

HDSL2 Modem Modeling and Simulation

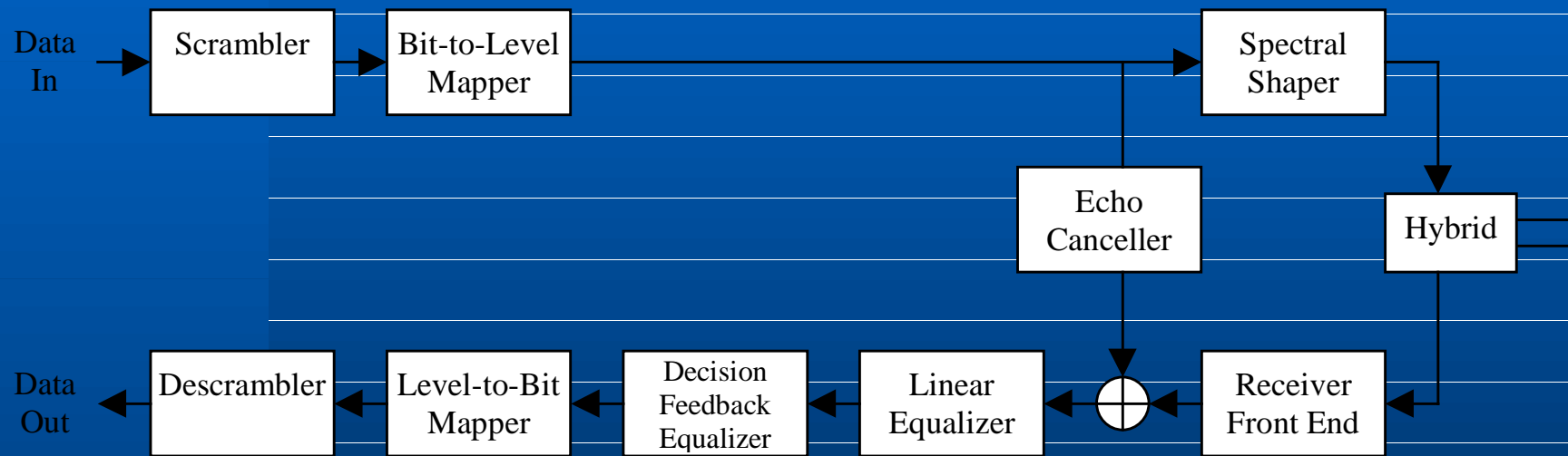
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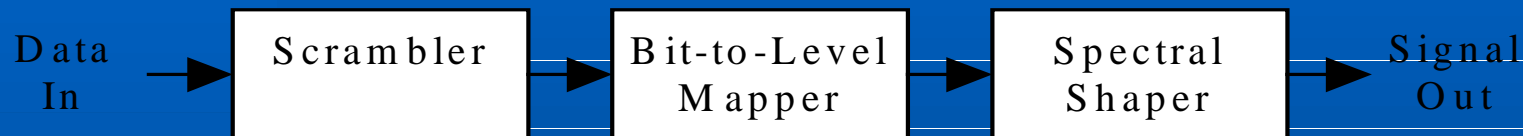
Introduction

- **Full-Duplex 1.544 Mbps**
- **T1 Replacement**
- **Advantages Over T1**
 - **Single Copper Pair**
 - **Bridge Taps OK**
 - **12 kft Range**
 - **Spectral Compatibility**
- **Ptolemy Simulation**

Startup Mode

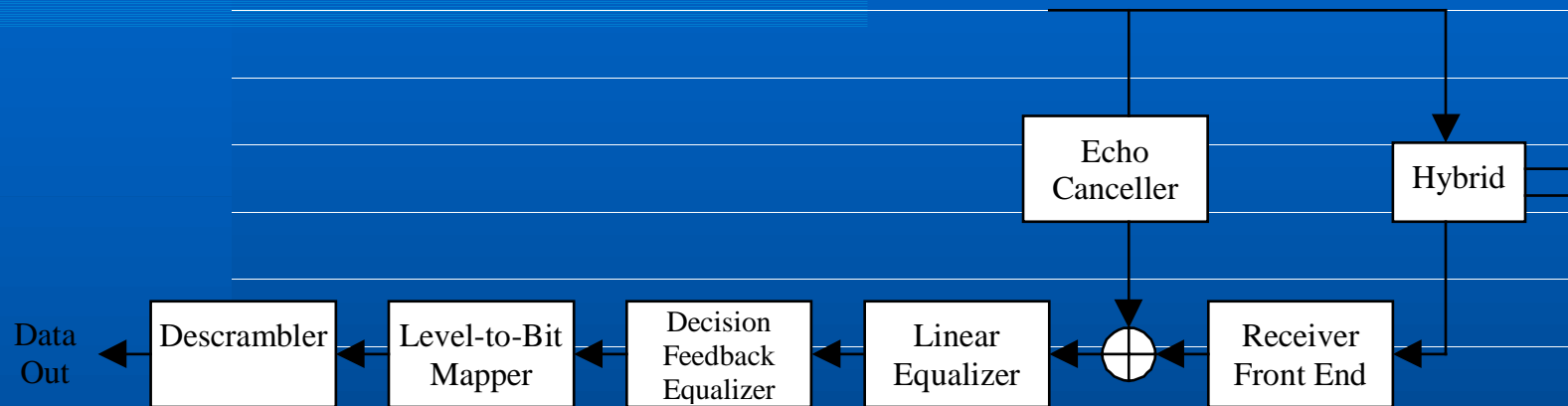


Startup Mode Transmitter



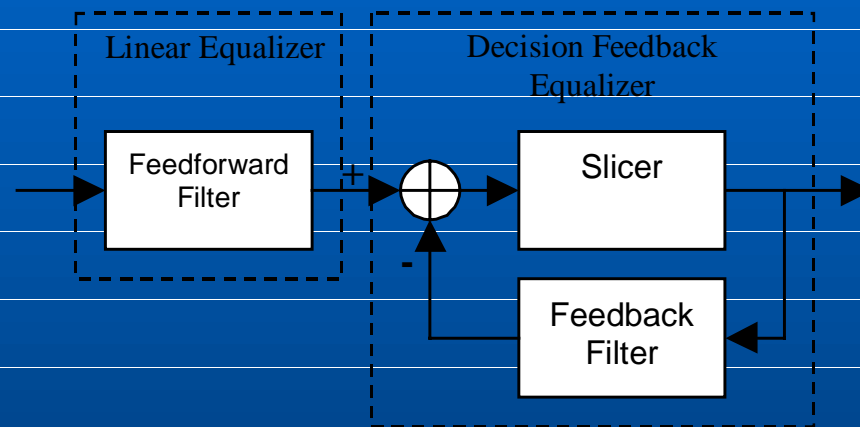
- **Scrambler**
 - Whitens Data
- **Bit-to-Level Mapper**
 - Converts Bits to 2-PAM Pulses
- **Spectral Shaper**
 - Filters Pulses to Continuous Waveform

Startup Mode Receiver



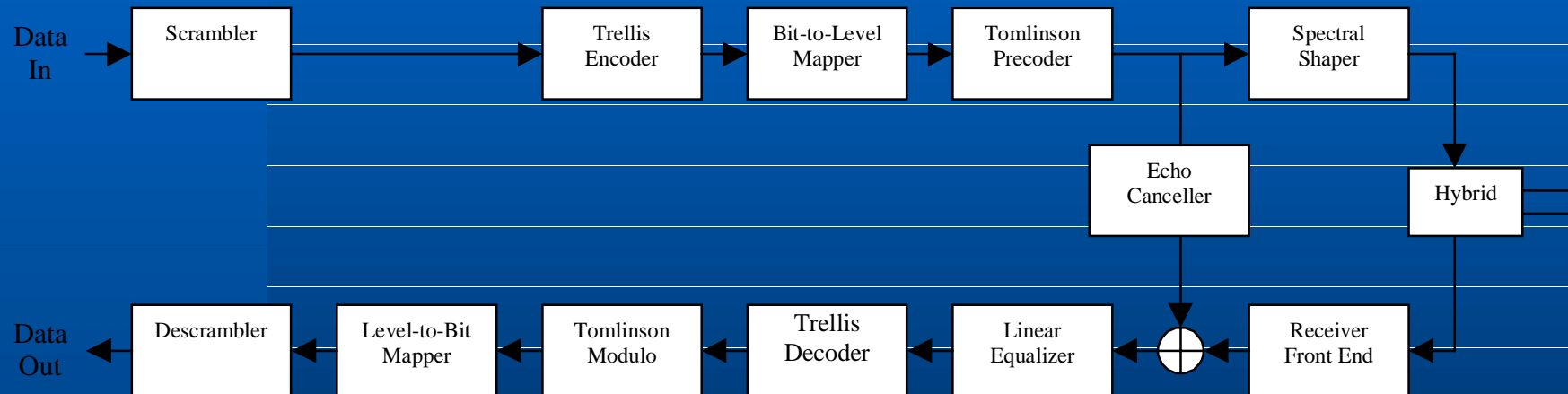
- **Front End**
 - Timing recovery and sampling
- **Echo Canceller**
 - Removes Signal Reflected by Hybrid

Startup Mode Equalization

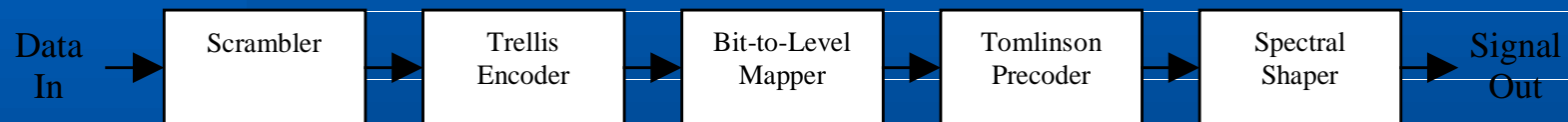


- **Linear Equalizer**
 - Removes precursor ISI
- **Decision Feedback Equalizer (DFE)**
 - Removes postcursor ISI

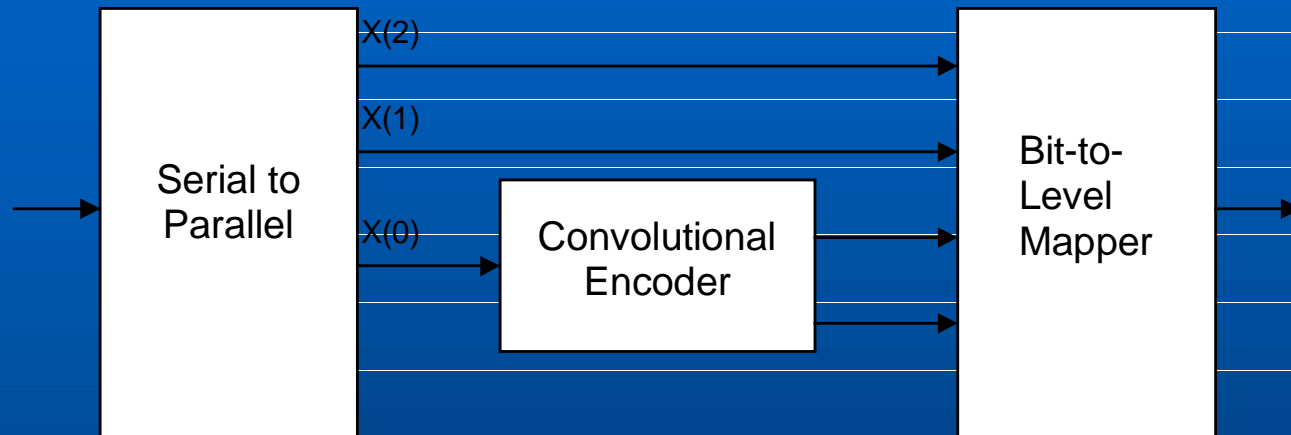
Data Mode



Data Mode Transmitter

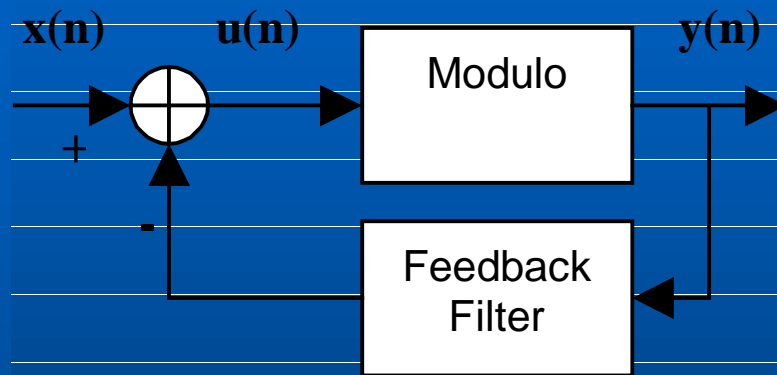


Trellis Encoder



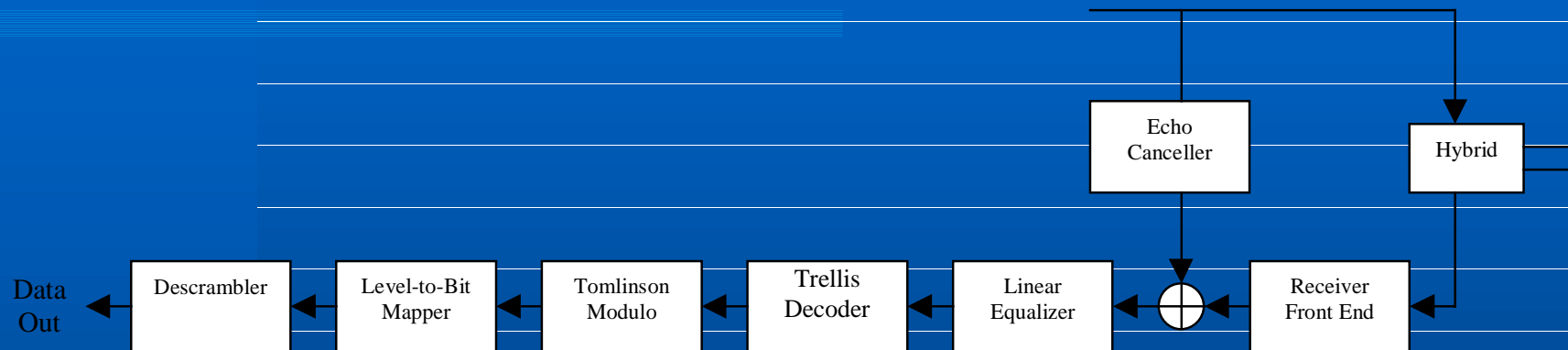
- **Trellis Encoder**
 - Adds redundancy
 - Increases SNR
 - 3 bits in - 16-PAM pulse out

Tomlinson Precoder



- Tomlinson Precoder
 - Removes postcursor ISI (DFE function)
 - Modulo: $y(n) : \{-1 < x(n)+2d(n) < 1\}$
 - Results in expanded symbol set

Data Mode Receiver



- **Trellis Decoder**
 - Viterbi algorithm
- **Tomlinson Modulo Operator**
 - Recover symbol from expanded symbol set

Ptolemy Simulation

- **Use SDF and BDF Domains**
- **Train in Startup Mode**
 - Allow adaptive filters to converge
- **BDF Switch to Data Mode**
 - Move DFE in receiver to precoder in transmitter
 - Add other data mode components
 - Trellis encoder and decoder
 - Tomlinson modulo operators