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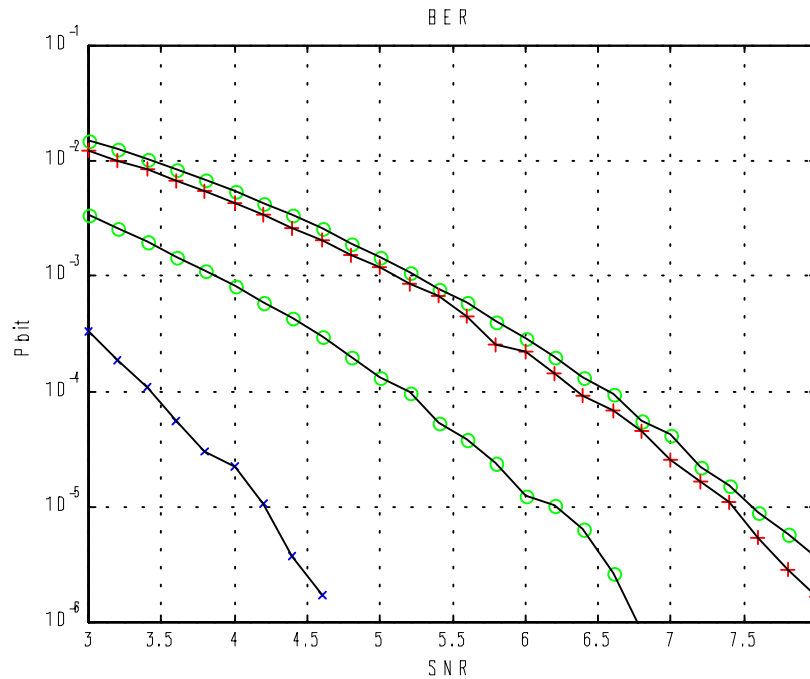
# Joint Equalization and Decoding

*Chris Heegard*  
*and*  
*Matthew Shoemake*



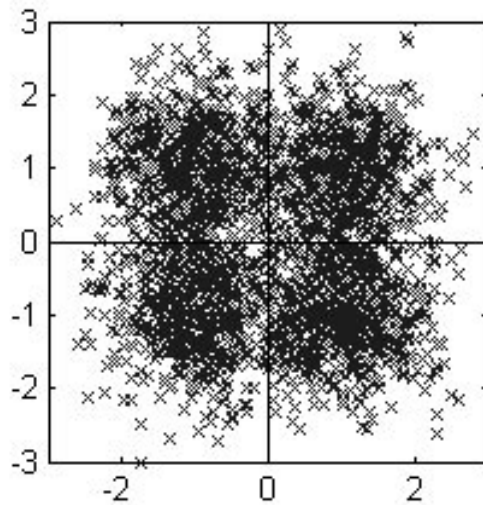
# Decoding without ISI

- Lucent, Harris & Alantro at 11Mbps

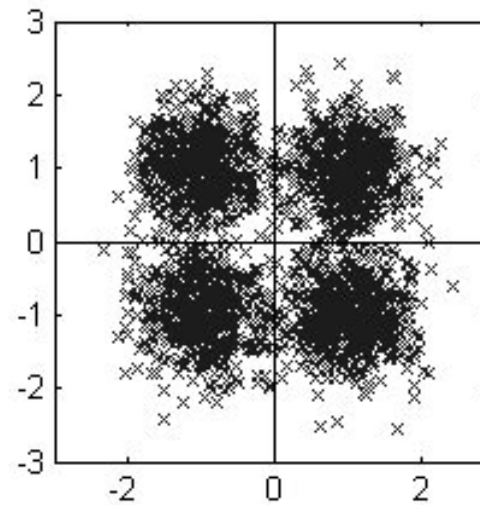


# QPSK with Noise

QPSK @ 4.2dB

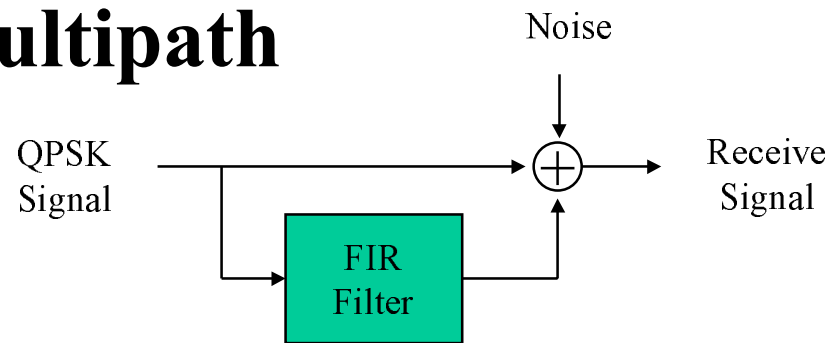


QPSK @ 7.2dB

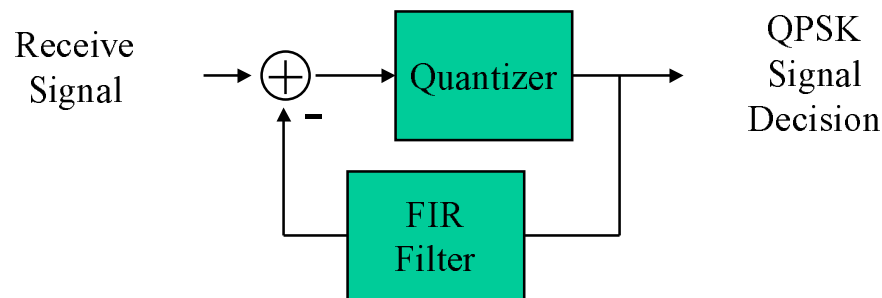


# Equalization of ISI

- **FIR models for Multipath**

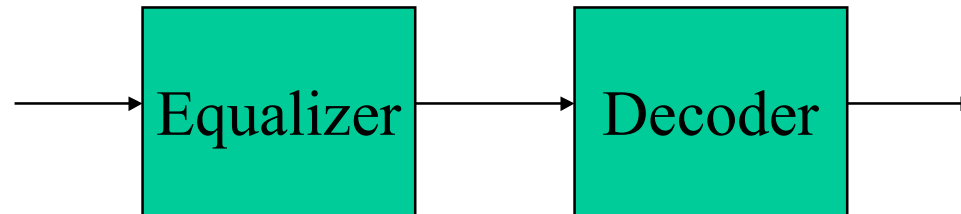


- **FFE + DFE**



- **FIR with QPSK is a FSM**

# Equalize/Decode

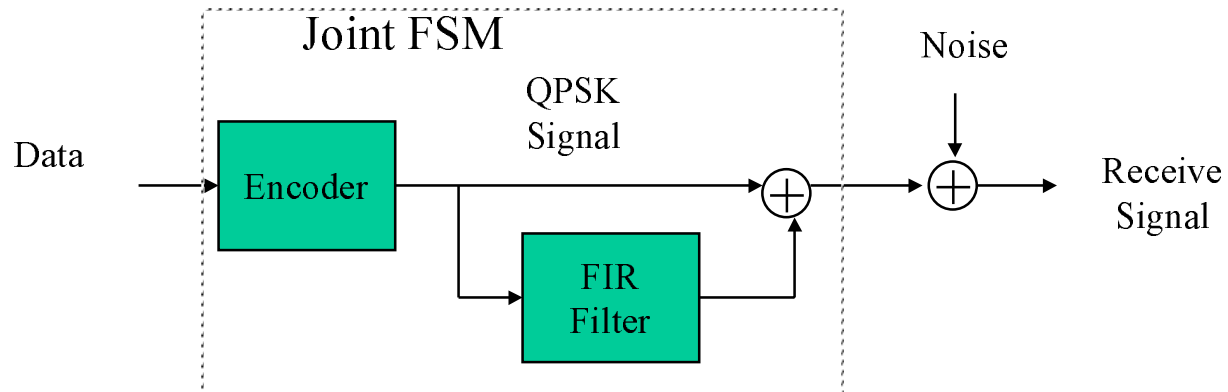


# Decision Feedback Equalizer

- **DFE makes no error  $\Rightarrow$  Code Not Required**
- **DFE makes error  $\Rightarrow$  Code overloaded**
- **Interleaving  $\Rightarrow$  small improvement**
- **Fundamentally: Signal Distortion is Predictable, Noise is not**

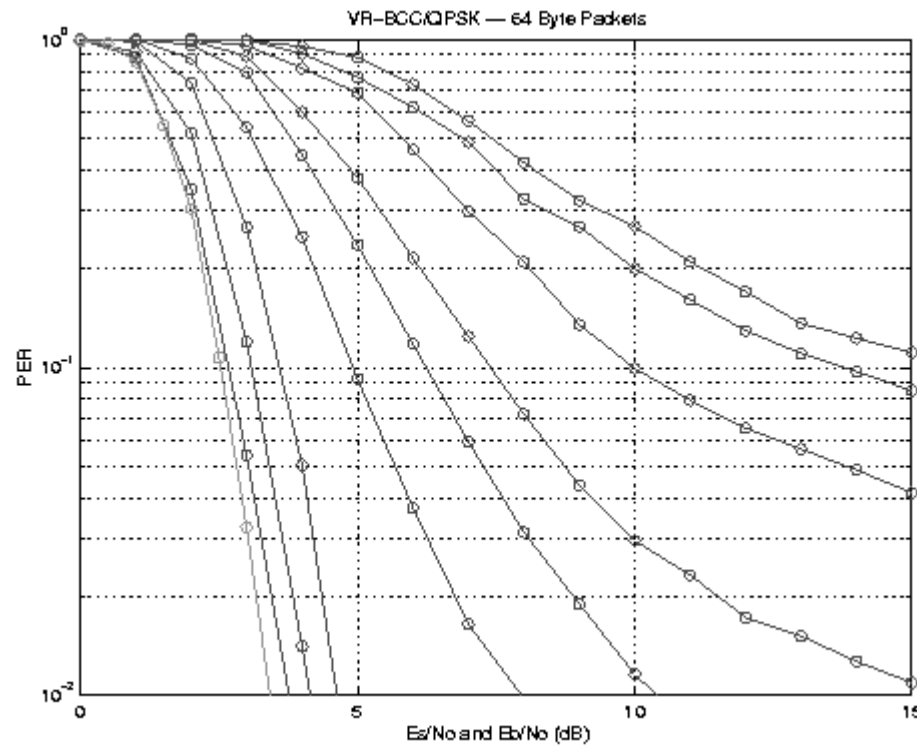
# Joint E/D is viable

- **Model Code/Channel**



# Viterbi Decode Joint Model

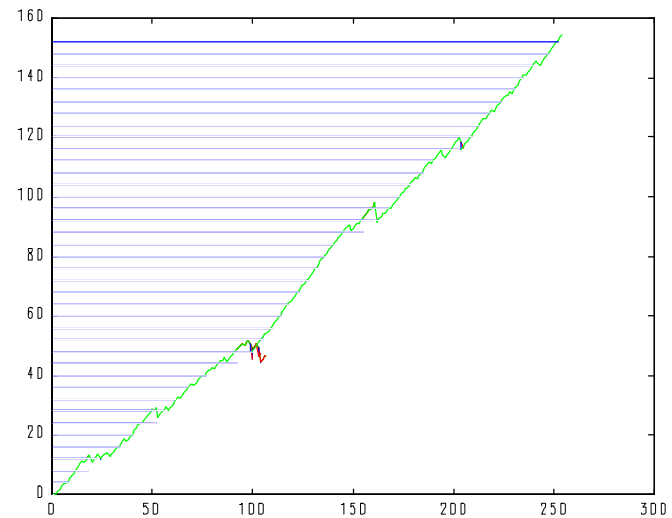
25, 50, 100, 150,  
200, 250, 300, 400,  
500 ns





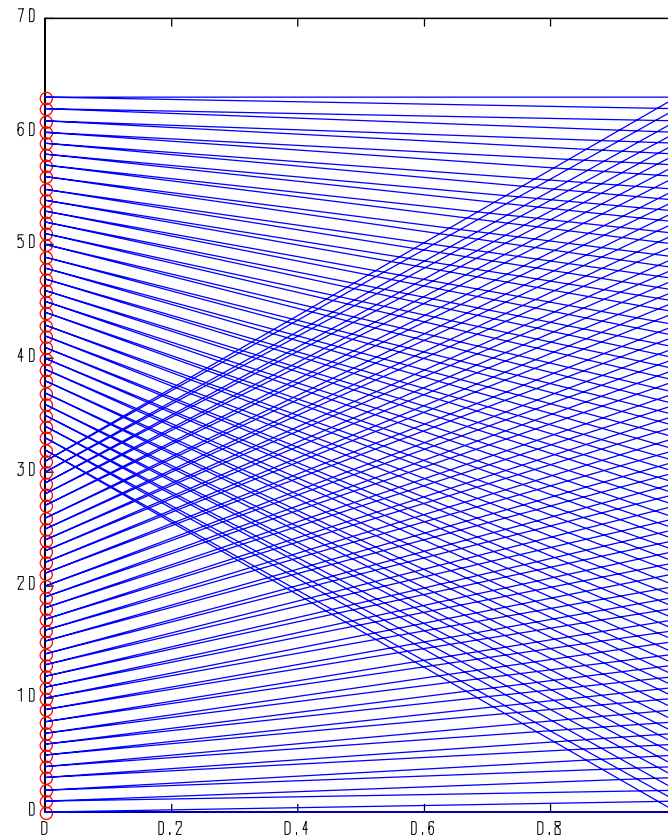
# Sequential Decoding

- **Less Complex**
- **Small loss w.r.t. Viterbi**
- **Good for Packet Based Systems**
  - **No “restart” problem**



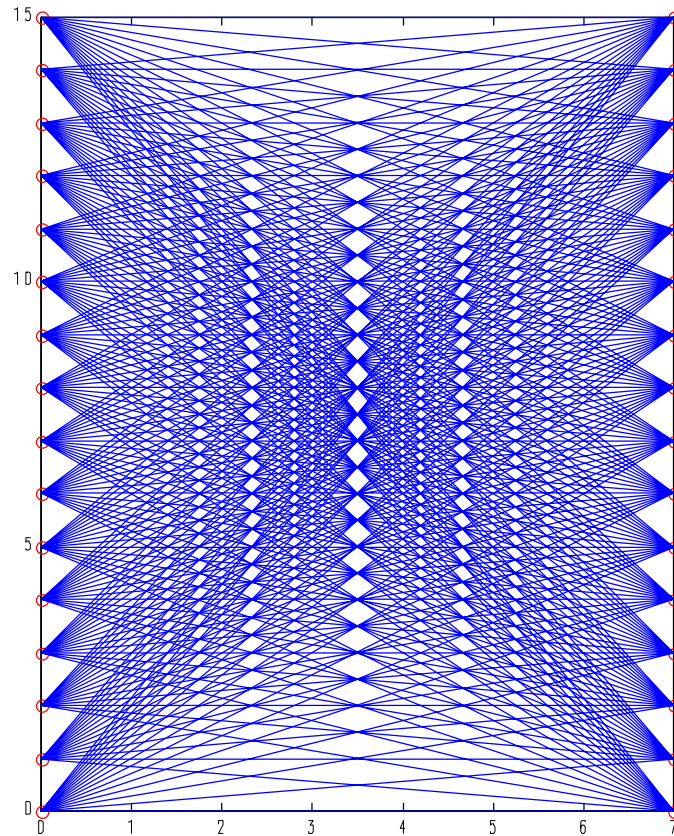
# Trellis Descriptions

- **Alantro BCC**



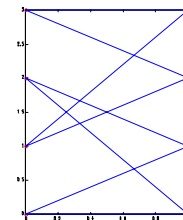
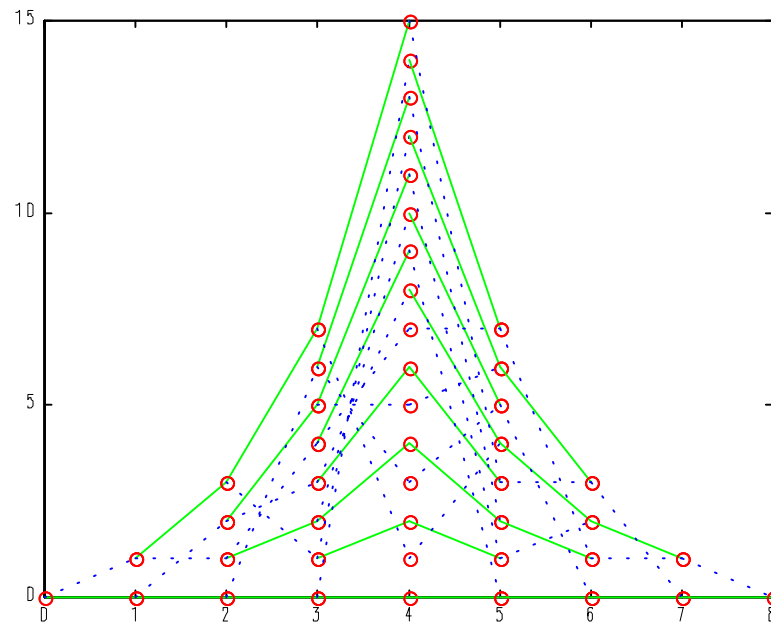
# Trellis Descriptions

- **Lucent OPPM**



# Trellis Descriptions

- **Harris Walsh (Extended Hamming Code)**



# Can Joint E/D Be used with every proposal?

- **Yes, but**
- **BCC's have aperiodic trellis**
  - **Complexity/Clocking issue**
- **BCC's have binary trellis**
  - **Important for Sequential decoding**
- **BCC's a single encoder on I/Q**
  - **Better combining with Joint Model**

# Summary

- **BCC's give superior performance in AWGN**
- **Regular Trellis Structure means practical joint equalizer/decoding**