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Channel Estimation for Wired MIMO Communication Systems

Literature Survey Presentation

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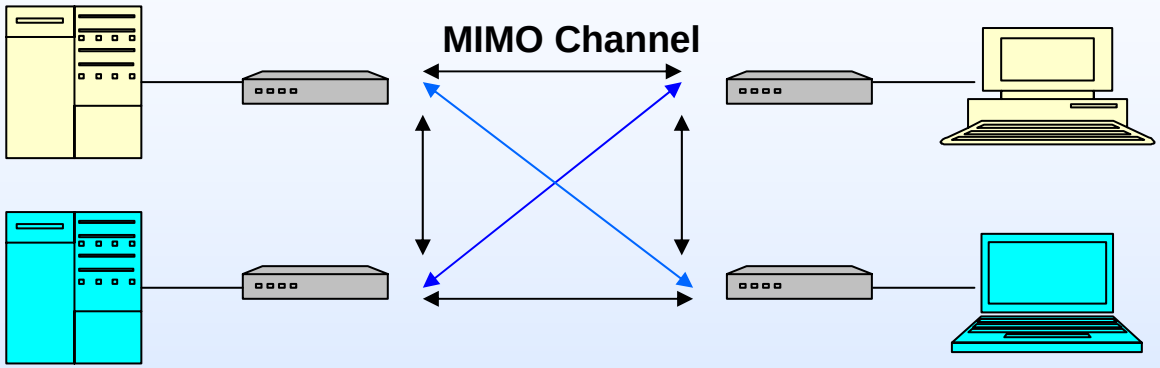
Introduction

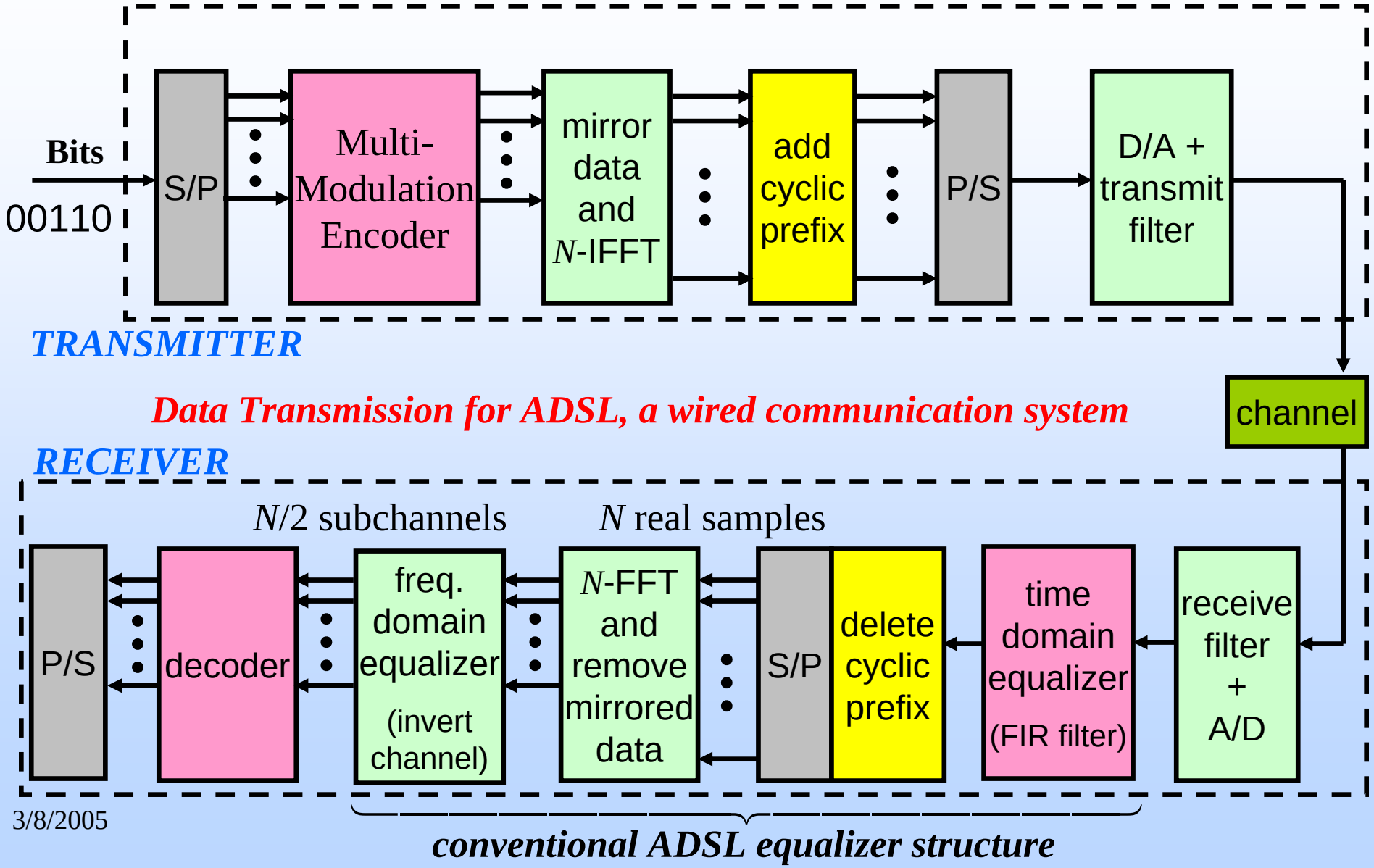
- **MIMO – Multiple Input Multiple Output**



- **Wired Communications – Telephone, ADSL, VDSL**
- **Multicarrier Modulation – DMT, OFDM**
- **Channel Estimation –**

  To estimate an unknown channel by sending a known training/pilot sequence

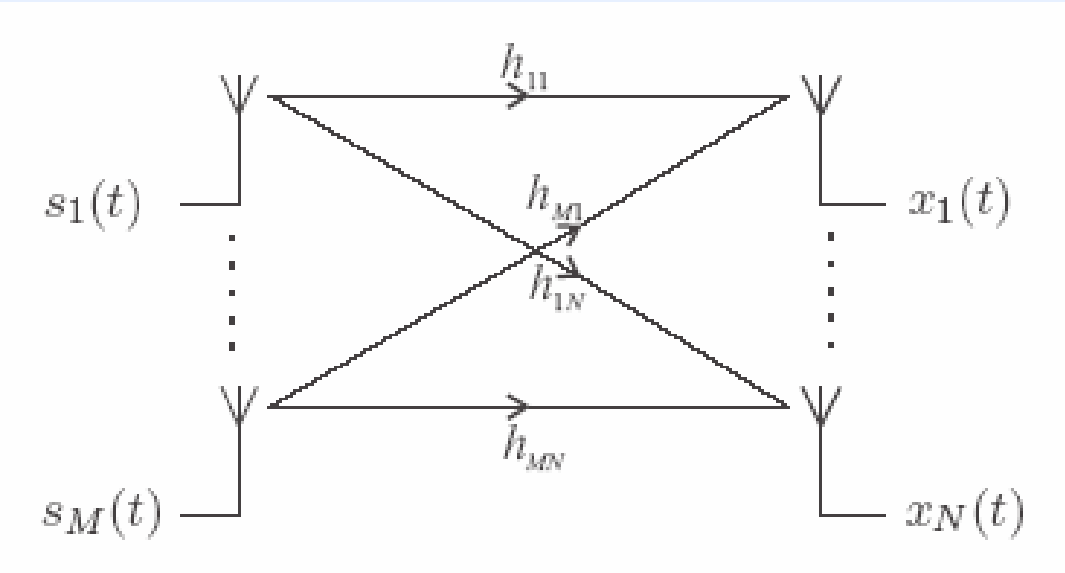
Background


Bits
00110
S/P
Multi-
Modulation
Encoder
mirror
data
and
N-IFFT
add
cyclic
prefix
P/S
D/A +
transmit
filter
TRANSMITTER
Data Transmission for ADSL, a wired communication system
channel
RECEIVER
N/2 subchannels
N real samples
P/S
decoder
freq.
domain
equalizer
(invert
channel)
N-FFT
and
remove
mirrored
data
S/P
delete
cyclic
prefix
time
domain
equalizer
(FIR filter)
receive
filter
+
A/D
conventional ADSL equalizer structure

Key Paper I – MIMO Channel

[A.Goldsmith, 2003]

- **Why MIMO? – to obtain the higher data rate**
- **Challenges! – Power, Bandwidth, Complexity, Capacity**
- **Typical MIMO Channels – Single-User MIMO, Multiuser-MIMO(Multiple-Access Channel, Broadcast Channel)**



MIMO with M transmitters and N receivers

- **Channel Model**

x=Hs+w

s – M*1 transmitted vector

H – N*M channel matrix

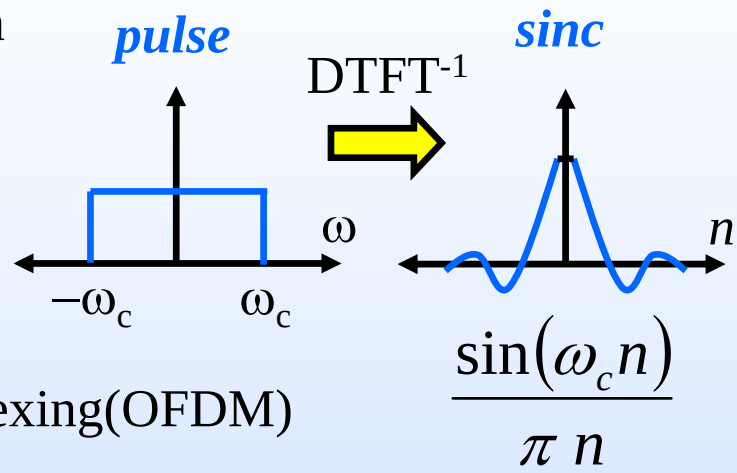
x – N*1 received vector

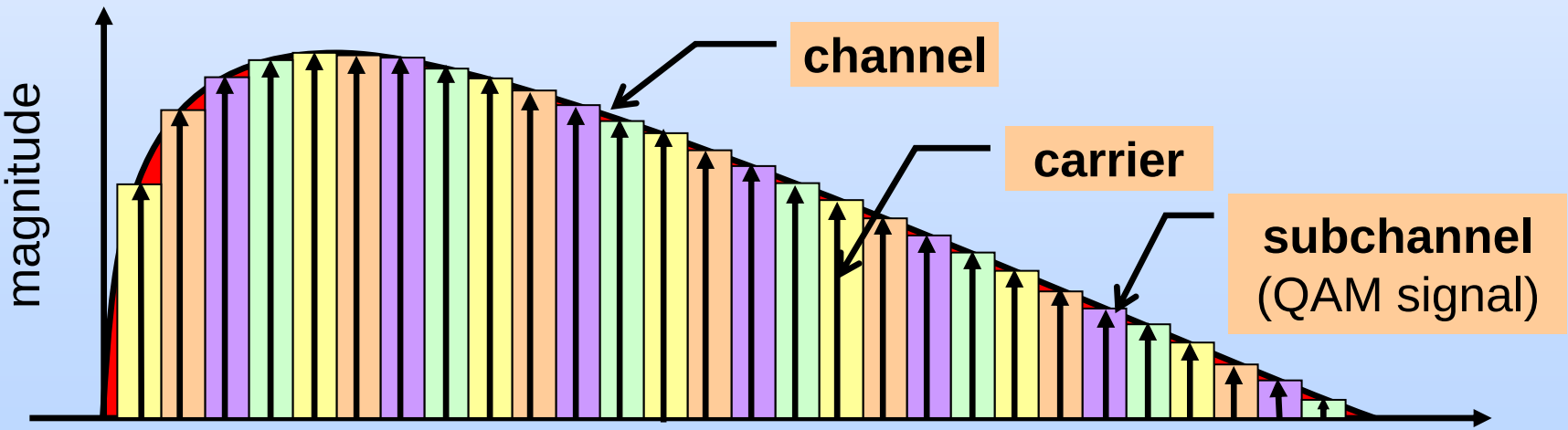
w – N*1 noise vector

Key Paper II - Multicarrier Modulation

[John A.C. Bingham, 2000]

- **Divide broadband channel into narrowband subchannels**
  - No ISI in *subchannels* if constant gain in every subchannel and if ideal sampling
  - Each subchannel has different carrier
- **Discrete multitone modulation**
  - Based on fast Fourier transform
  - Orthogonal Frequency Division Multiplexing(OFDM)





Subchannels are 4.3 kHz wide in ADSL and VDSL

Key Paper III - Channel Estimation

[Ye Li, 2002]

- **OFDM – Multicarrier Modulation for MIMO**
- **Training Sequence – Obtain initial estimation for channel parameters, timing, frequency offset, etc.**
- **Channel Estimation**

Algorithm	Advantage	Disadvantage
Simplified Estimation [Ye Li, 2002]	The computational complexity ↓	Performance degradation but negligible
Linear Interpolation [Kim,Park&Hong,2005]	MSE on Comb-type channel estimation	Block-type estimator for indoor channels
Linear Precoding [Petropulu,Zhang&Lin,2004]	Converges fast Good for fast-varying channels	Introduce a bias to each carrier