S-38.211 Signal Processing in Communications Exercise 3, October 22, 1997	Stefan Werner phone: 451 2437 room: SG224 email: stefan.werner@hut.fi

Figure 1 below shows a discrete-time model of a digital communication system. n_k is white Gaussian noise.

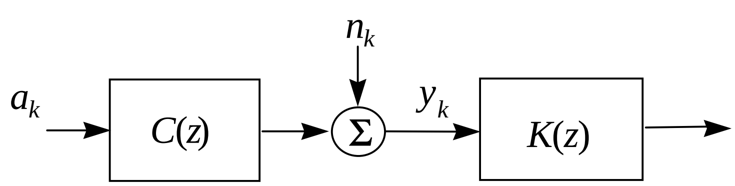

Figure 1: *Block diagram over the communication system.*

Exercise 3-1

The channel that introduces ISI can be described with the discrete-time transfer function $C(z) = 1 + \alpha z^{-1}$.

a) Assume that α is a positive constant smaller than unity ($0 < \alpha < 1$). Draw the pole-zero diagram. Find the optimal linear zero-forcing (LE-ZF) equalizer $K(z)$ and draw the filter structure.

b) Assume that $\alpha > 1$. Draw the pole-zero diagram. Find the optimal LE-ZF equalizer $K(z)$ (which is minimum-phase to guarantee stability) and draw the filter structure.

c) Show that the magnitude of the frequency responses of the two equalizers are the same (regardless of the value of α).

d) Compute the output noise power spectrum (assuming that the noise of the equalizer input is white) and determine the noise power (variance).
Hint: use Parseval's relation.

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Homework 3 (Return time: November 6, 1997)

The channel that introduces ISI can be described with the recursive channel $C(z) = \frac{1}{1+\alpha z^{-1}}$

a) Assume that α is a positive constant smaller than unity ($0 < \alpha < 1$). Draw the pole-zero diagram. Find the optimal linear zero-forcing (LE-ZF) equalizer $K(z)$ and draw the filter structure.

b) Assume that $\alpha > 1$. Draw the pole-zero diagram. Find the optimal LE-ZF equalizer $K(z)$ (which is minimum-phase) and draw the filter structure. Is it a problem here to have a maximum-phase equalizer? Why?

c) Show that the magnitude of the frequency responses of the two equalizers are the same (regardless of α).

d) Compute the output noise power spectrum (assuming that the noise of the equalizer input is white) and determine the noise power (variance).