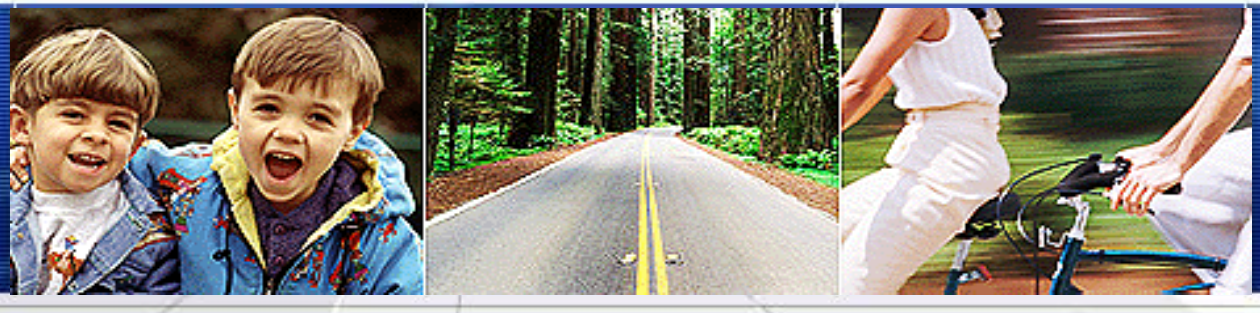

LTE Channel coding

(R1-060334)

Samsung

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Requirements for 3G LTE Channel coding

- High decoder Throughput
- Performance enhancement
  for high code rate & high-order modulation
- Simple implementation

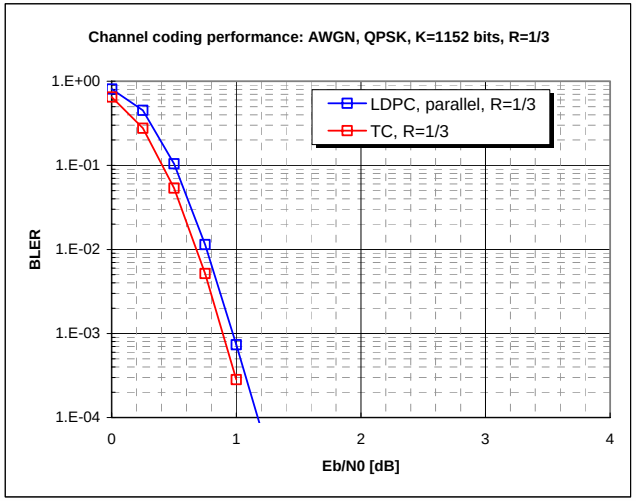
Current Turbo codes vs. LDPC codes

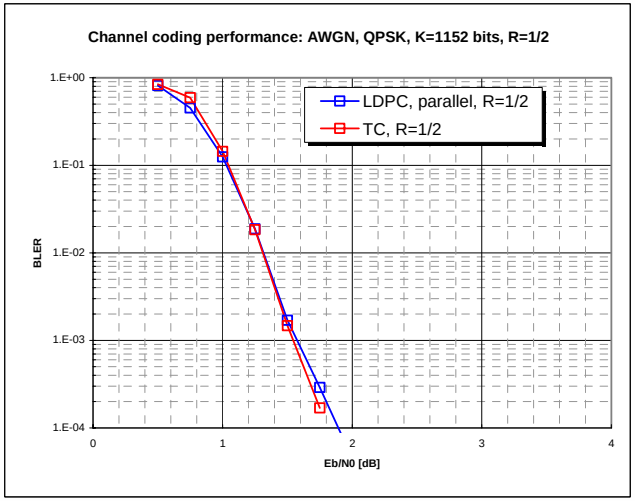
Hardware complexity of turbo codes and LDPC codes

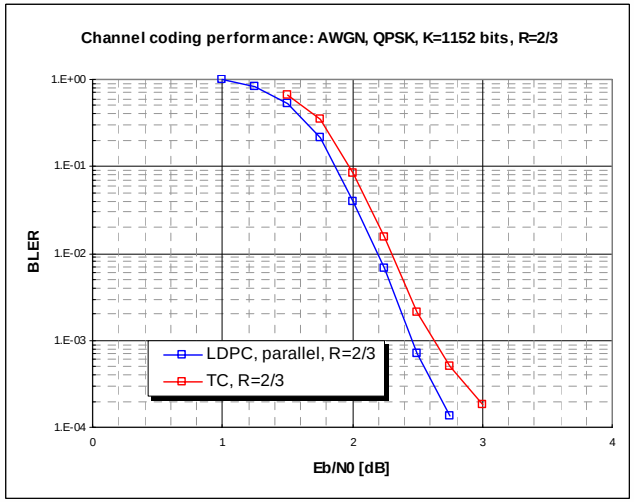
	Turbo code (3GPP) (8 iterations)	**LDPC code** (50 iterations)
bits / clock (R=5/6)	1	Relatively 7.35 times
Gate size (Enc & Dec)	The same gate size is used	
bits / clock (R=5/6)	The same decoder throughput is used	
Gate size (Enc & Dec)	Relatively 7.35 times	1

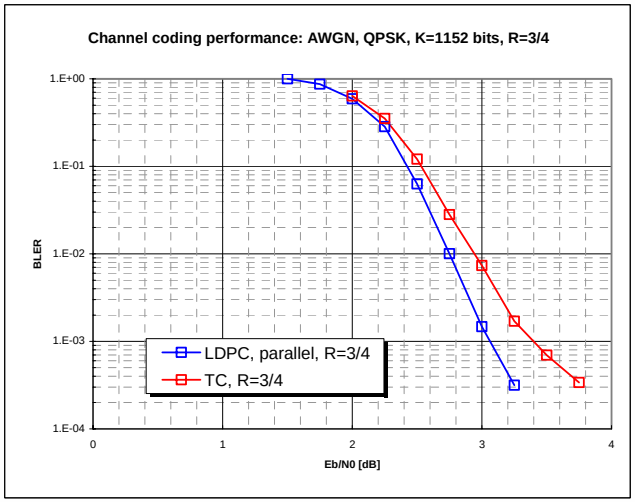
- Throughput of LDPC decoder is approximately **7.35 times higher** over Turbo decoder
- To support the same data throughput, the H/W size of an LDPC code can be significantly reduced

Current Turbo codes vs. LDPC codes









Structured LDPC vs. Concatenated Zigzag

Complexity

Operational complexity

	Rate 1/3		Rate 1/2		Rate 2/3		Rate 3/4	
Code	LDPC	Con. ZZ	LDPC	Con. ZZ	LDPC	Con. ZZ	LDPC	Con. ZZ
Coding parameters	dv=3.3750	U=4	dv=3.7292	U=4	dv=3.8542	U=4	dv=3.9375	U=4
	dc=5.0625	J=2	dc=7.4583	J=4	dc=11.5625	J=8	dc=15.7500	J=12
SO/IB/Iter.	70.88	60	52.21	48	40.47	42	36.75	40

- Concatenated Zigzag decoding includes several interleaving/deinterleaving operations
  → Structured LDPC codes have comparable complexity with Concatenated Zigzag codes

Latency problem

- The larger the dimension of concatenated Zigzag codes and the larger the interleaver, the longer the decoding latency of Concatenated Zigzag codes

Parallel decoding for high decoder throughput

- Structured LDPC codes has flexibility for trade-off between decoder throughput and complexity

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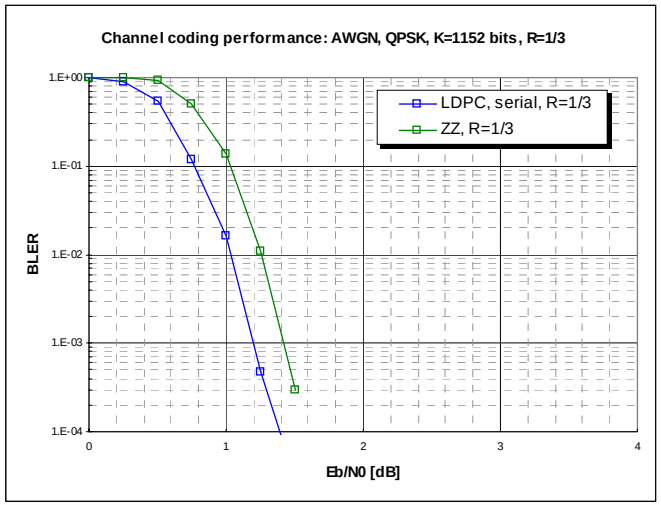
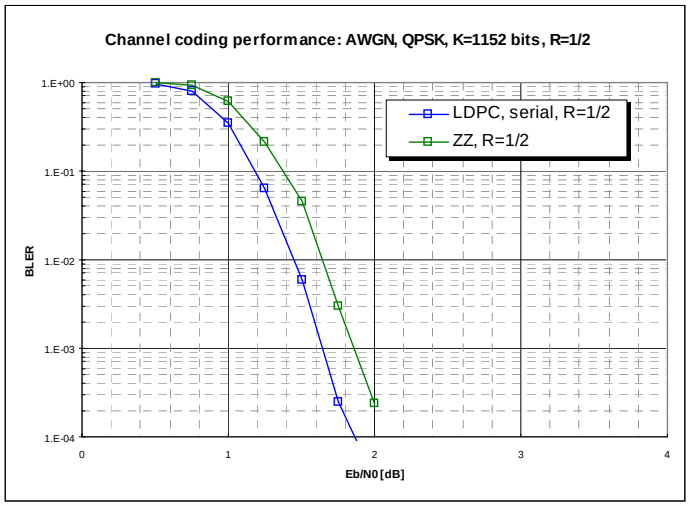
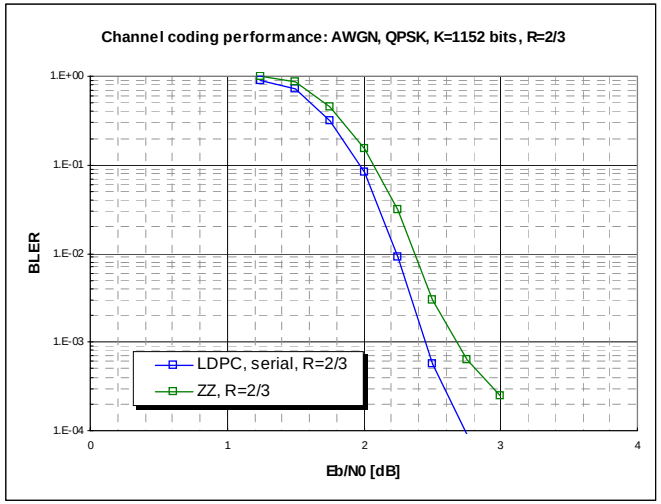
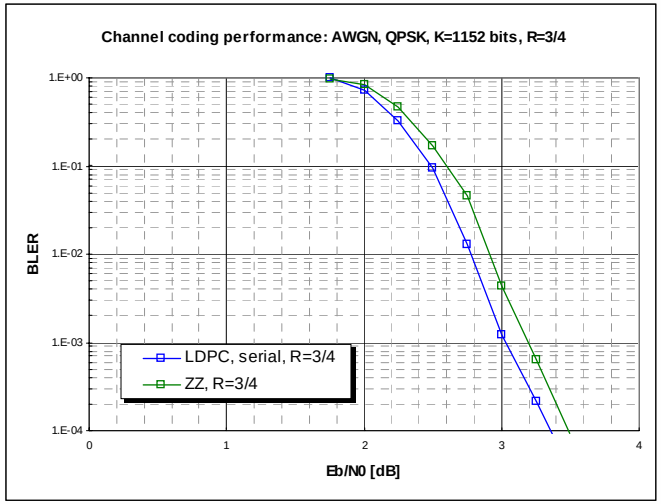
Structured LDPC vs. Concatenated Zigzag

Performance









Conclusion

- **Advanced coding scheme should be considered for 3G LTE system Moreover, LDPC codes can be a good candidate**
  - LDPC codes have better performance than Turbo codes in high code rate
  - LDPC codes support high decoder throughput

- **Structured LDPC codes have several advantages over Concatenated Zigzag codes**
  - Structured LDPC codes have better performance than Concatenated Zigzag codes
  - Structured LDPC codes have comparable complexity with Concatenated Zigzag codes
  - Zigzag codes requires high latency over LDPC codes
  - The decoder of Structured LDPC codes has flexibility for trade-off between decoder throughput and complexity

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