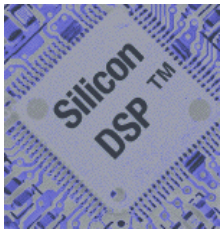
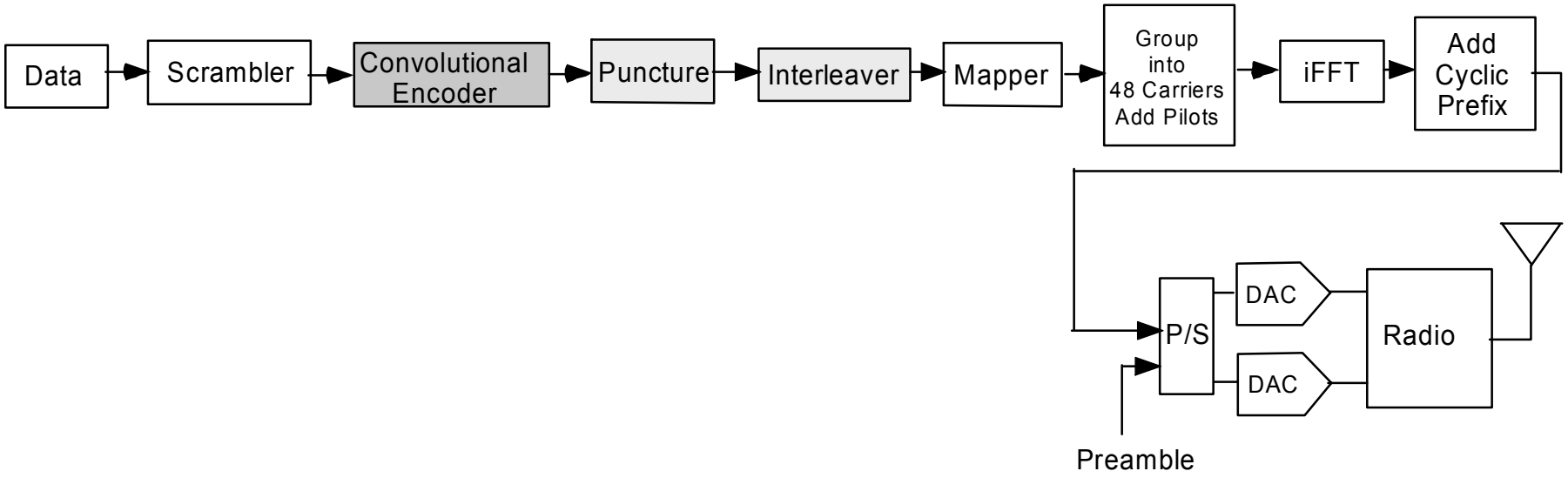
Forward Error Correction (FEC)

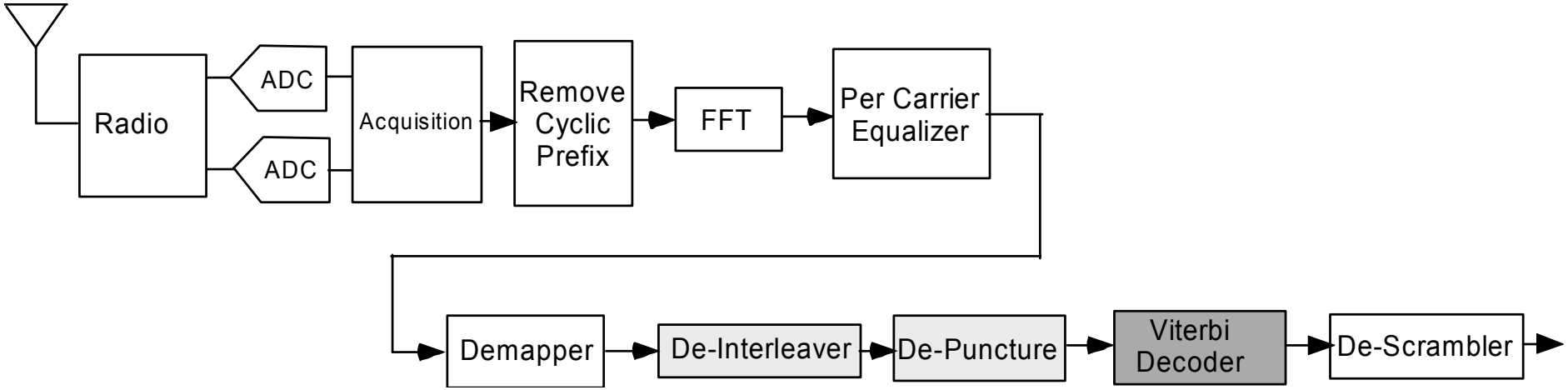
Convolutional Encoder

Viterbi Decoder



Silicon DSP Corporation





References

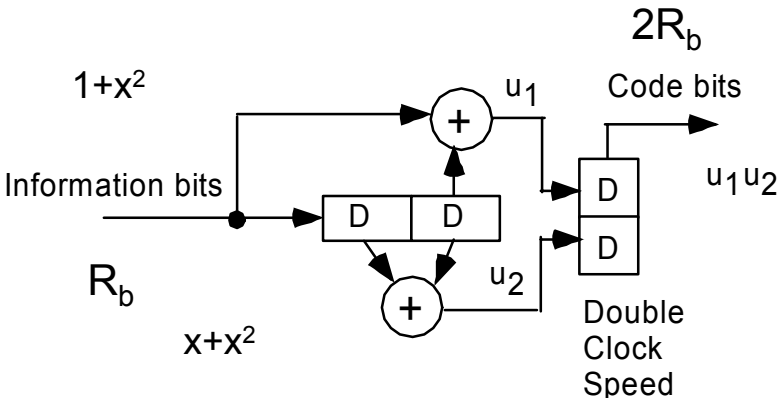
Theory and Practice of Error Control Codes, Richard E. Blahut, Addison-Wesley, 1983

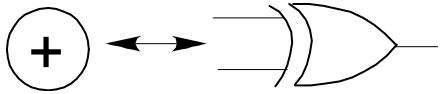
Error-Control Coding for Data Networks, Irving S. Reed, Xuemin Chen,Springer, 2003

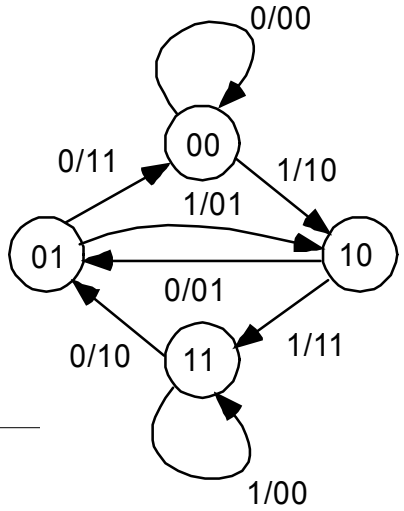
A tutorial on Convolutional Coding with Viterbi Decoding, Chip Fleming, 1999-2006, http://home.netcom.com/~chip.f/viterbi/tutorial.html

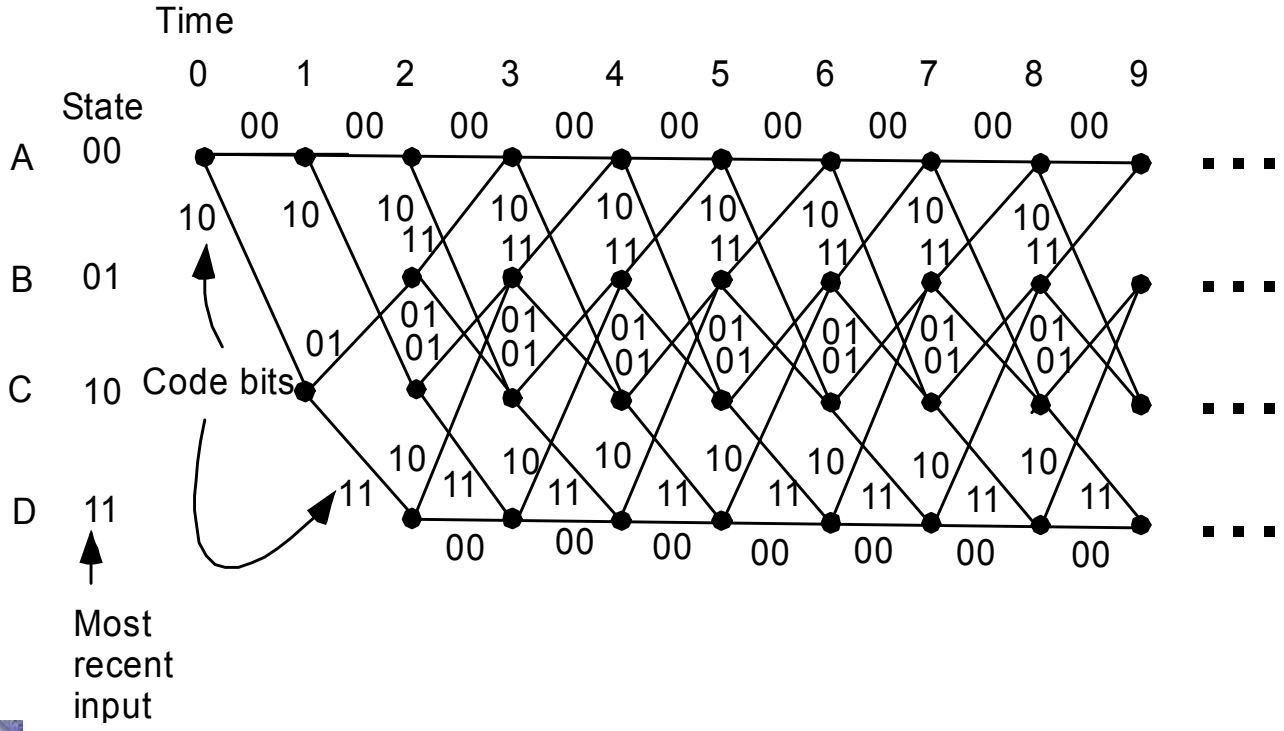
Digital Communications, Bernard Sklar, Second Edition, Prentice Hall, 2001

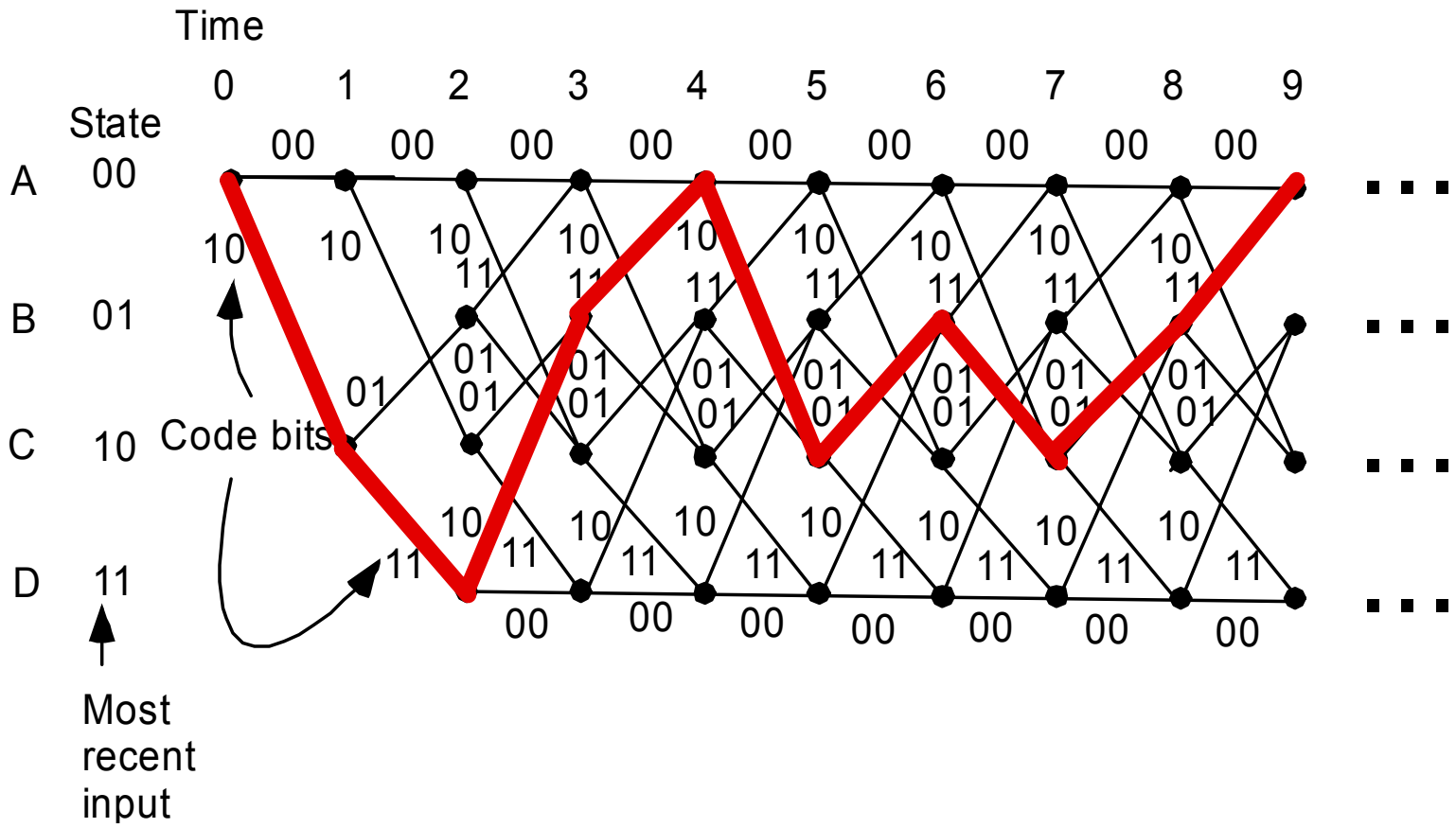
Convolutional Encoder











Input Stream 110010100

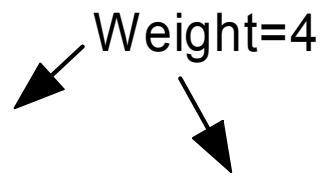
Output Stream 10 11 10 11 10 01 01 01 11

Error Correction and d_{min}

C1=1010111011

C2=1011001001

C1+C2=0001110010



Hamming Distance=4

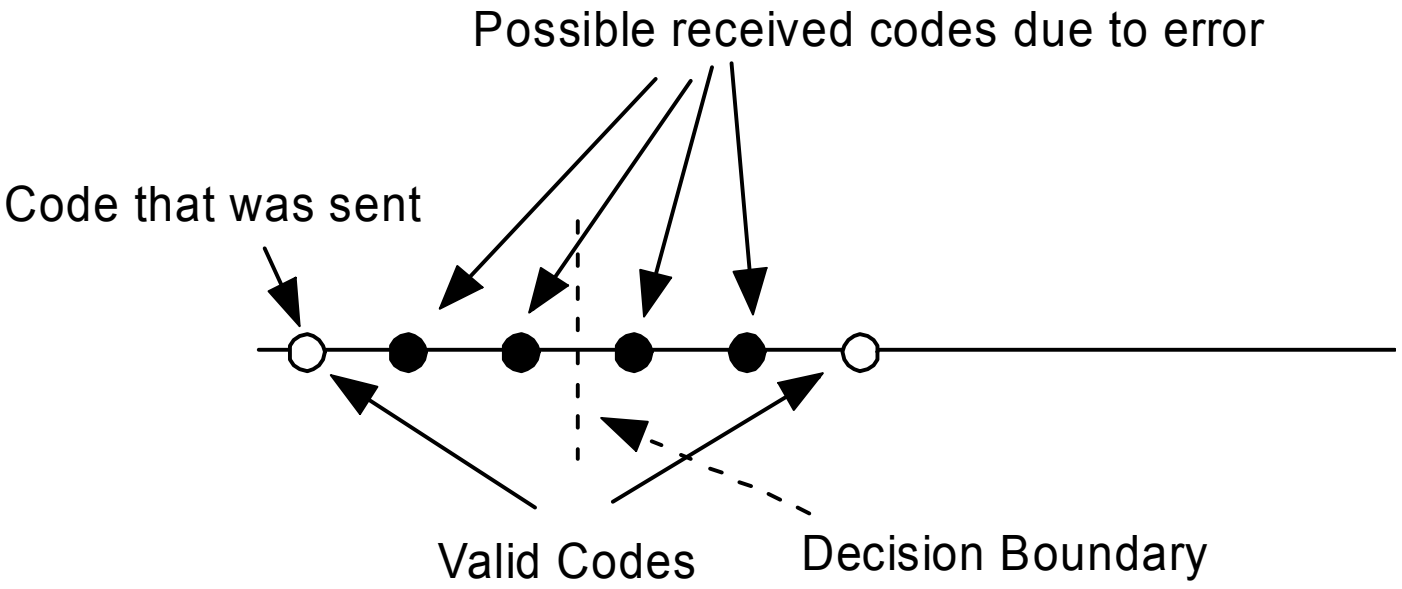
C

$C_1\ C_2\ C_3\ ..\ C_n$

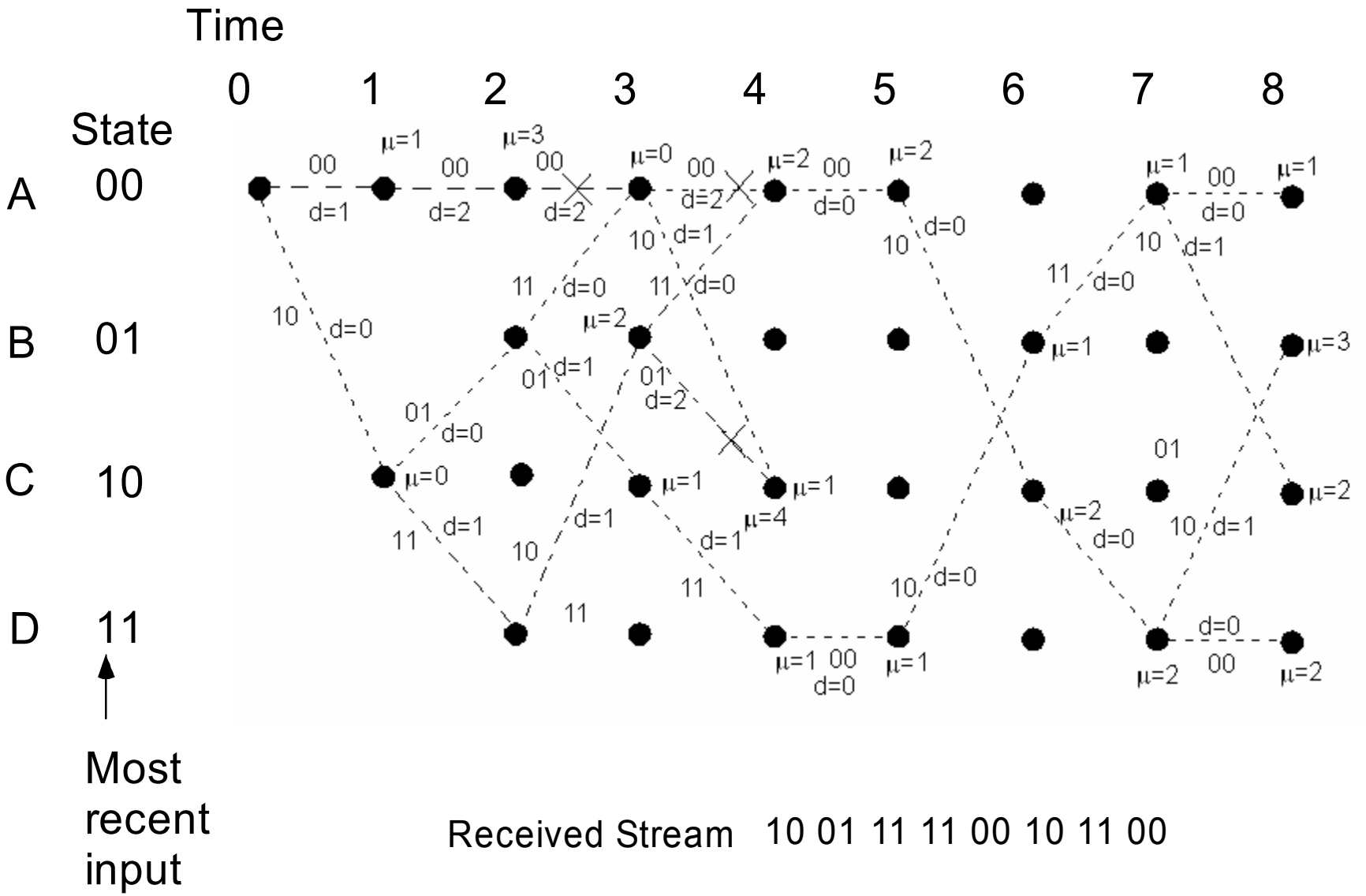
(C-C)

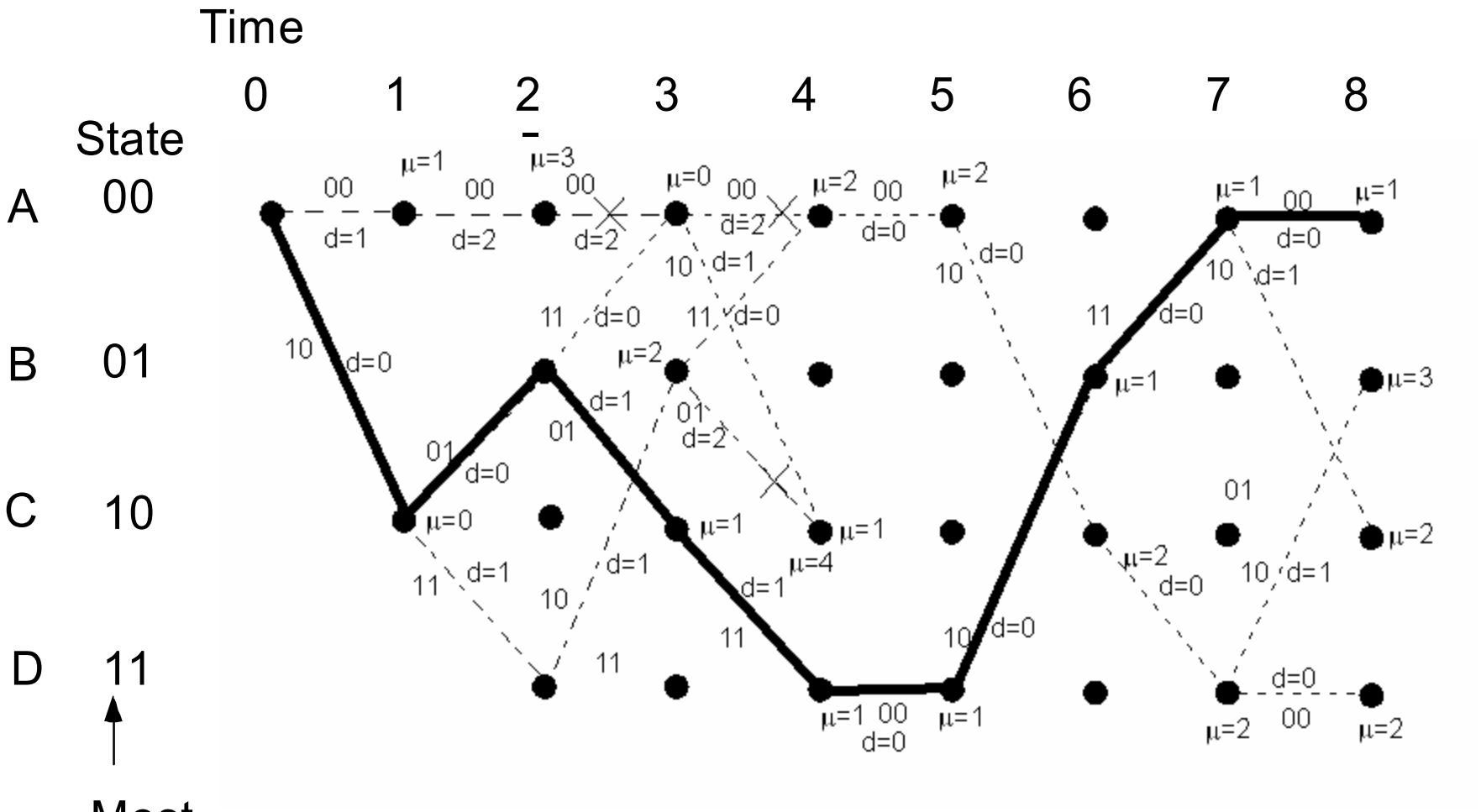
$(C_1\text{-}C)\ (C_2\text{-}C)\ ...\ (C_n\text{-}C)$

Error Correction



$$2t+1=d_{min}$$

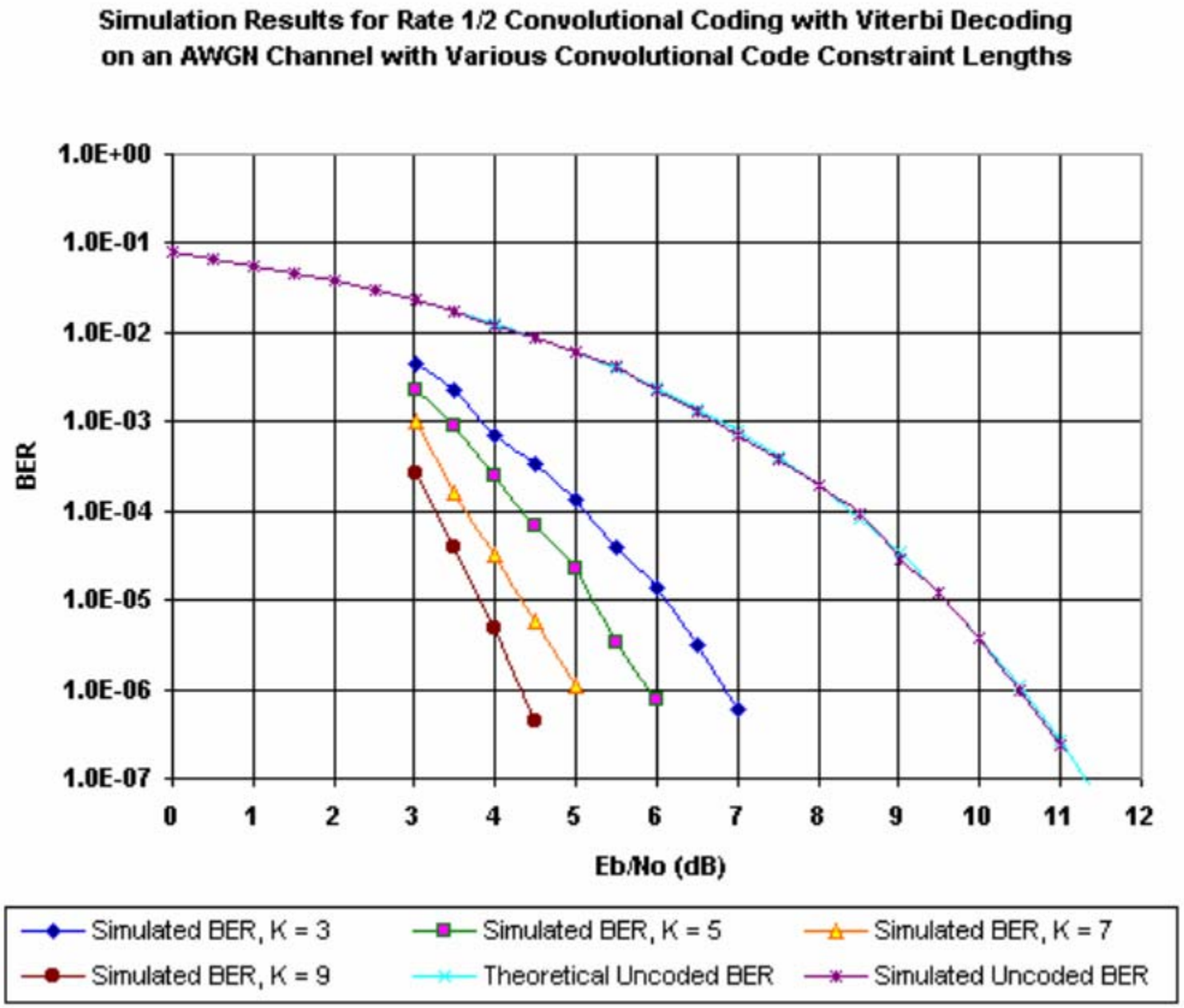




Received Stream 10 01 11 11 00 10 11 00

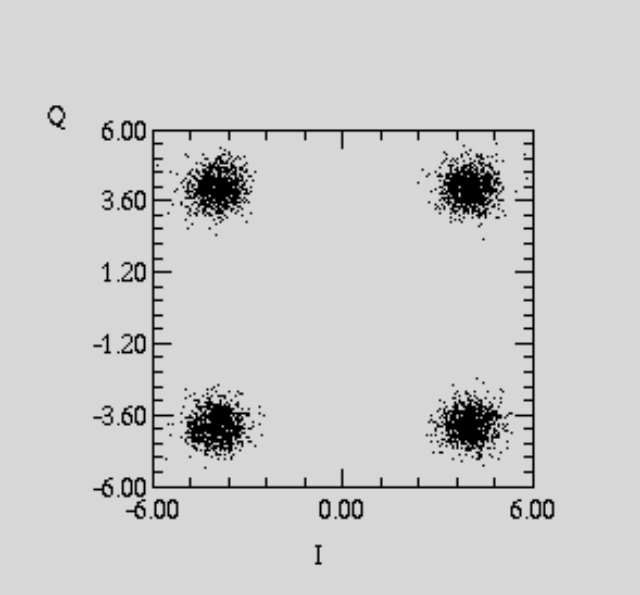
Decoded Stream 10 01 01 11 00 10 11 00

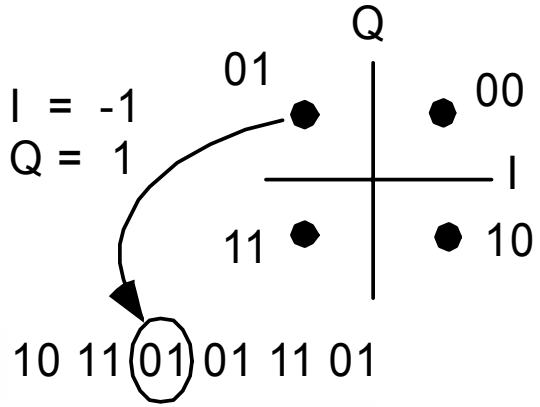
Decoded Message 10111000

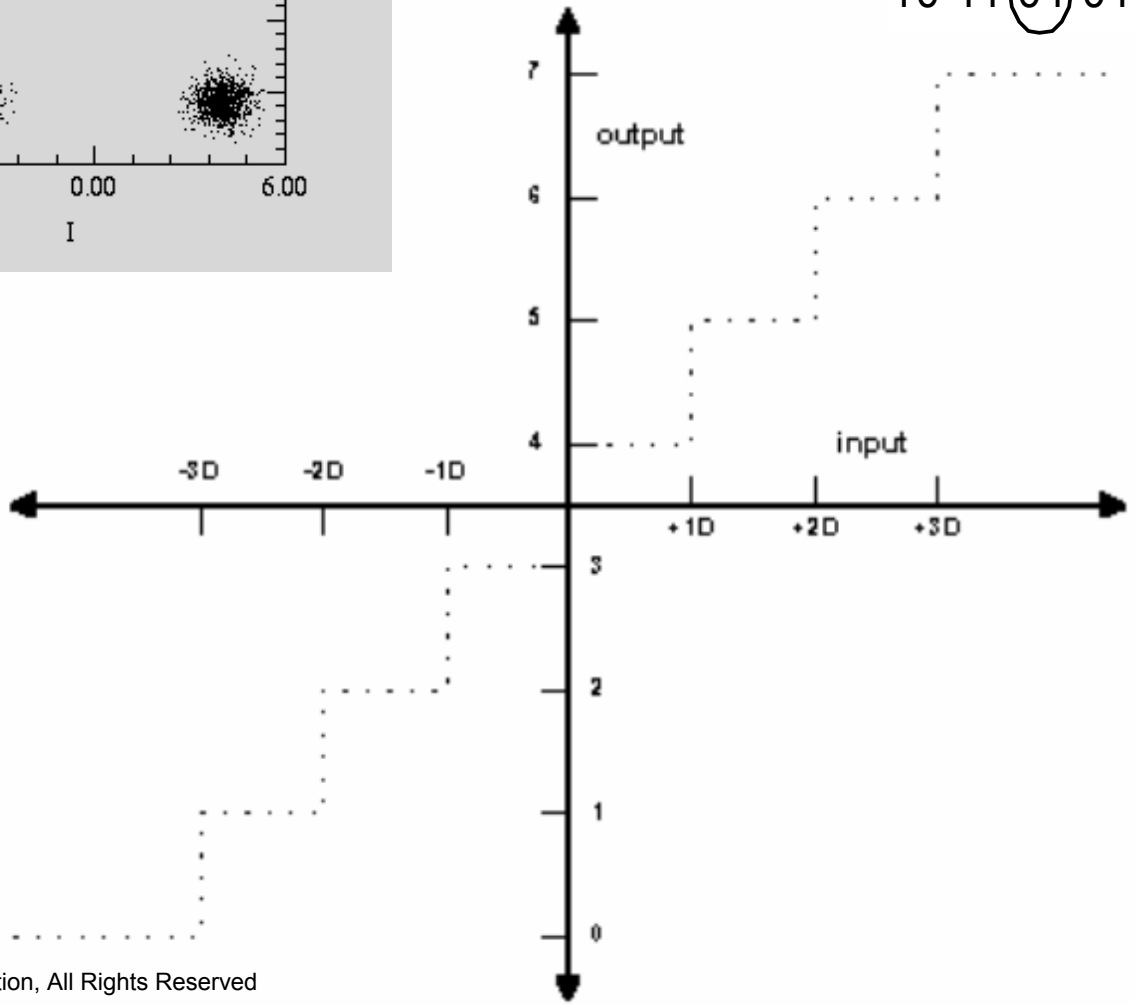


A tutorial on Convolutional Coding with Viterbi Decoding, Chip Fleming, 1999-2006,
http://home.netcom.com/~chip.f/viterbi/tutorial.html

Soft Decisions







Ref: Chip Fleming

Soft Decision Gain

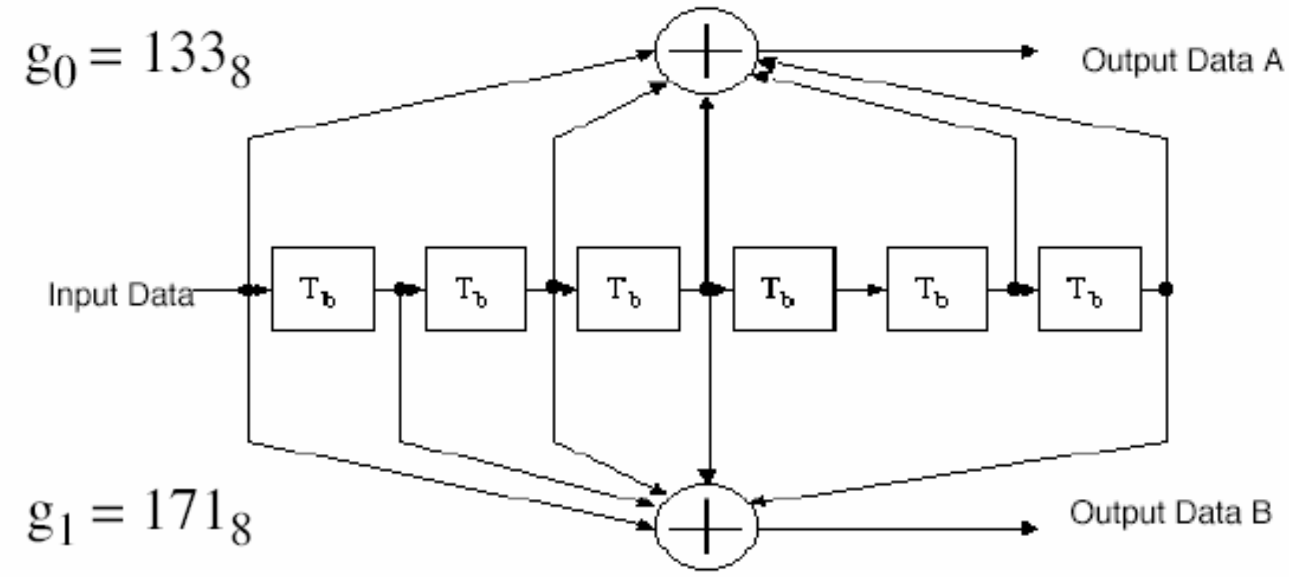
- Soft Decision Viterbi Decoding has about 3 dB gain over hard decision (all references).
- The gain diminishes after number of bits >4. Most gain from 3 to 5 bits.
- Reported Gains of 5-6 dB in 16 and 64 QAM

Soft Decision Demapper Reference

Filippo Tosato, Paola Bisaglia, “Simplified Soft-Output Demapper for Binary Interleaved COFDM with Application to HIPERLAN/2, HP Laboratories Bristol, October 10th, 2001

IEEE 802.11a Convolutional Encoder

$1+x^2+x^3+x^5+x^6$



$1+x+x^2+x^3+x^6$

Constraint Length K equal to 7=6+1

A Output First Then B

- Traceback length 48 for non-punctured and 96 for punctured (Xilinx)

For hard-decision input the Viterbi decoder’s smallest accumulated error metric in the final state indicates how many channel symbol errors occurred.

Traceback depth K x 5 more if puncturing used. Example 60.

Flush K bits.