

# Pulses Having the Zero ISI Property

Riccardo Miccini<sup>1</sup>   Eren Can <sup>1</sup>

<sup>1</sup>Technical University of Denmark  
Digital Communication

October 8, 2016

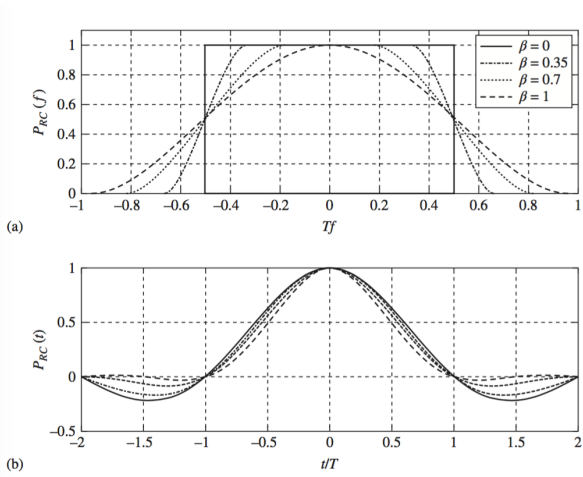
# Pulse Shaping: Nyquist's Criterion For Zero ISI

- It will focus on the investigating the designs for the transmitter and receiver filters that shape the overall signal pulse-shape function
- It will eliminate interference between adjacent pulses.

# Pulses Having the Zero ISI Property

- The transmission of a lowpass signal with bandwidth "W" is sending a minimum of  $2W$  independent sps.
- The transmission of the  $n$ th piece of info through the channel at time  $t = nT = n/(2W)$
- The output of the channel due to this impulse at the input is;  
$$y_n(t) = a_n * \text{sinc}(2 * W * (t - (n/2 * W)))$$

# Cosine Spectra and Corresponding Pulse Responses



# Nyquist's Pulse- Shaping Criterion

- Having a F.T of  $p(t)$ , results in a pulse-shape function with sample values;



$$p(nT) = \left\{ \begin{array}{ll} 1, & \text{for } n \leq 0 \\ 0, & \text{for } 0 \leq n \leq \inf \end{array} \right\}$$

# Transmitter and Receiver Filters for Zero ISI

- Considering simplified transmitter model under consideration here,  $k$ -th sample value multiplies a unit impulse occurring at time  $kT$  and this weighted impulse train is the input to a transmitter filter with impulse response  $h_t(t)$  and corresponding frequency response  $H_T(f)$
- We can mathematically explain by following calculations,  
$$x(t) = \sum_{k=-\infty}^{\infty} a_k * \delta(t - kT) * h_T(t)$$
- So output of the channel will be:  $y(t) = x(t) * h_c(t)$
- And the output of the receiver filter is :  $v(t) = y(t) * h_r(t)$
- We want output to have the zero-ISI property and, to be specific set:  $V(t) = \sum_{k=-\infty}^{\infty} a_k * a_k * A(pRC)(t - kT - t_d)$