S-38.211 Signal Processing in Communications Exercise 2, October 15, 1997	Stefan Werner phone: 451 2437 room: SG224 email: stefan.werner@hut.fi

Exercise 2-1

Consider transmitting bits X_k (zeros and ones) over a channel with additive white Gaussian noise. Assume that $X_k = 0$ for $k \le 0$ and $k \ge K$. Suppose that $K = 3$ and the observation sequence is $\{y_0, y_1, y_2, y_3\} = \{0.6, 0.9, 1.3, 0.3\}$. The model for the ISI channel model is $g_k = \delta_k + 0.5\delta_{k-1}$

a) Model the system as a shift register process and draw the state transition diagram. Label the arcs with the input/output pairs (X_k, S_k).

b) Draw one stage of the trellis and label with the input/output pairs (X_k, S_k).

c) Draw the trellis for the Markov model and label the transition weights. What is the ML detection of the incoming bit sequence?

d) Find the ML decision sequence $\hat{x}_k$ assuming that the additive noise is the only degradation (no ISI) and that X_k are i.i.d.

Homework 2 (Return time: October 29, 1997)

Assume X_k is equally likelly to be 0 or 1, and the X_k are independent for all k. Assume additional additive Gaussian white noise with variance σ^2. The ISI channel is given as $g_k = \delta_k - 0.5\delta_{k-1} + 0.1\delta_{k-2}$.

a) Model the system as a shift register process and draw the state transition diagram. Label the arcs with the input/output pairs (X_k, S_k).

b) Draw one stage of the trellis and label with the input/output pairs (X_k, S_k).

c) Assume $\Psi_k = 0$ for $k \le 0$ and $k \ge 5$. Suppose the observation sequence is $\{y_0, y_1, y_2, y_3, y_4\} = \{0.5, -0.2, 0.9, 1.2, 0.1\}$. Draw a complete trellis with branch weights labeled.

d) Use the Viterbi algorithm to find the ML decision sequence!

e) What is the ML decision sequence $\hat{x}_k$ assuming only additive noise (no ISI)?