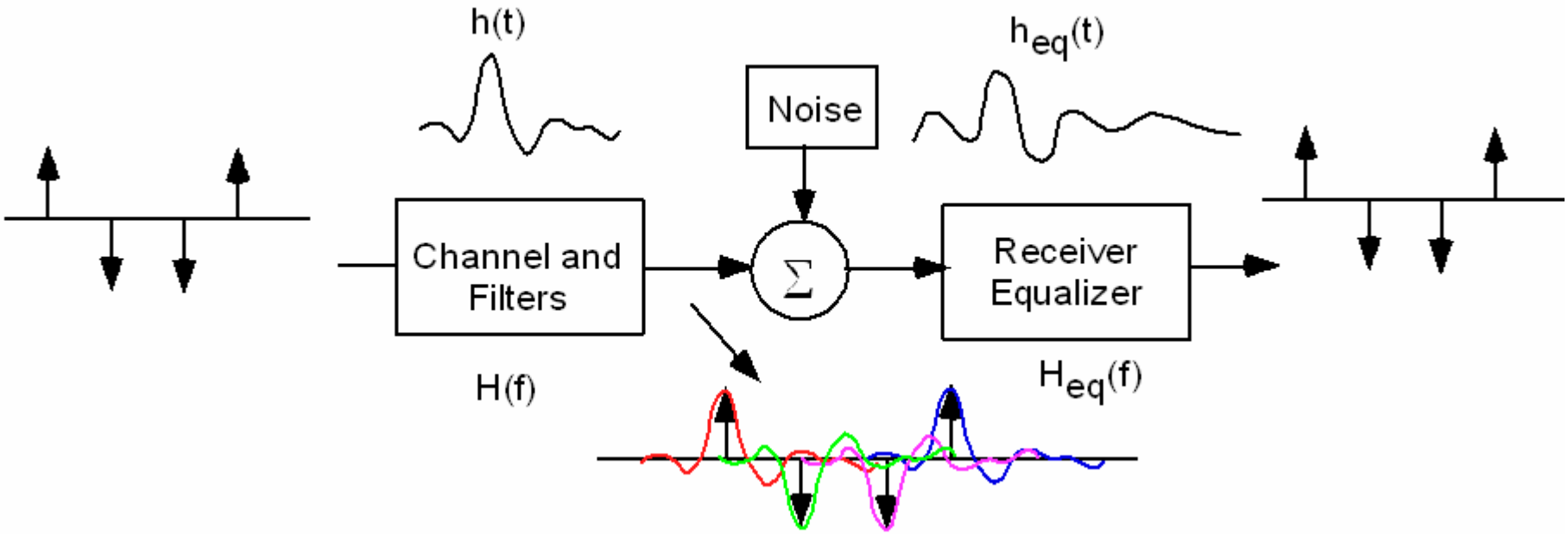


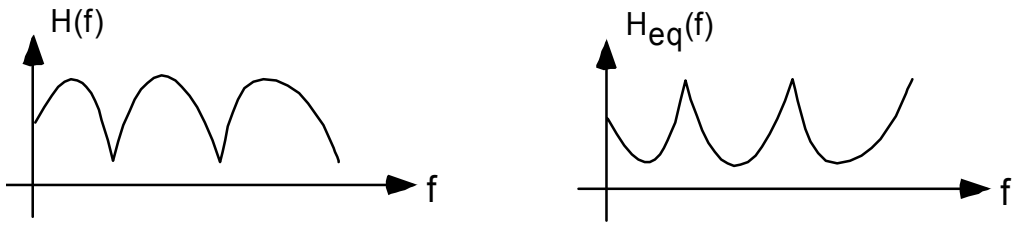
$$\tau_d = 250ns$$
$$f_s = 20\ MHz$$

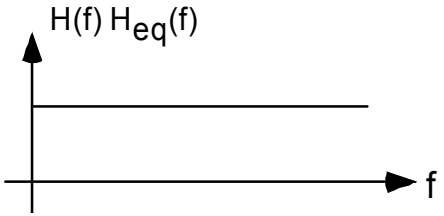
$$\tau_d = N\frac{1}{f_s} = N\Delta t$$

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

Equalizer





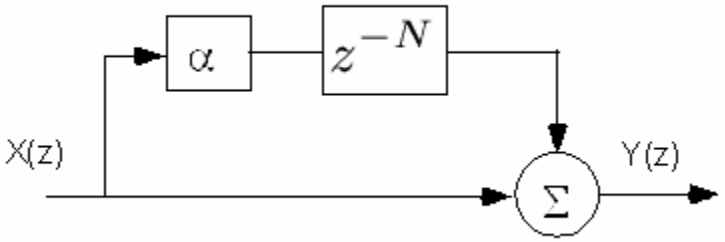


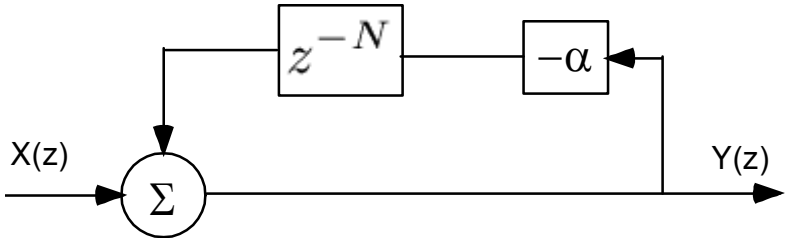
Multipath Implications

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

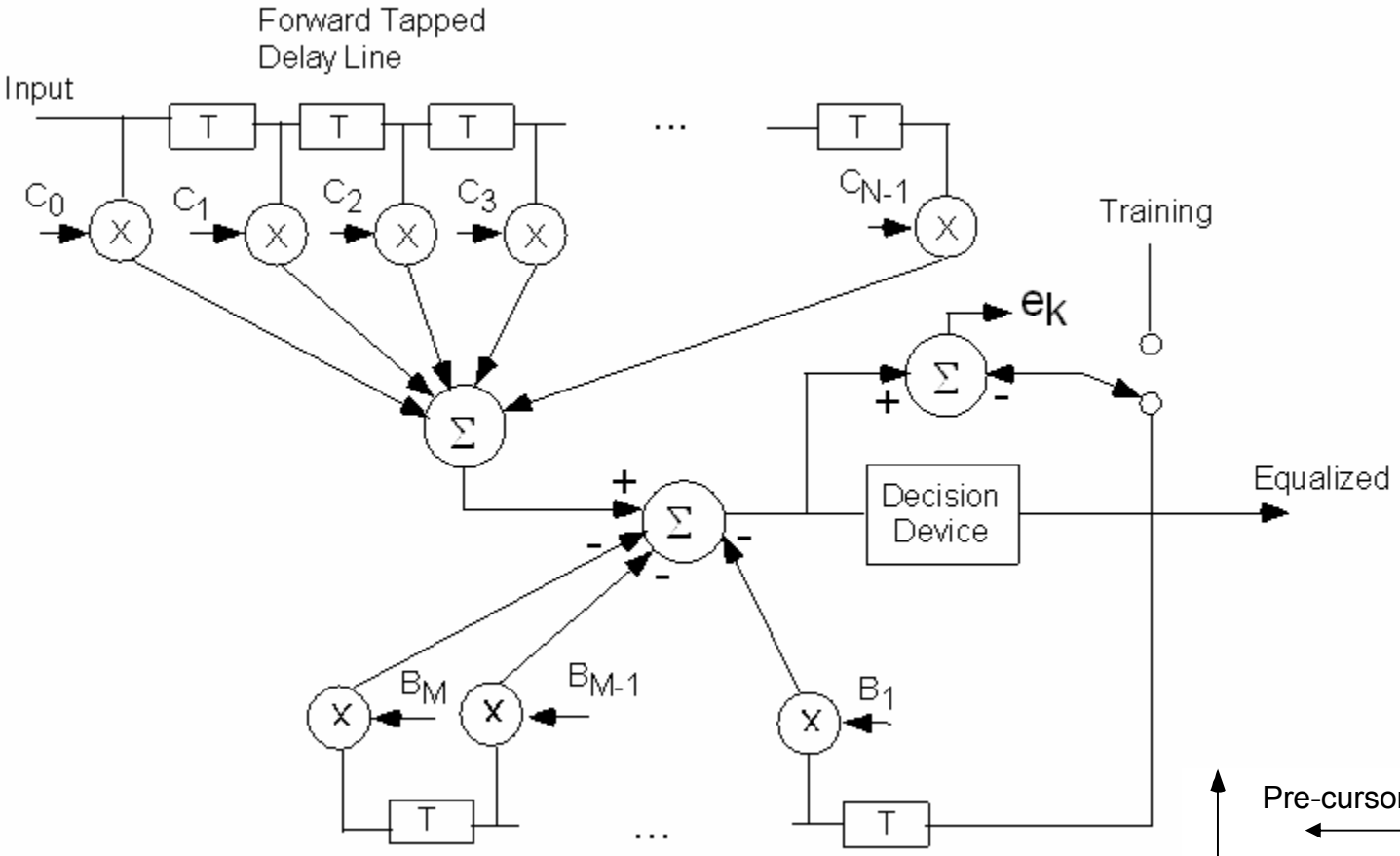
Solution

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

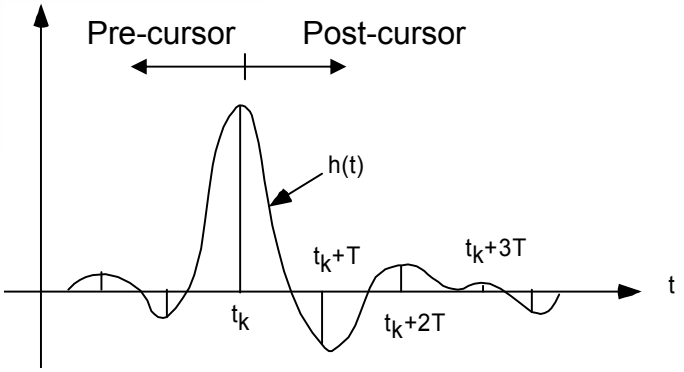




Digital Adaptive Equalizer



Feedback Tapped
Delay Line



Channel Impulse Response

Complex Equalizer