Rate-Adaptive Distributed Source Coding using Low-Density Parity-Check Codes

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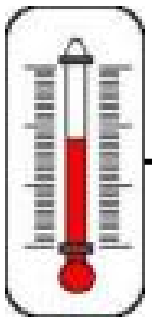
Outline

- Slepian-Wolf coding
- LDPC codes for Slepian-Wolf coding

- Rate-adaptive Slepian-Wolf coding
- Extension of LDPC codes
- LDPC Accumulate (LDPCA) codes
- Sum LDPC Accumulate (SLDPCA) codes

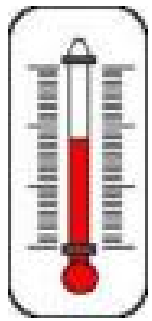
Distributed Source Coding Example



$T_X \bmod 10$

Weather Station

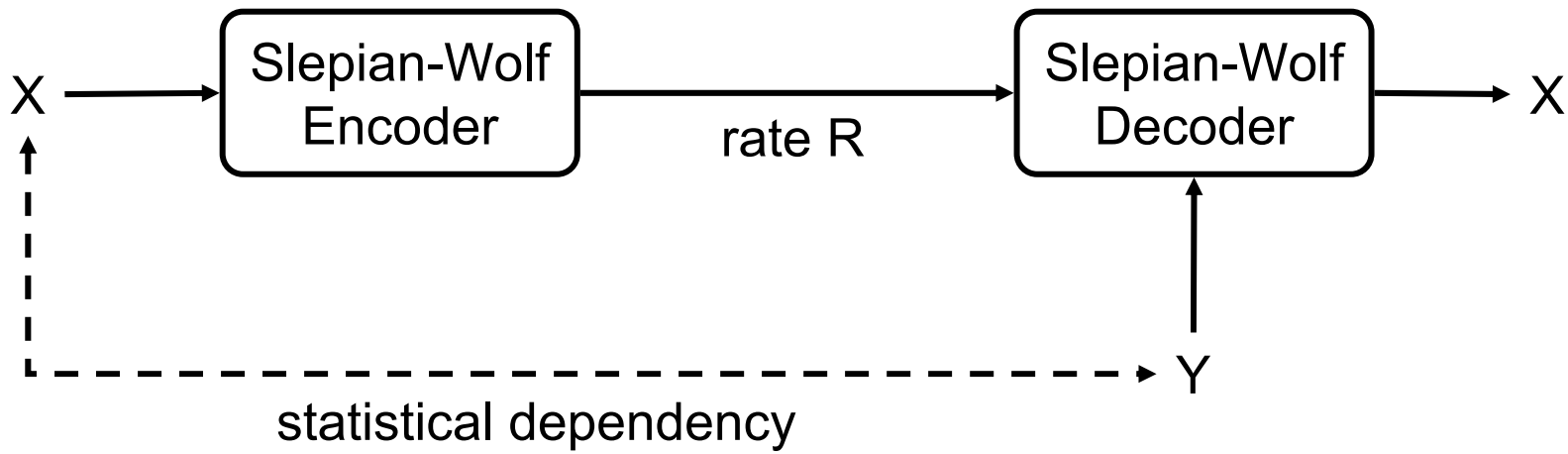
$T_X = 68F$



$T_Y = 71F$

$|T_X - T_Y| < 5$

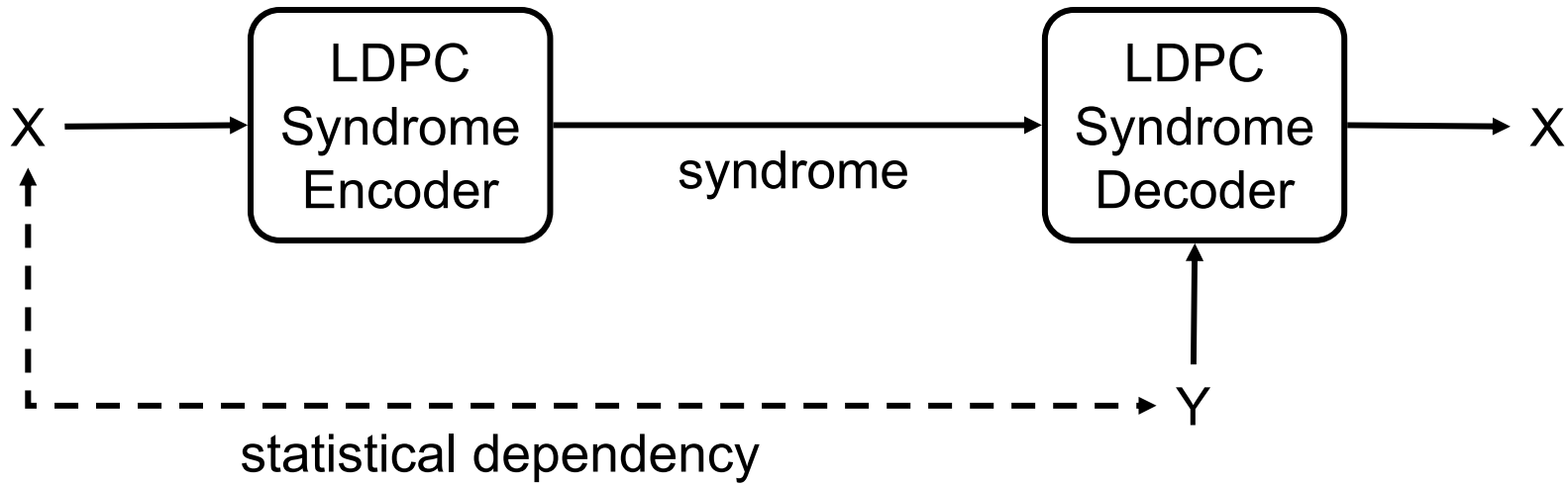
Slepian-Wolf Coding



X can be compressed losslessly at R > H(X|Y).

[Slepian, Wolf, 1973]

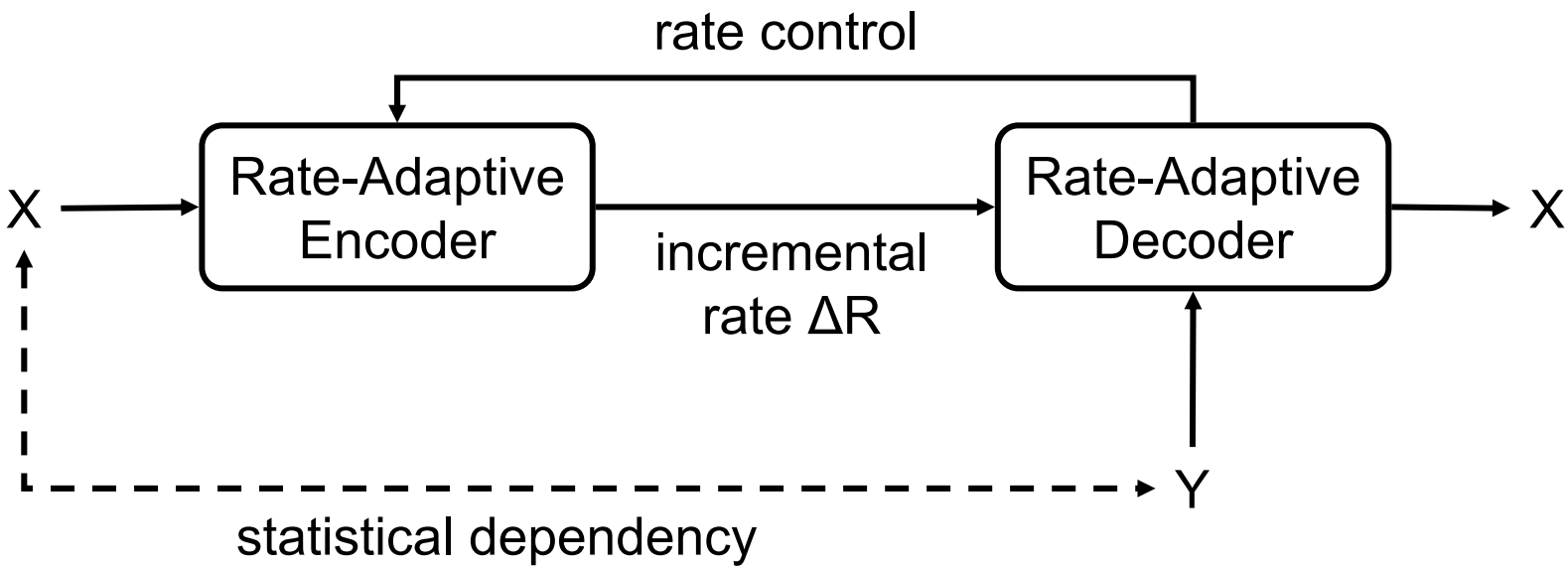
LDPC Codes for Slepian-Wolf Coding



Perform within 5-10% of Slepian-Wolf bound

[Liveris, Xiong, Georghiades, 2002]

Rate-Adaptive Slepian-Wolf Coding

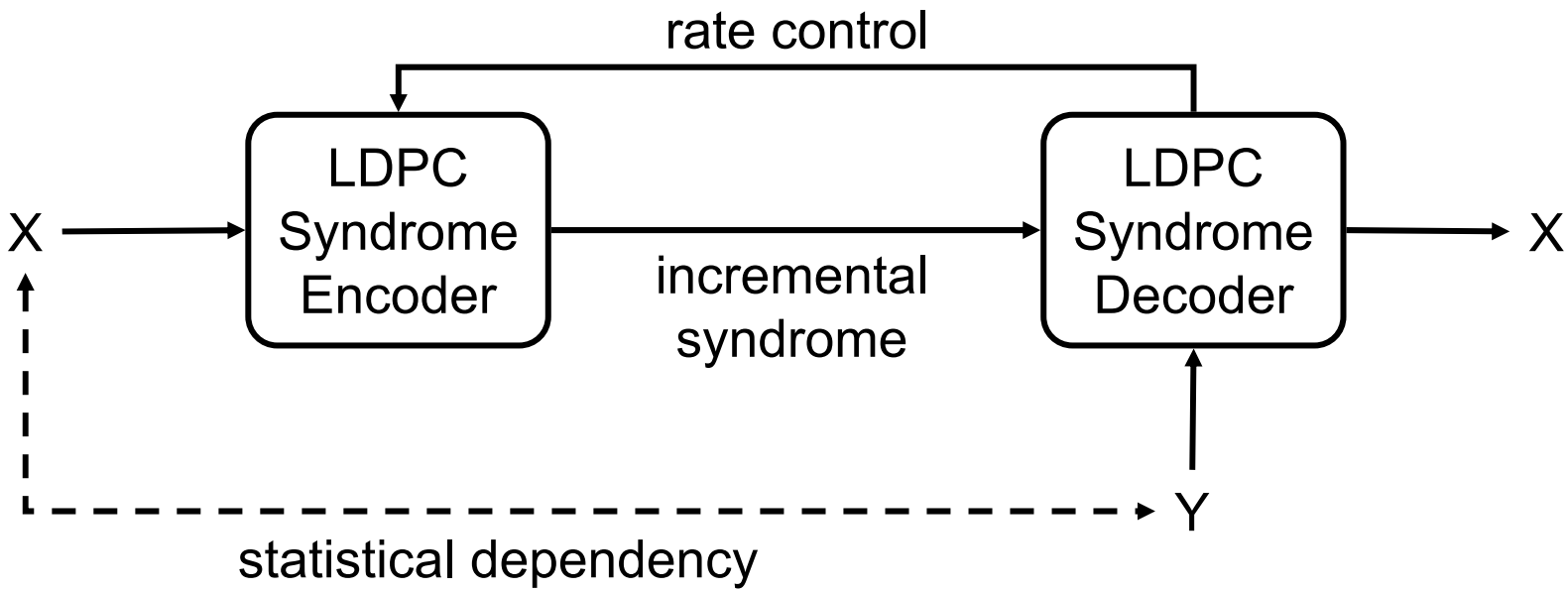


If the encoder does not know H(X|Y),

an incremental rate scheme can find a sufficient R.

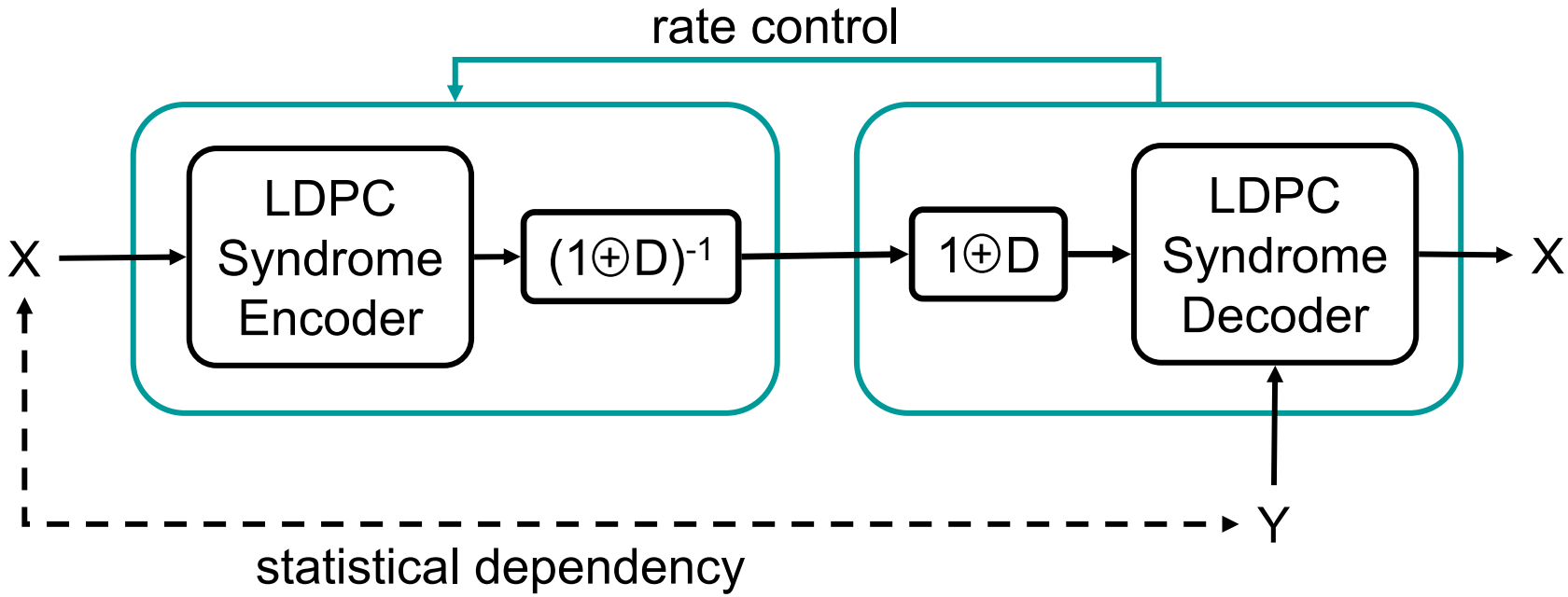
This requires feedback and good rate-adaptive codes.

Extension of LDPC Codes



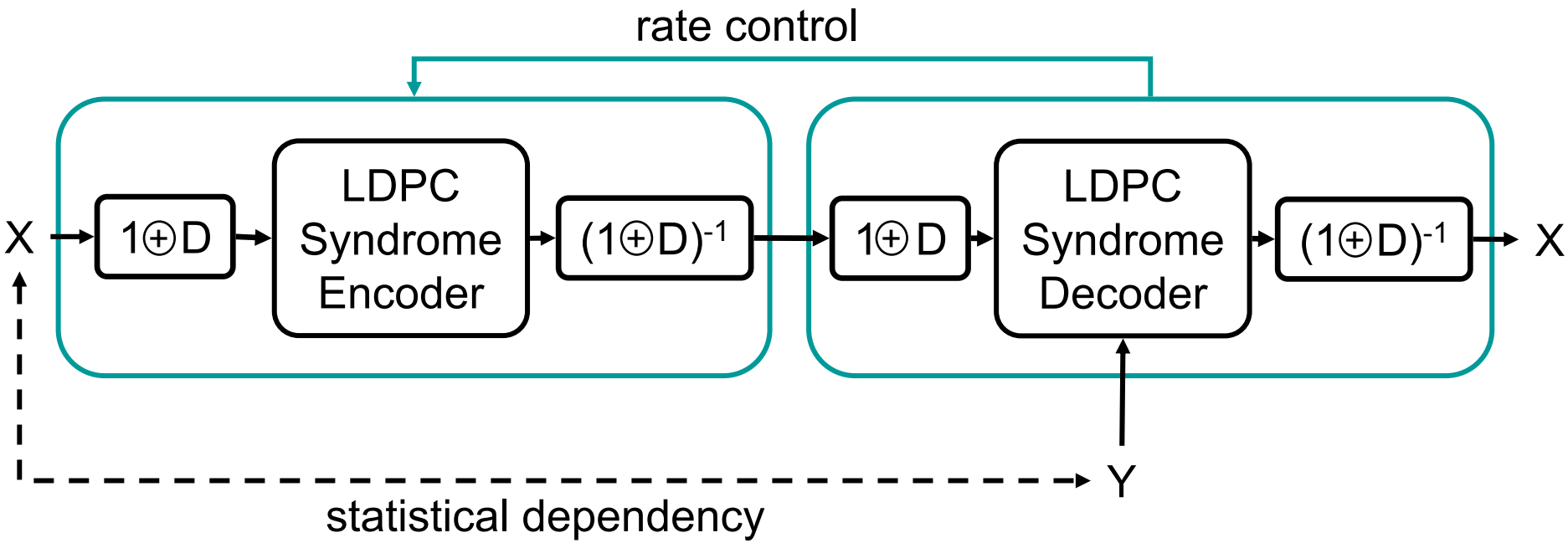
Below the full rate, the LDPC decoding algorithm is severely degraded and performance is poor.

LDPC Accumulate (LDPCA) Codes



For all rates, the LDPC decoding algorithm is effective and performance is near the Slepian-Wolf bound.

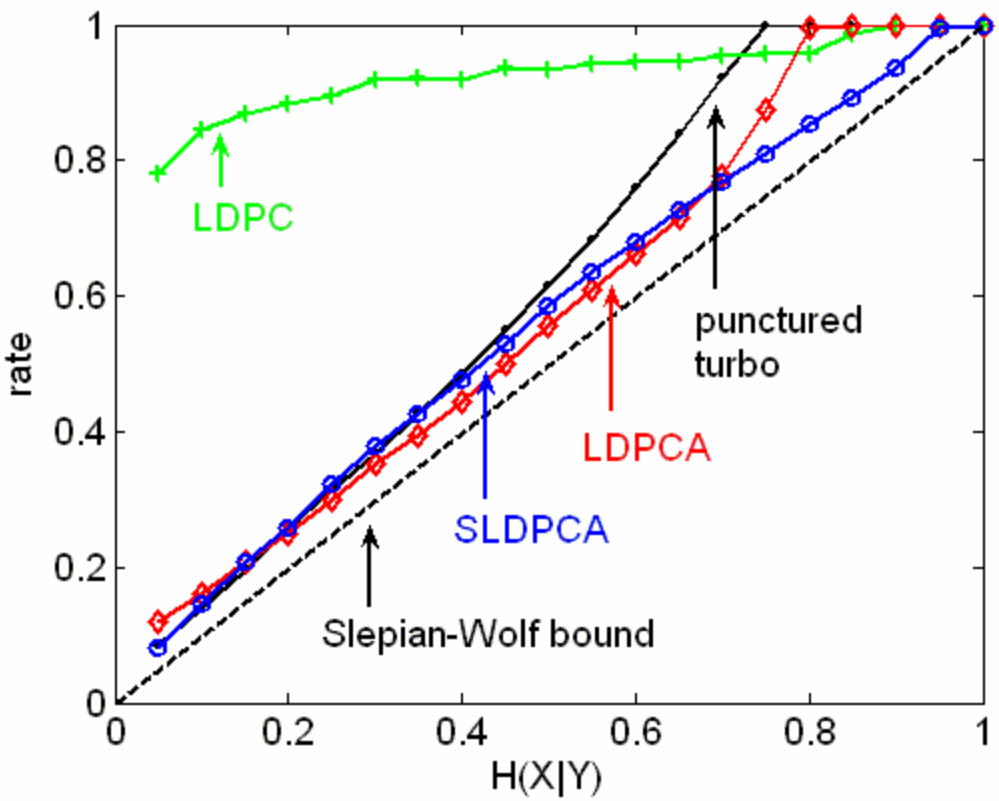
Sum LDPC Accumulate (SLDPCA) Codes



Performance is also near the Slepian-Wolf bound for all rates. LDPC and BCJR decoding algorithms are used jointly.

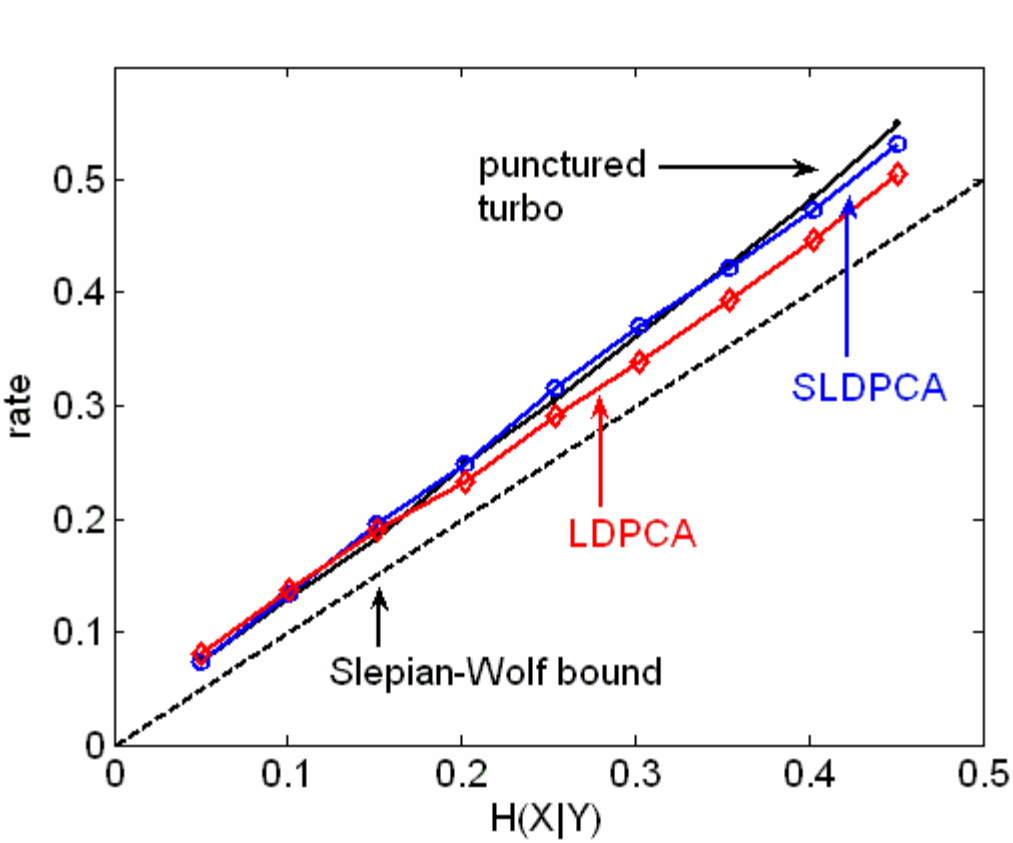
Simulation Results

- X is binary iid, unbiased
- Binary symmetric correlation btw X and Y
- Length 6336 bits
- 75 trials per point
- Turbo codes from [Aaron, Girod, 2002]



Simulation Results

- X is binary iid, biased 9:1
- Binary symmetric correlation btw X and Y
- Length 6336 bits
- 75 trials per point
- Turbo codes from [Aaron, Girod, 2002]



Conclusions

- Extension of LDPC syndrome codes to rate-adaptive distributed source coding is ineffective
- LDPCA and SLDPCA codes are proposed
- Outperform punctured turbo codes
- Perform within 5% and 10% of the Slepian-Wolf bound at high and moderate rates
- Perform well for different source statistics