

# Presentation Outline

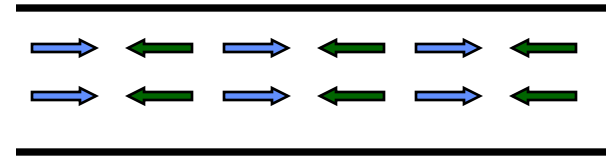
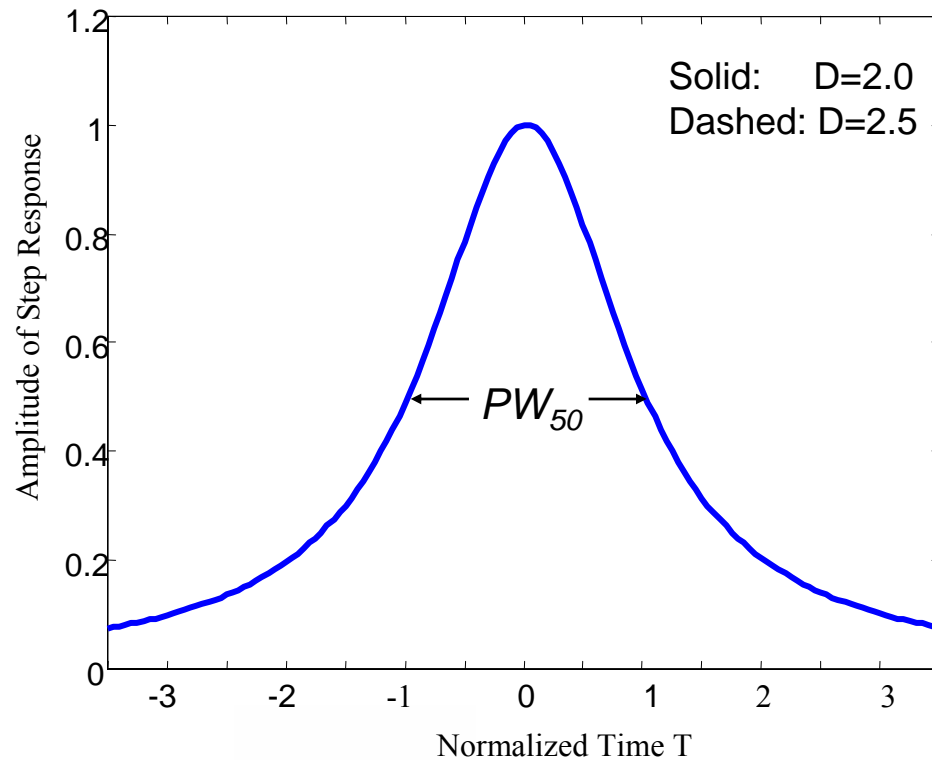
---

- Introduction
  - Introduction of 1-D MRC Channels
  - 2-D ISI Channel Model
- Detection for Uncoded 2-D ISI Channels
  - A Decision-Feedback MAP Algorithm
  - A Row-by-Row Detection Algorithm
  - A Column-and-Row Detection Algorithm
- Decoding for Coded 2-D ISI Channels
  - Decoder Diagrams and Performances



# Channel Response

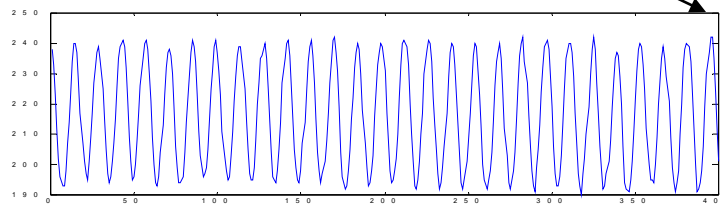
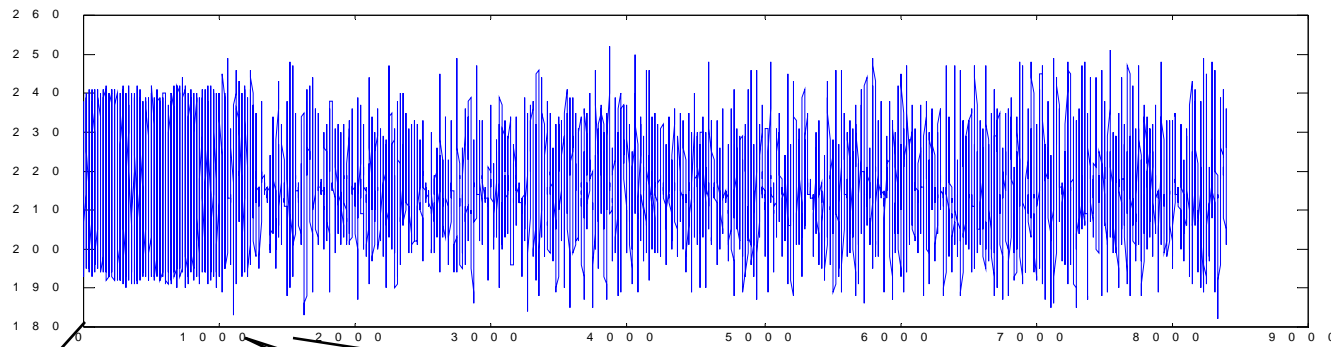
## Lorentzian Pulse



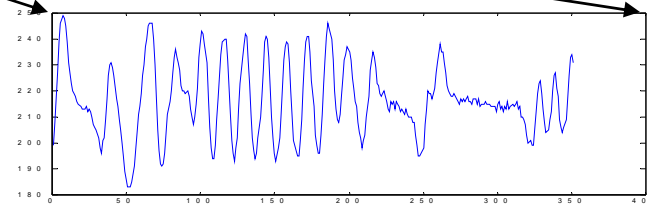
$$D = \frac{PW_{50}}{T}$$



# Readback Signal



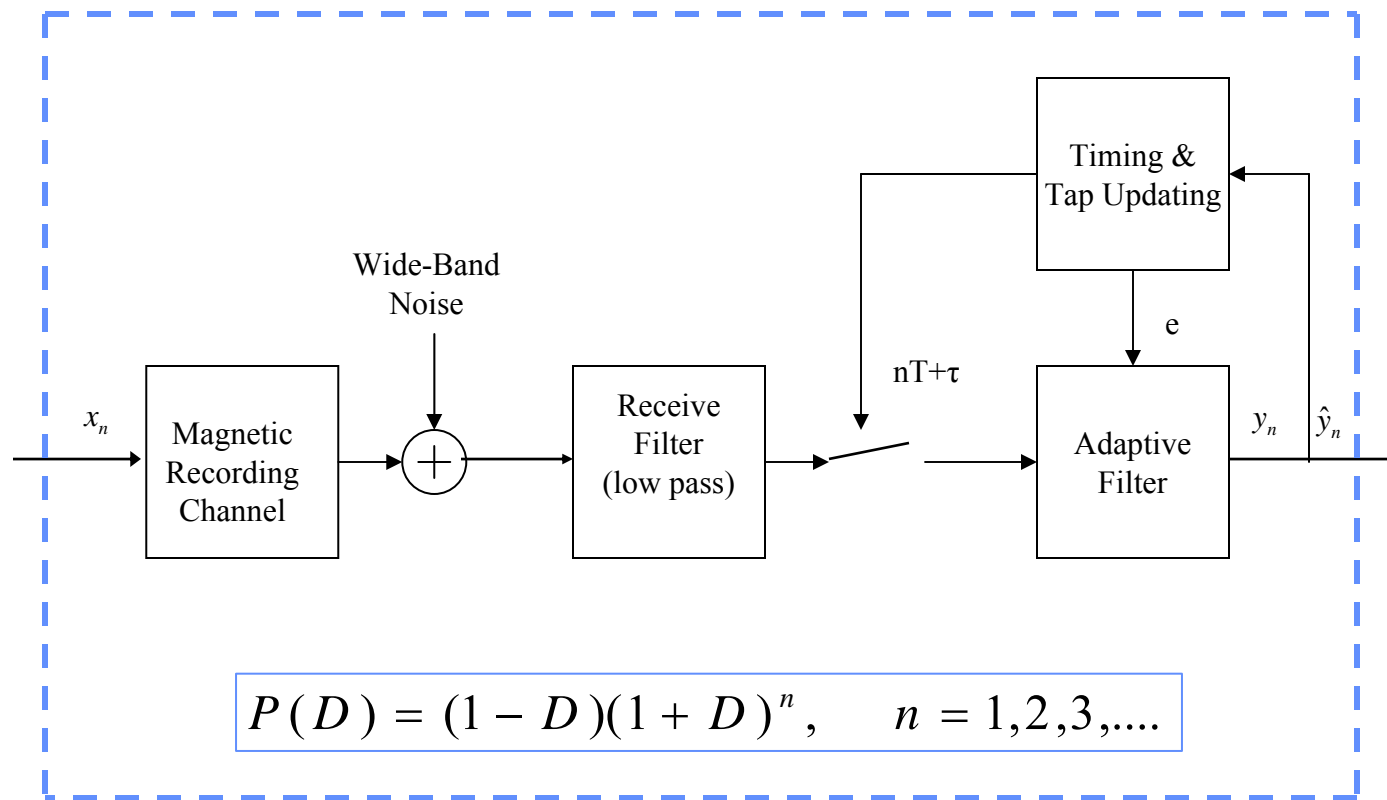
Preamble



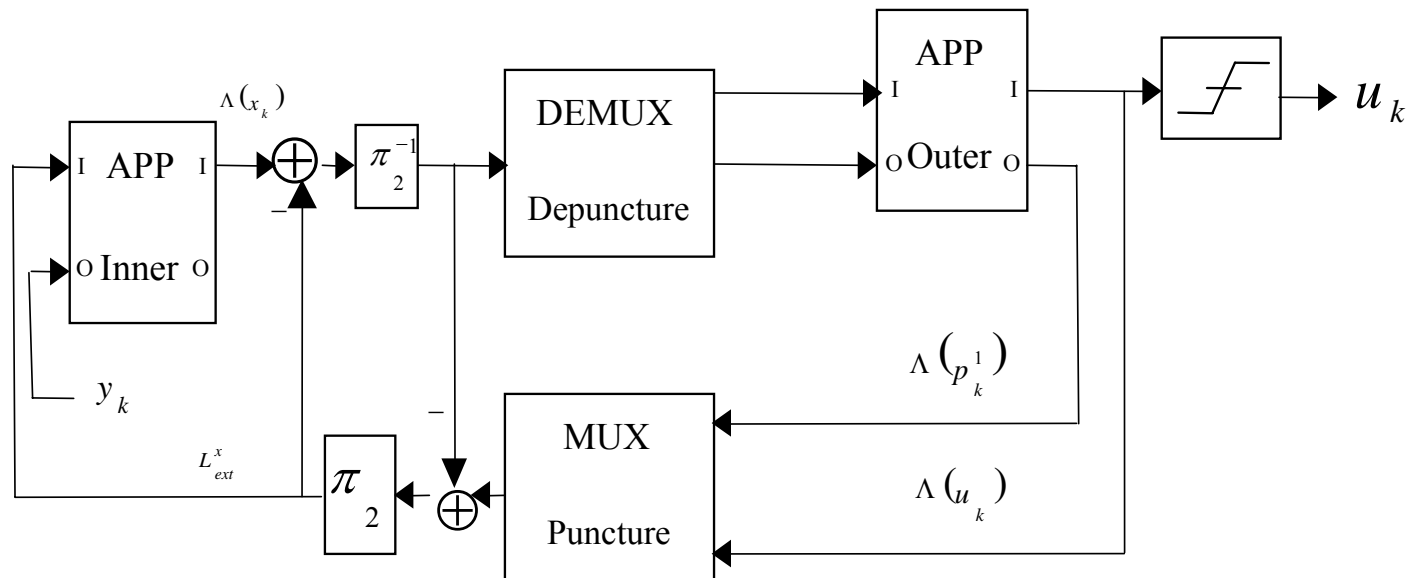
Synchronization Marker



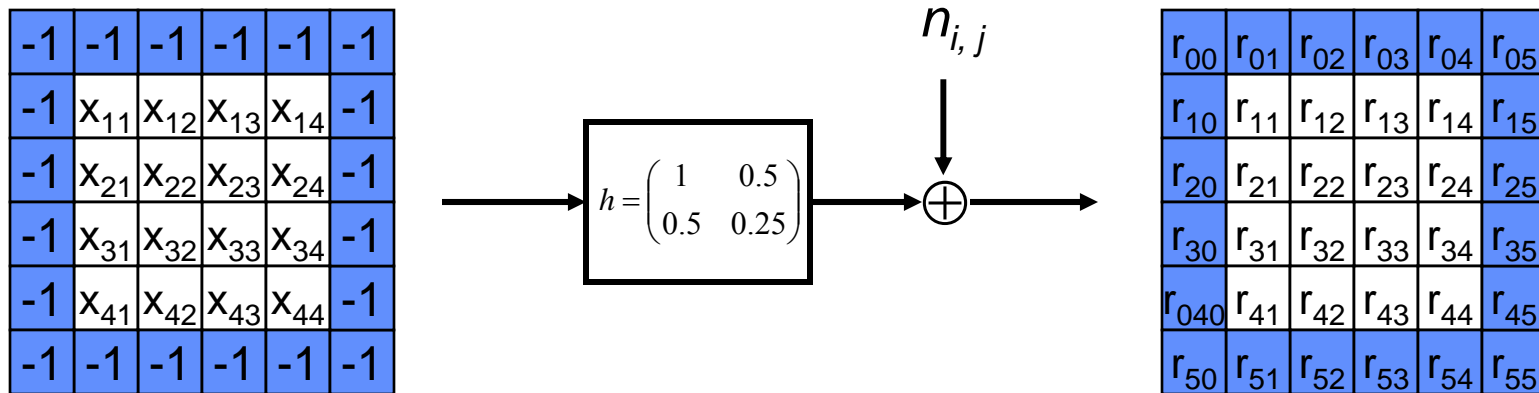
# A Digital Front-End



# Serial Turbo Detector

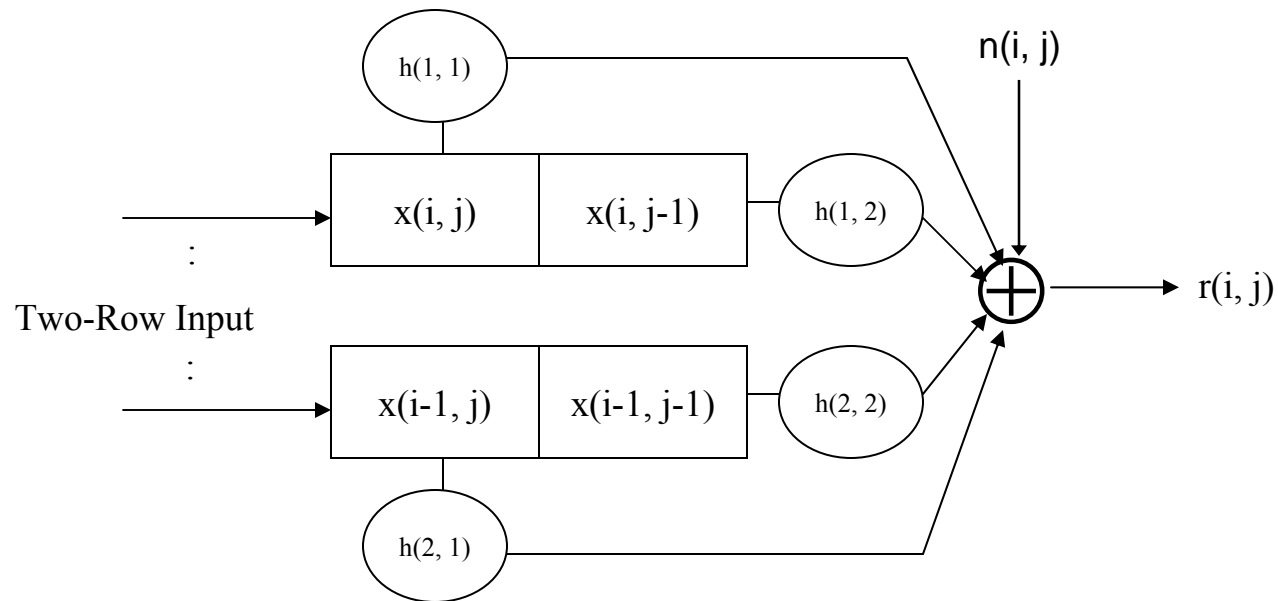


# 2-D Intersymbol Interference

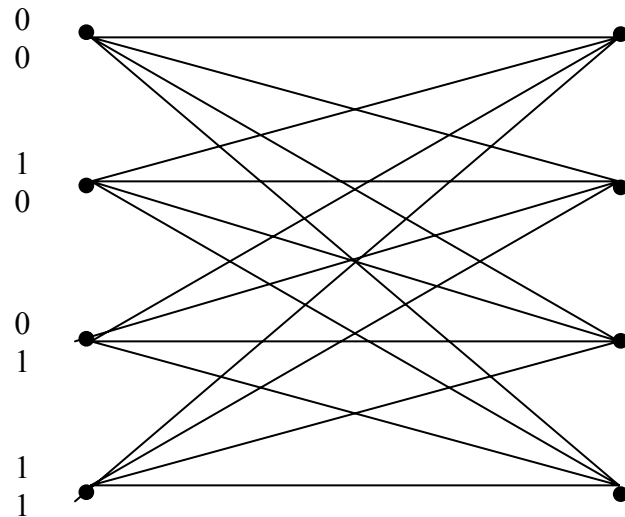


$$r_{i,j} = x_{i,j} + 0.5x_{i-1,j} + 0.5x_{i,j-1} + 0.25x_{i-1,j-1} + n_{i,j}$$

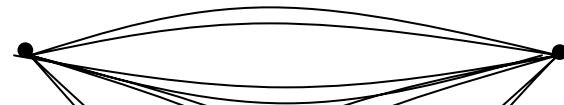
# 2-D ISI Structure



# 2-D ISI Trellis



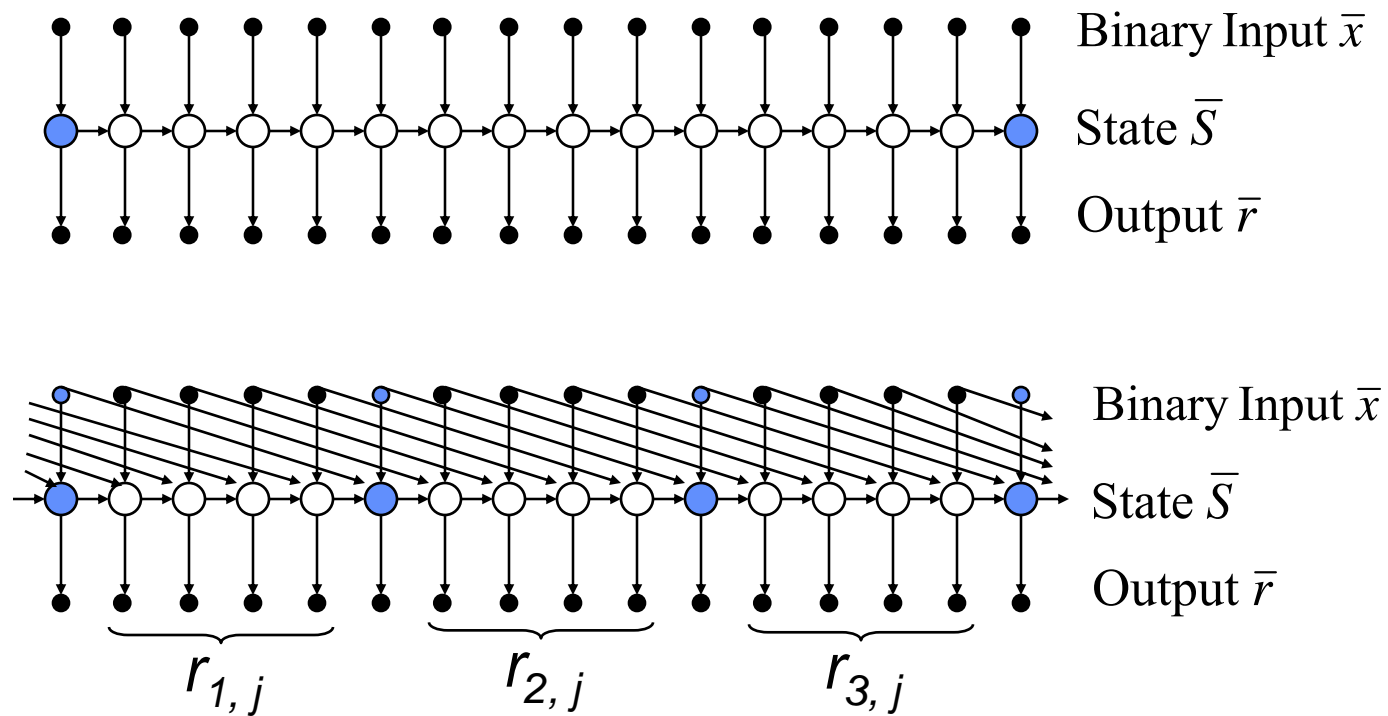
Row  $i-1$ :  $\varphi$   
Row  $i$  : 0



Row  $i$ :  $\varphi$   
Row  $i-1$ : 1

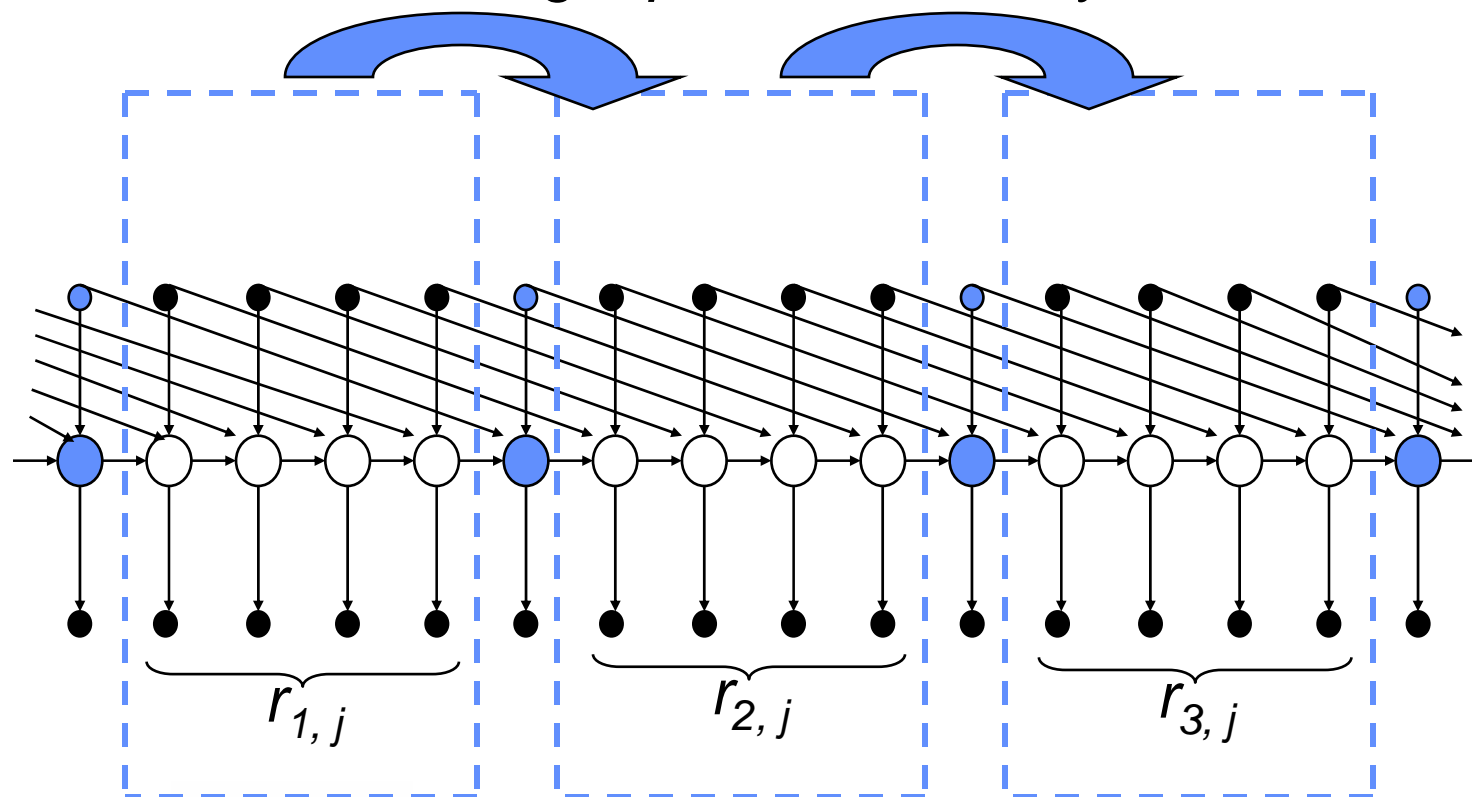


# Bayesian Networks

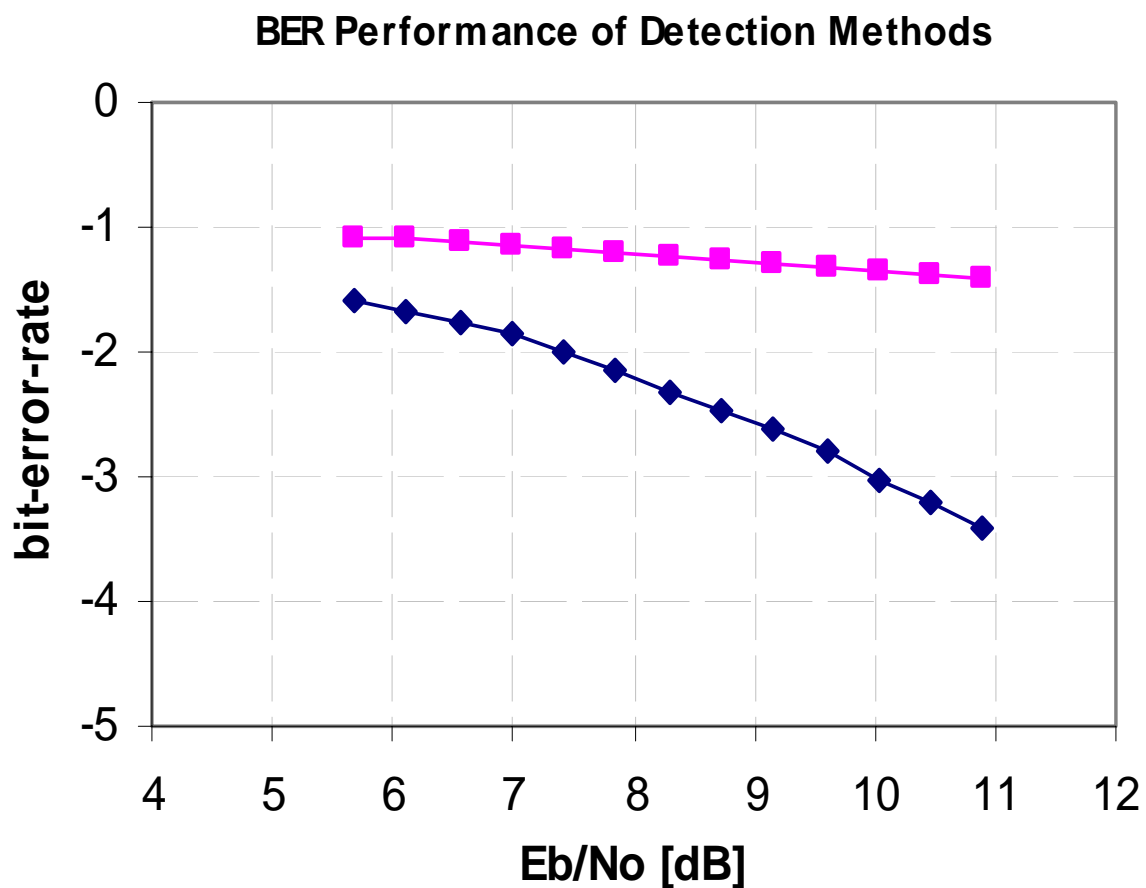


# Decision-Feedback MAP

Passing *a priori* Probability

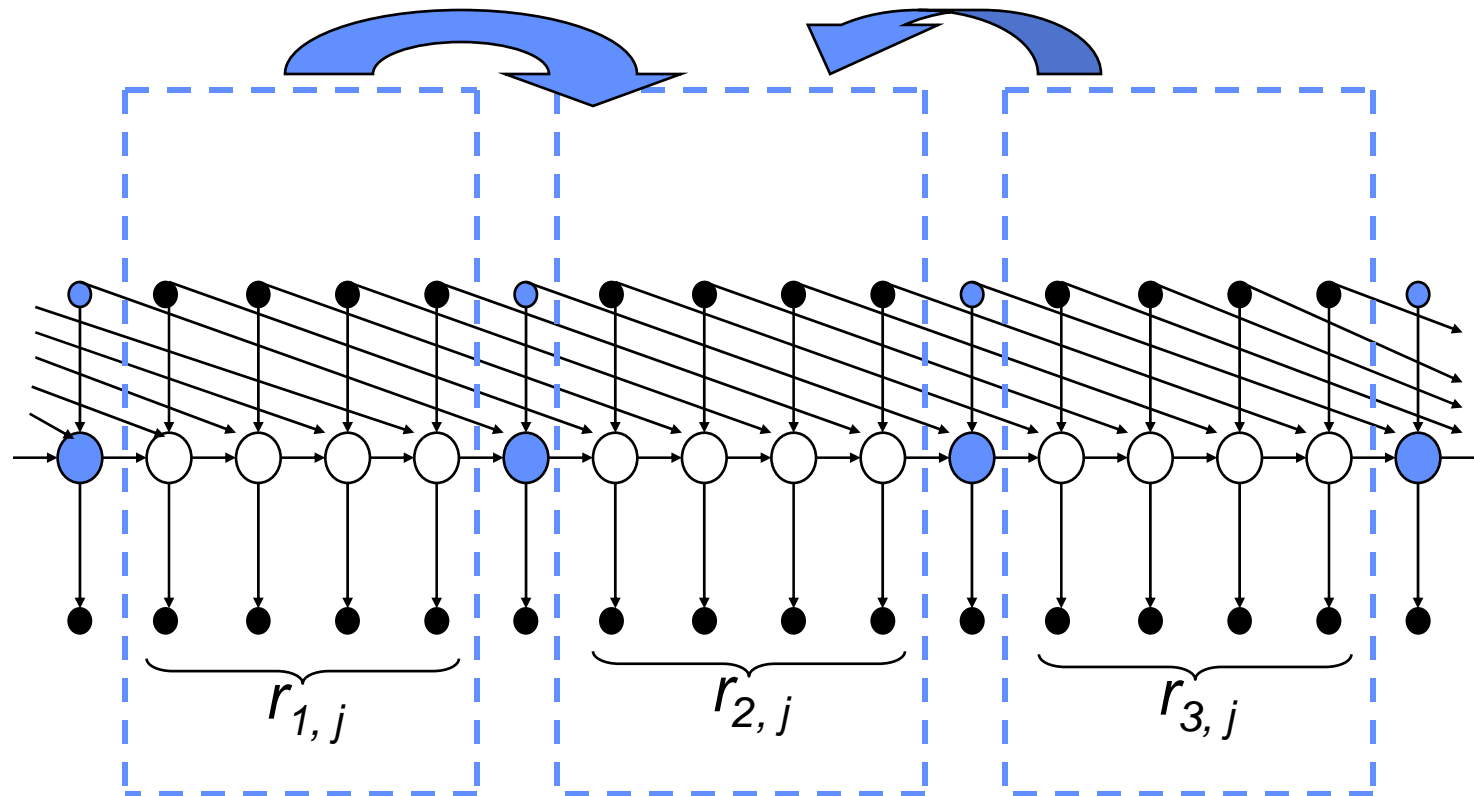


# Bit-Error-Rate Performance



# DFMAP Improvement

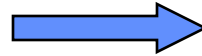
Passing *a priori* Probability



# Row-by-Row Algorithm

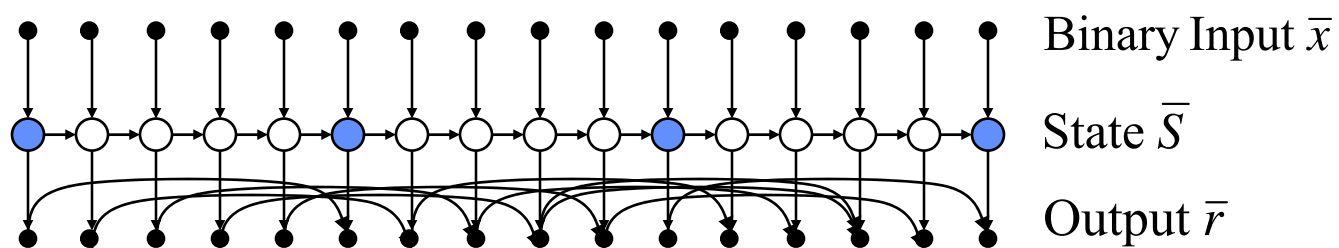
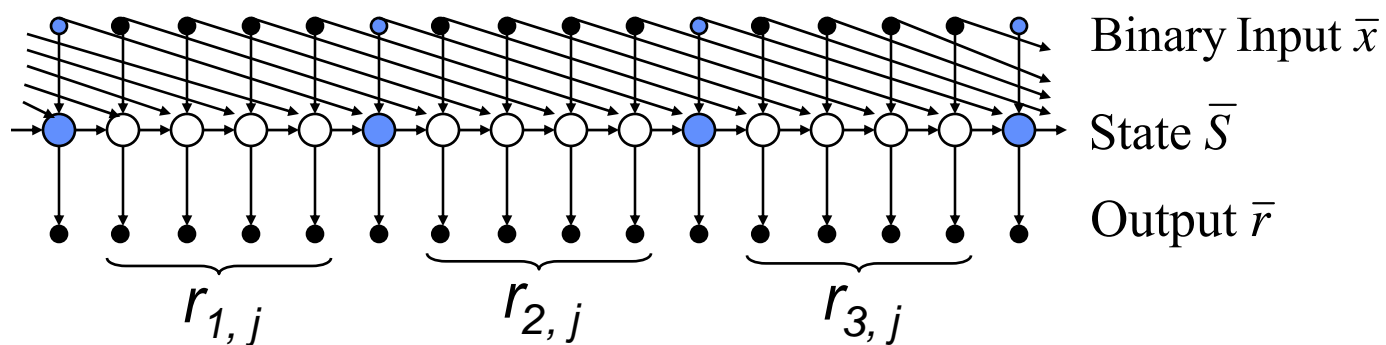
$r_{00}$	$r_{01}$	$r_{02}$	$r_{03}$	$r_{04}$	$r_{05}$
$r_{10}$	$r_{11}$	$r_{12}$	$r_{13}$	$r_{14}$	$r_{15}$
$r_{20}$	$r_{21}$	$r_{22}$	$r_{23}$	$r_{24}$	$r_{25}$
$r_{30}$	$r_{31}$	$r_{32}$	$r_{33}$	$r_{34}$	$r_{35}$
$r_{40}$	$r_{41}$	$r_{42}$	$r_{43}$	$r_{44}$	$r_{45}$
$r_{50}$	$r_{51}$	$r_{52}$	$r_{53}$	$r_{54}$	$r_{55}$

Column  
Filtering

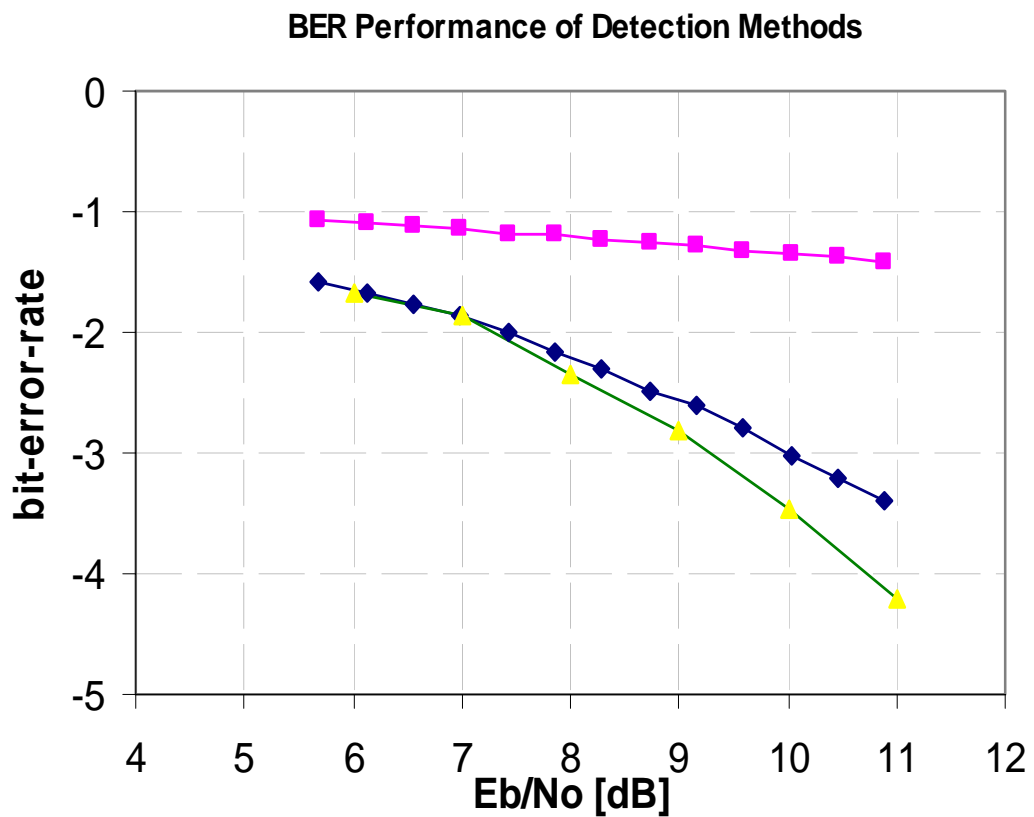


$r'_{00}$	$r'_{01}$	$r'_{02}$	$r'_{03}$	$r'_{04}$	$r'_{05}$
$r'_{10}$	$r'_{11}$	$r'_{12}$	$r'_{13}$	$r'_{14}$	$r'_{15}$
$r'_{20}$	$r'_{21}$	$r'_{22}$	$r'_{23}$	$r'_{24}$	$r'_{25}$
$r'_{30}$	$r'_{31}$	$r'_{32}$	$r'_{33}$	$r'_{34}$	$r'_{35}$
$r'_{40}$	$r'_{41}$	$r'_{42}$	$r'_{43}$	$r'_{44}$	$r'_{45}$
$r'_{50}$	$r'_{51}$	$r'_{52}$	$r'_{53}$	$r'_{54}$	$r'_{55}$

# Row-by-Row Algorithm



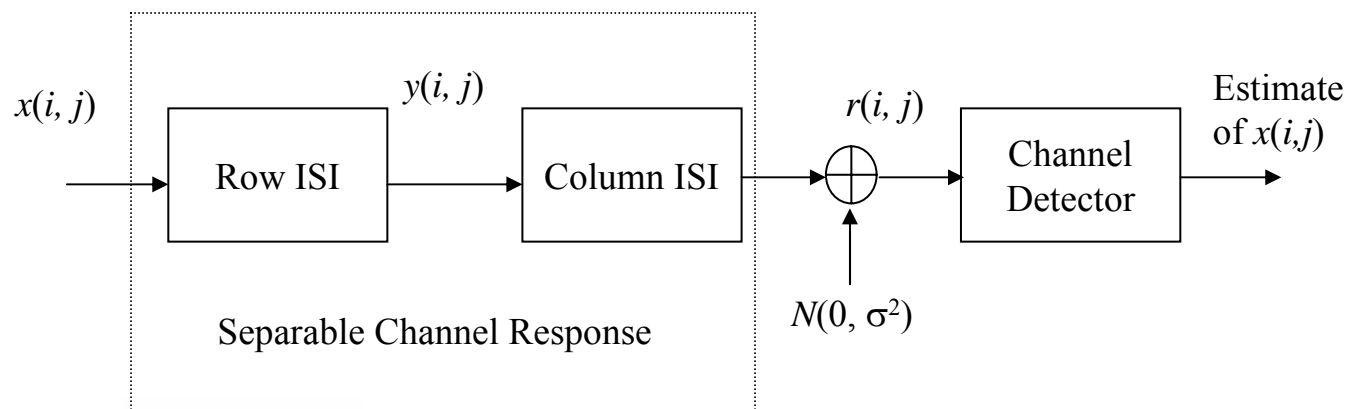
# Performance



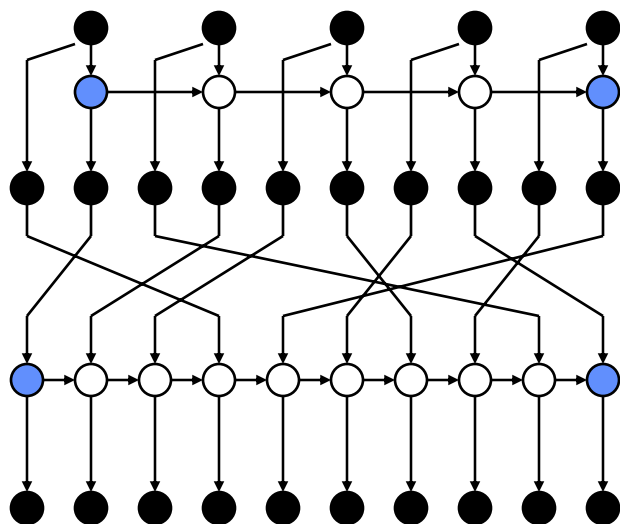
# Column-and-Row Algorithm

## □ Separable Channel Response

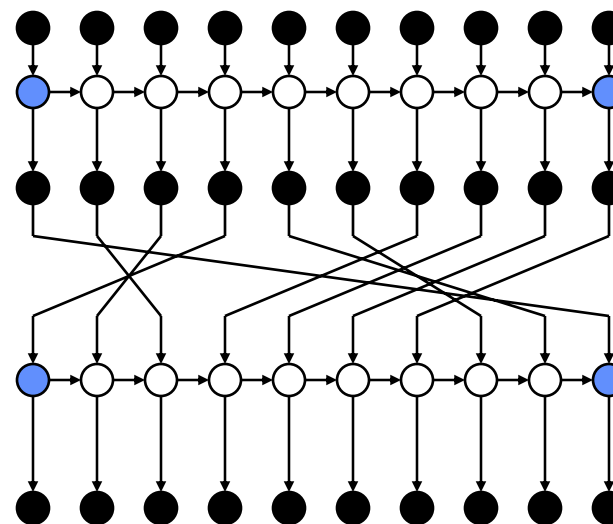
$$h = \begin{pmatrix} 1 & 0.5 \\ 0.5 & 0.25 \end{pmatrix} = \begin{pmatrix} 1 \\ 0.5 \end{pmatrix} (1 \quad 0.5)$$



# Serial Turbo Codes



Rate 1/2 Systematic Encoder

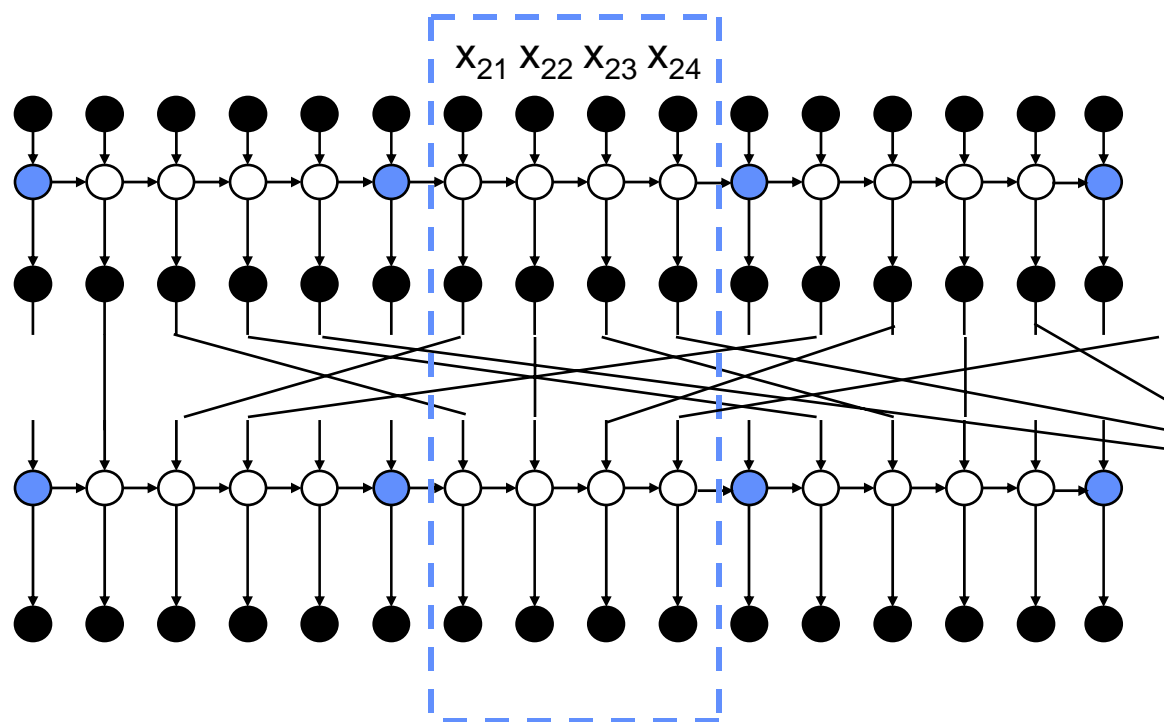


Rate 1/1 Non-Systematic Encoder

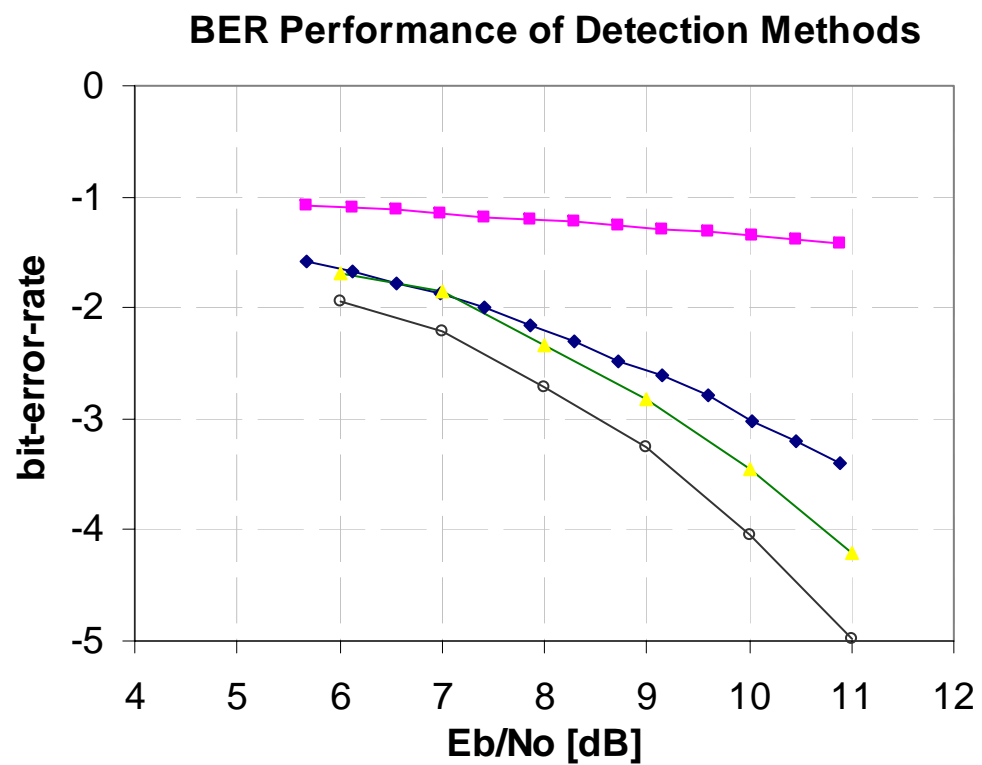


# Separable 2-D ISI

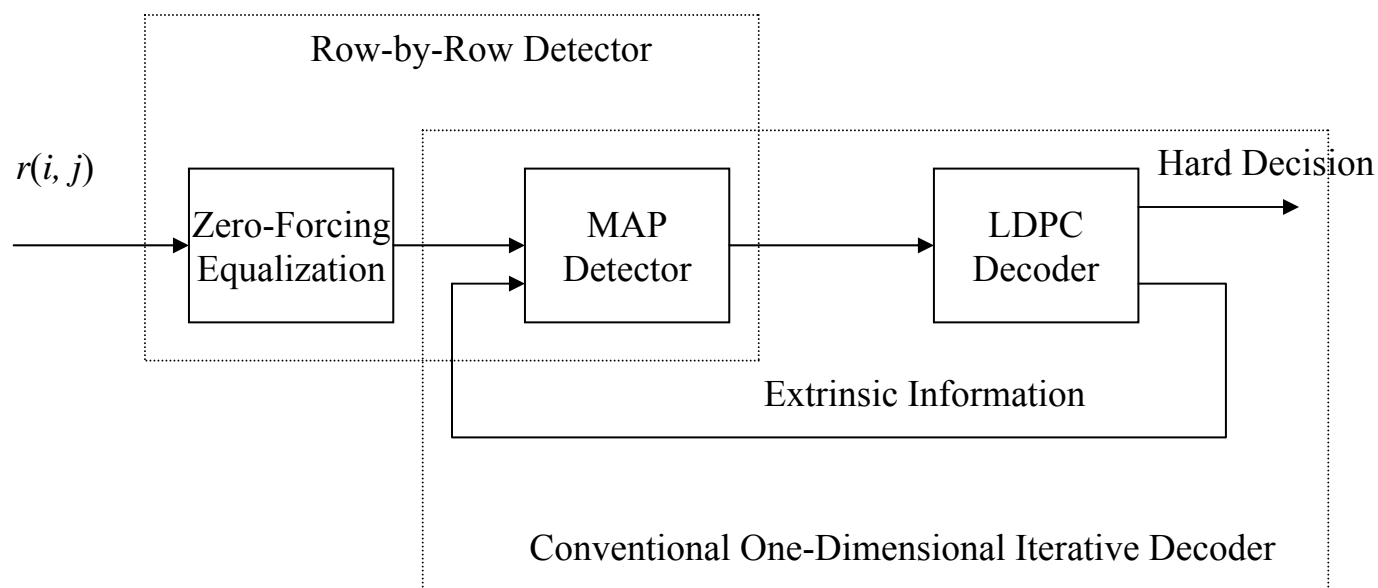
-1	-1	-1	-1	-1	-1
-1	$x_{11}$	$x_{12}$	$x_{13}$	$x_{14}$	-1
-1	$x_{21}$	$x_{22}$	$x_{23}$	$x_{24}$	-1
-1	$x_{31}$	$x_{32}$	$x_{33}$	$x_{34}$	-1
-1	$x_{41}$	$x_{42}$	$x_{43}$	$x_{44}$	-1
-1	-1	-1	-1	-1	-1



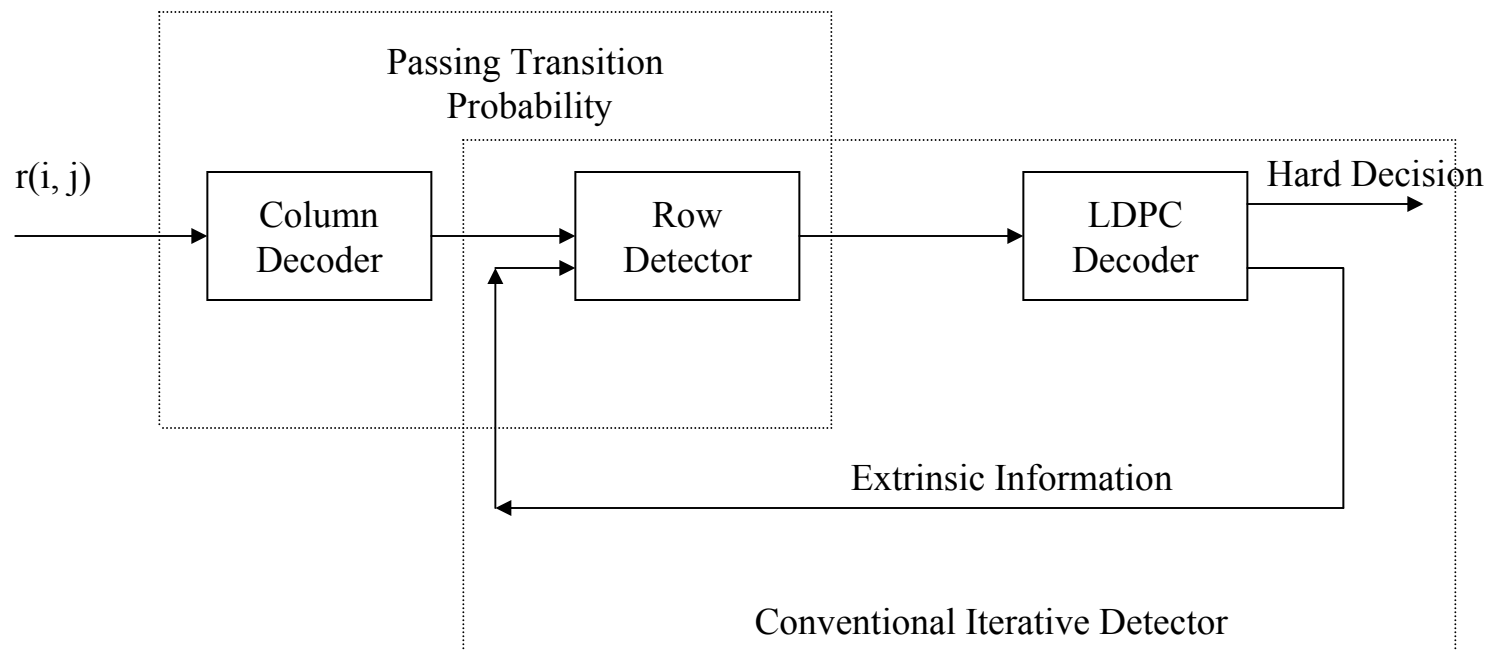
# Performance



# Iterative Decoder Diagram I



# Iterative Decoder Diagram II



# Performance

