THP As A Companion To LDPC

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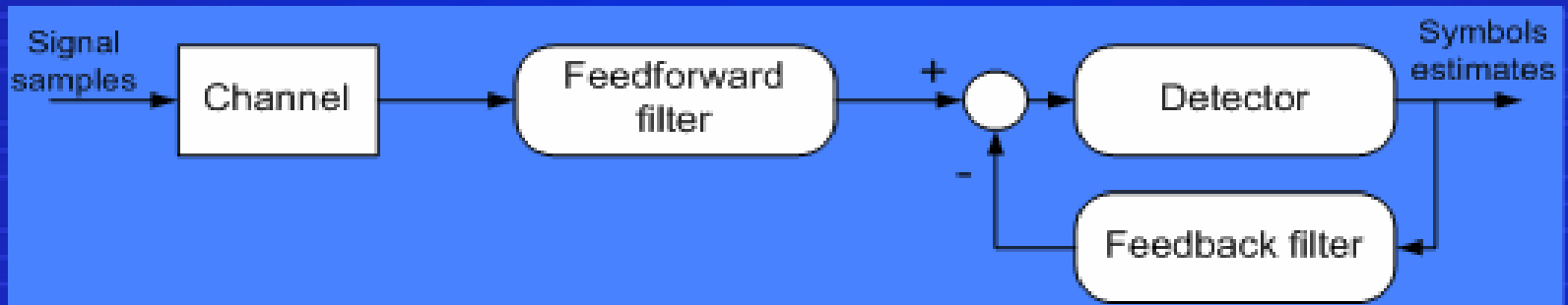
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Agenda

- LDPC + THP vs. LDPC + DFE
- Comparison to TCM + DFE
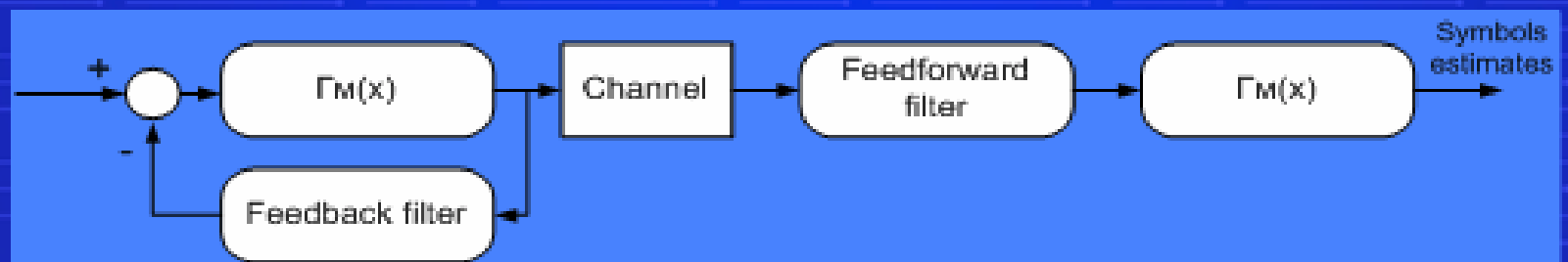- Conclusions

DFE vs. THP Approach

- Decision Feedback Equalizer (DFE)

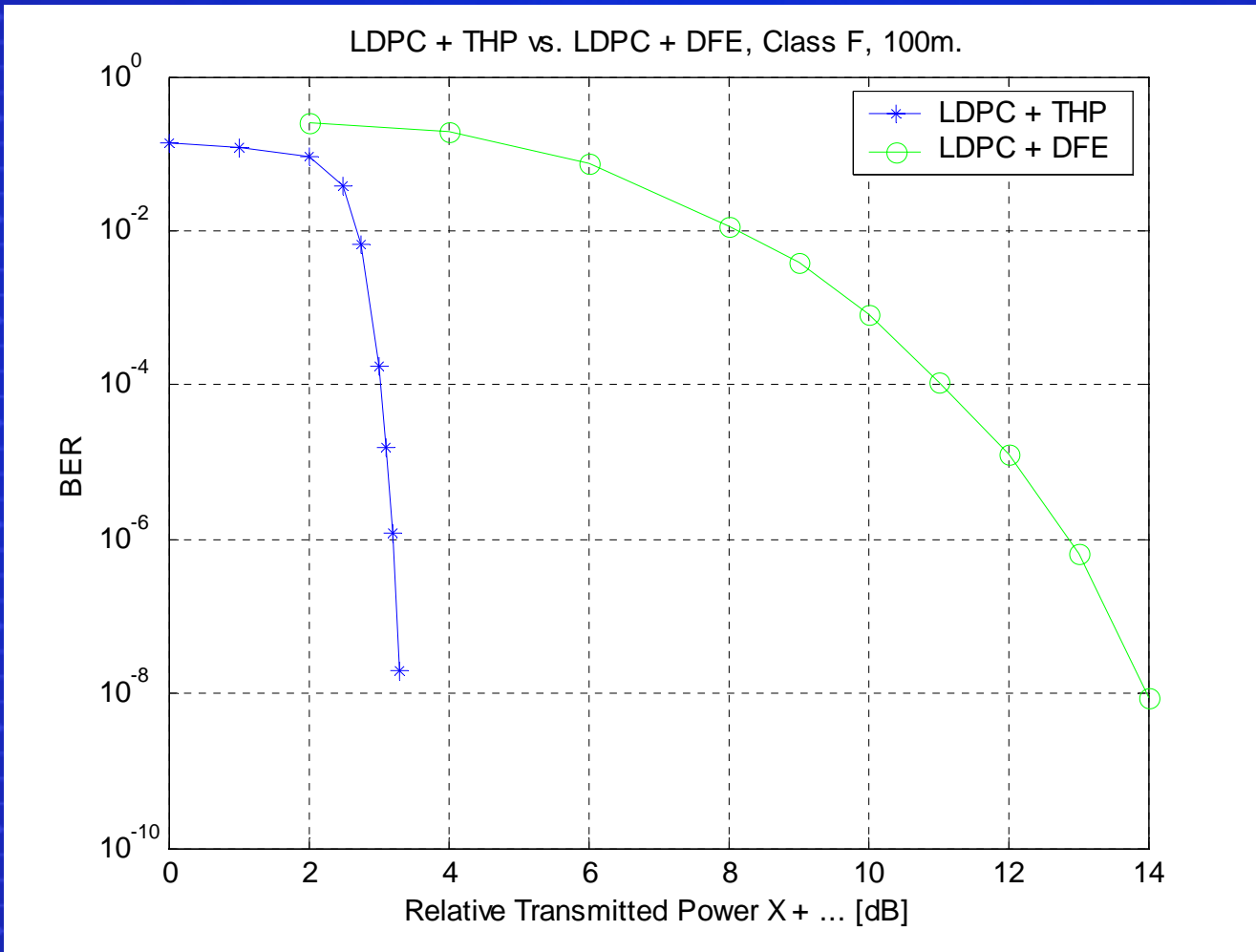- Tomlinson-Harashima Precoding (THP)

LDPC+THP vs. LDPC+DFE Scheme Outlines

- Class F cable models (Siemon, Sept. 2003)
- LDPC + THP
  - Tomlinson-Harashima Precoding (THP)
  - Currently LDPC coded modulation over PAM 8 was simulated
  - Code rate: 2.44/3=0.81
  - Signaling rate: 1026 MHz
- LDPC + DFE
  - Currently LDPC coded modulation over PAM 8 was simulated
  - Code rate: 2.44/3=0.81
  - DFE at the receiver
  - Signaling rate: 1026 MHz

LDPC+THP vs. LDPC+DFE Simulation Results

LDPC + THP vs. LDPC + DFE, Class F, 100m.

BER vs. Relative Transmitted Power X + ... [dB]

Legend:
- LDPC + THP
- LDPC + DFE

LDPC+THP vs. LDPC+DFE Results

- Gap between LDPC+THP and LDPC+DFE is >11 dB

- LDPC codes have excellent performance in memoryless channels

  - Joint LDPC coded modulation and DFE lead to performance degradation due to error propagation
  - With THP, no error propagation exists, allowing LDPC to display its high coding gain

Comparison To TCM+DFE Scheme Outlines

- Class F cable models (Siemon, Sept. 2003)

- LDPC + THP
  - Tomlinson-Harashima Precoding (THP)
  - Currently LDPC coded modulation over PAM 8 was simulated
  - Code rate: 2.44/3=0.81
  - Signaling rate: 1026 MHz

- TCM + DFE
  - 4D 8-state PAM 10 with TCM
  - DFE at the receiver
  - Code rate: 3bits / PAM10 symbol=0.903
  - Signaling rate: 833 MHz

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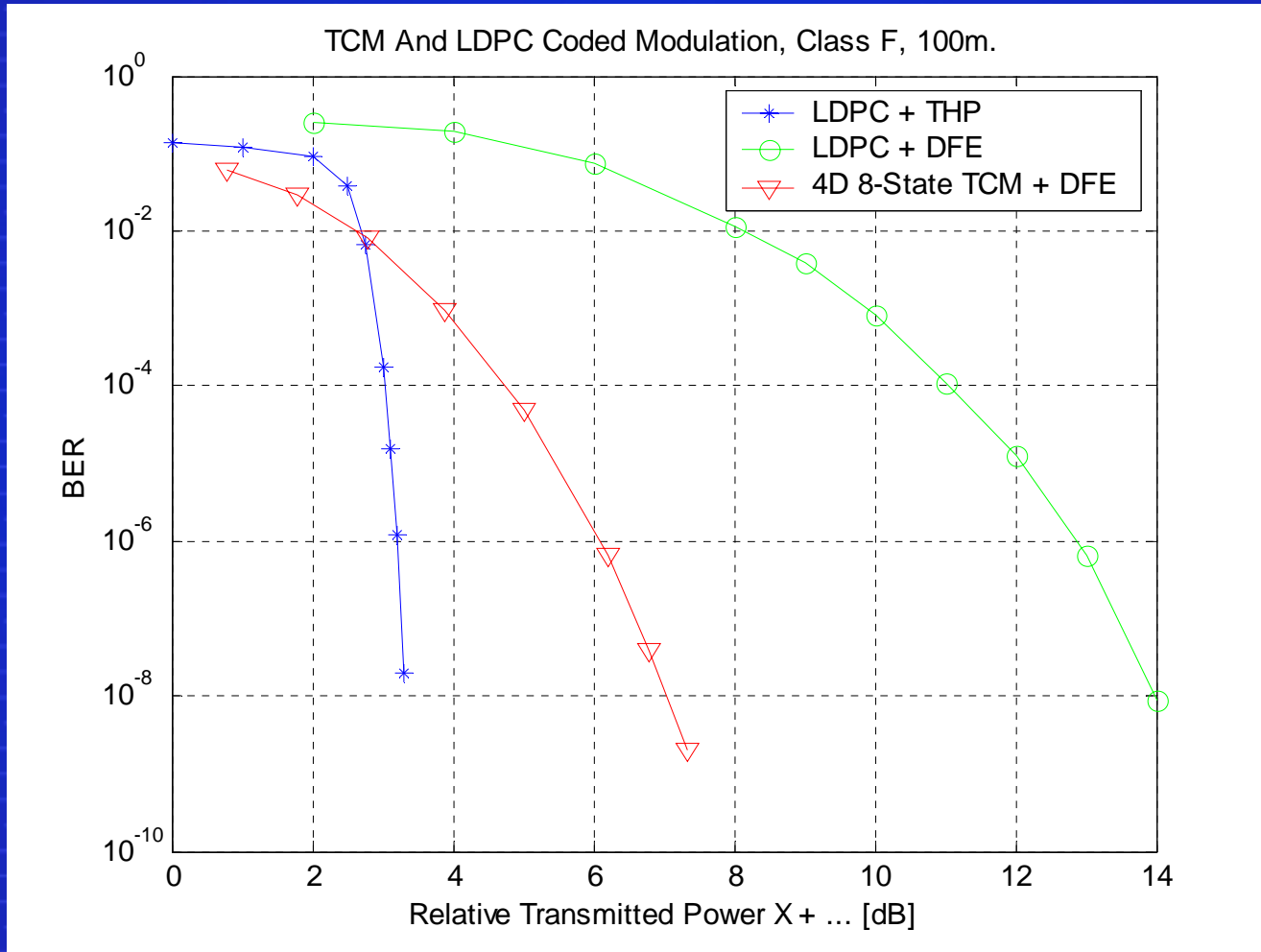# LDPC+THP vs. TCM+DFE Simulation Results

LDPC + THP vs. TCM + DFE, Class F, 100m.
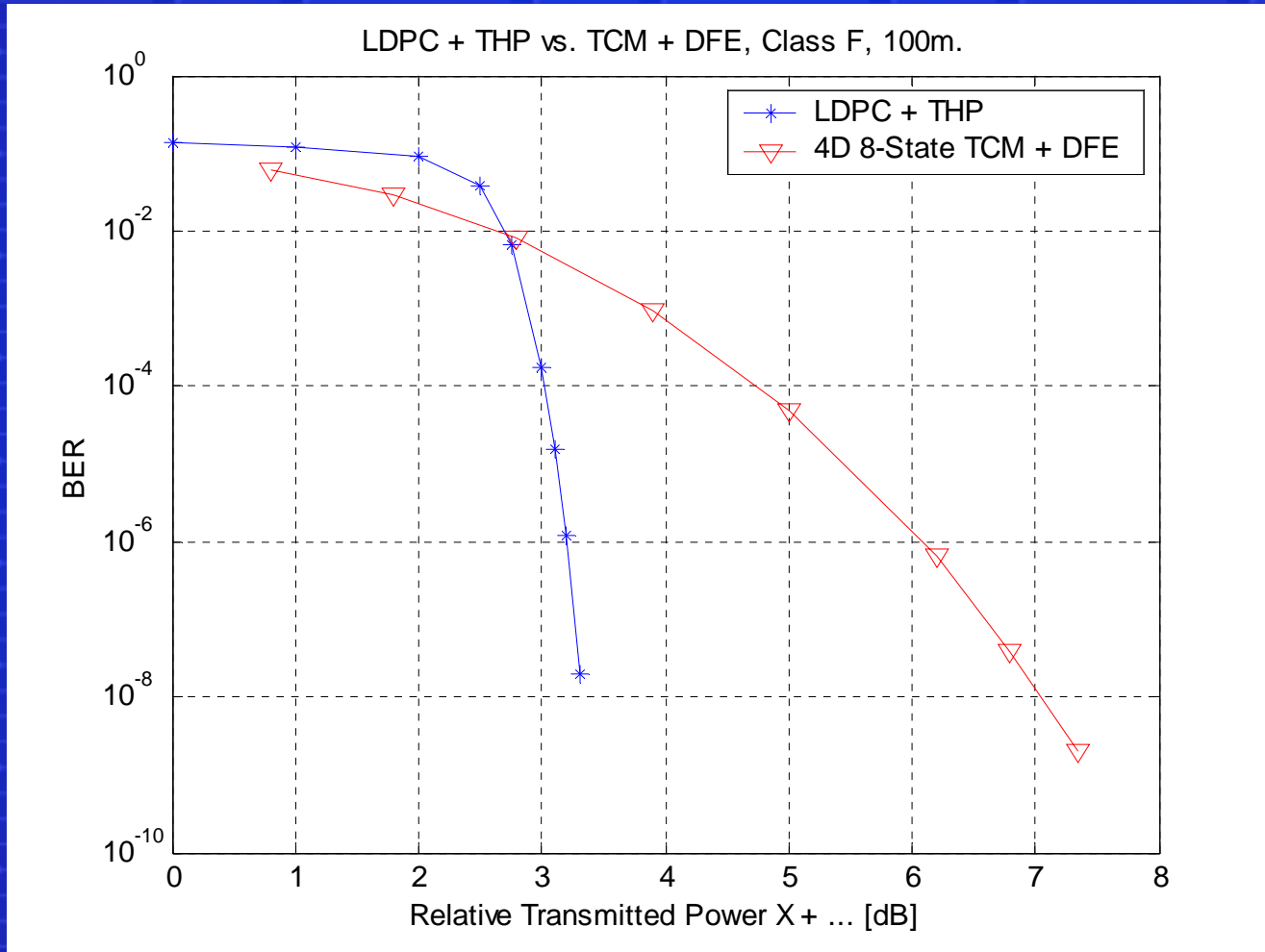
LDPC+THP vs. TCM+DFE Results

- LDPC+THP provide ~4 dB margin over TCM+DFE @BER=1e-8,

- Up to 6 dB gain (extrapolated) @BER=1e-12

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Summary Of Results

TCM And LDPC Coded Modulation, Class F, 100m.

Conclusions

- Without THP, LDPC coded modulation is not effective. No sense in using DFE with LDPC
- THP with LDPC codes gives up to 6 dB margin over TCM with DFE @BER=1e-12
  - Significantly reducing receiver analog complexity
- THP is the ideal companion for LDPC
- LDPC codes with reduced complexity can provide attractive solutions, maintaining excellent performance