

Rate-Compatibility and Incremental Redundancy HARQ for 802.16j LDPC codes

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Purpose:

Propose a Rate-Compatible and IR HARQ for 802.16j to improve reliability, throughput performance and lower cost for relay links.

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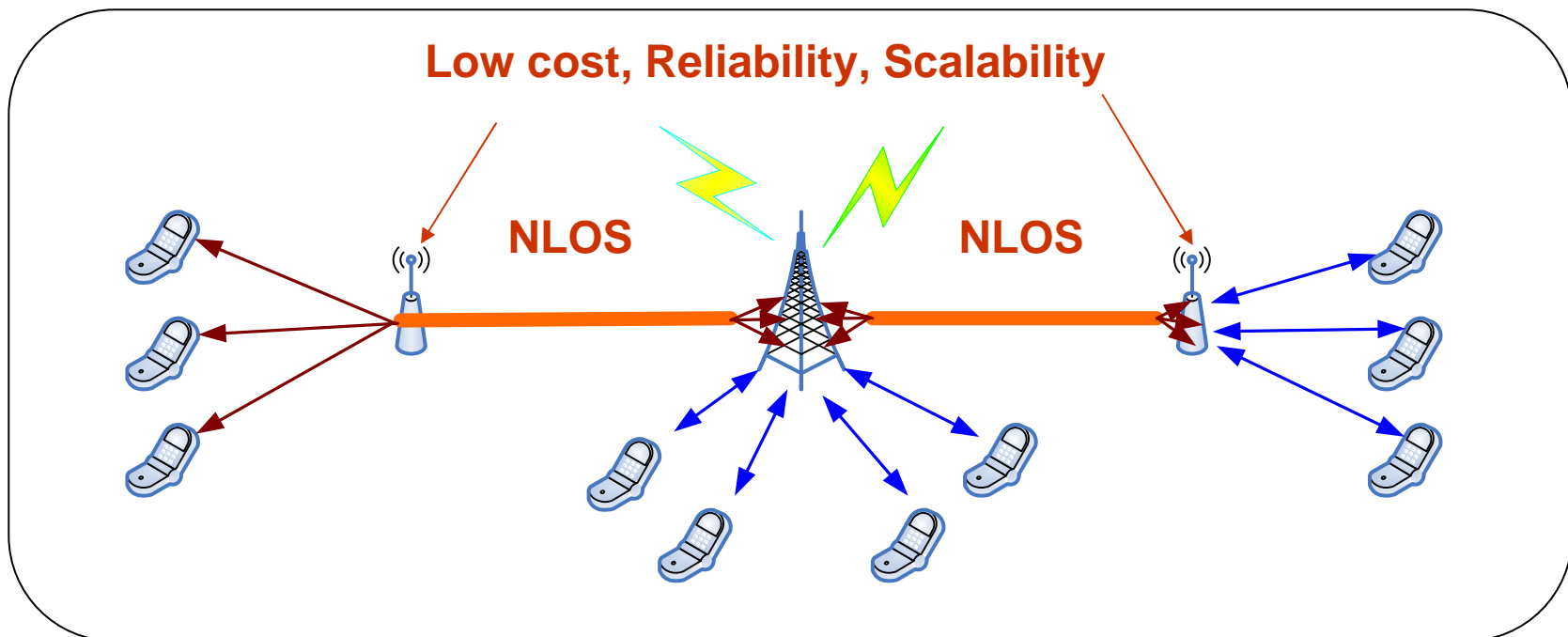
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Concept of Enhanced Hybrid ARQ (Rate Compatible LDPC)

- Propose a LDPC scheme which provides the hooks to enhance the current Hybrid ARQ
 - Low cost
 - Reliability
 - Scalability



Key Features of RC-LDPC

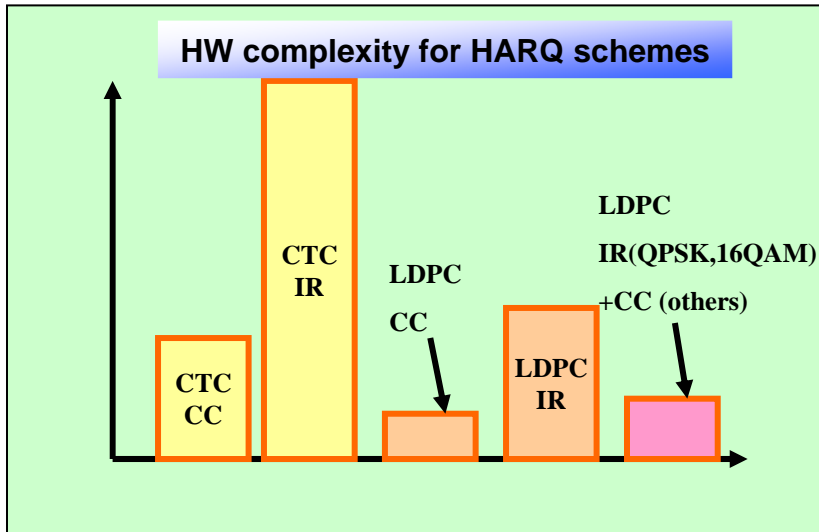


Fig1. Low Cost

- 802.16j LDPC does not support HARQ IR
- IR performs better than Chase Combining
- RC-LDPC supports HARQ IR

- LDPC codes can provide lower cost hardware than CTC.
- High reliability for low to mid data-rate region. → Expansion of coverage area
- RC-LDPC coexists with the 802.16e LDPC → Minimum additional circuits for RC-LDPC codes

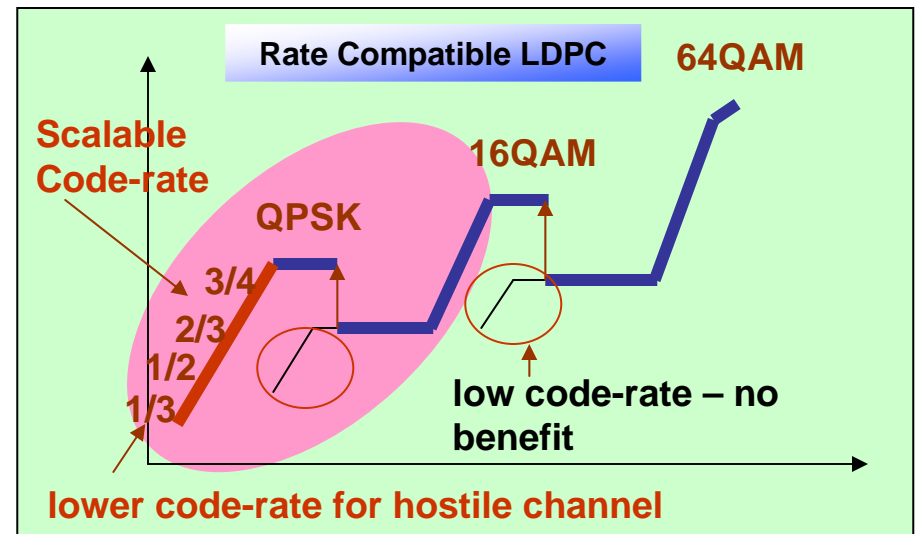


Fig2. Reliability and Scalability

Conclusions

- LDPC support high throughput with less hardware complexity and lower cost compared to Turbo codes
- RC-LDPC IR HARQ provide improved robustness for channel in hostile conditions for low to mid data rate
- RC-LDPC coexists and is an enhanced version of the 802.16e LDPC

- Backup Charts

Comparison with Turbo

Table. Operations count comparison of sub-optimal decoders LDPC and TC decoders.

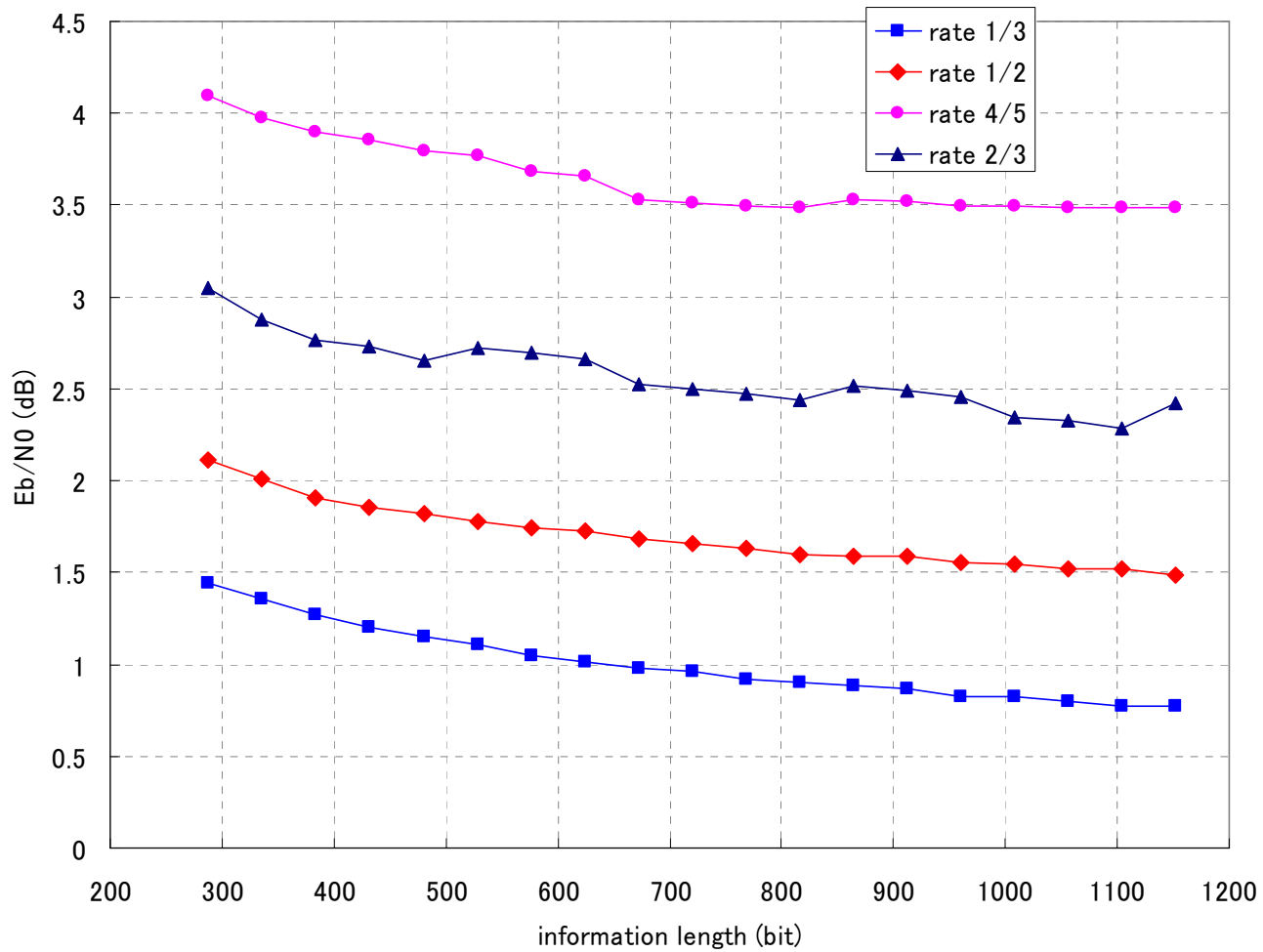
	LDPC	TC	Complexity of LDPC / Complexity of TC
Algorithm	LBP Min-Sum+Offset	Max Log Map +extrinsic scaling	
Number of Iterations	20	8	
Total cost (R=1/3)	38.5K x 20 = 770K	171K x 8 = 1368K	56%
Total cost (R=1/2)	28.8K x 20 = 576K	171K x 8 = 1368K	42%
Total cost (R=3/4)	20.6K x 20 = 412K	171K x 8 = 1368K	30%

Reference: R1-060874, " **Complexity Comparison of LDPC Codes and Turbo Codes** "

3GPP TSG RAN WG1#44bis, Athens, Greece 27-31 Mar. 2006.

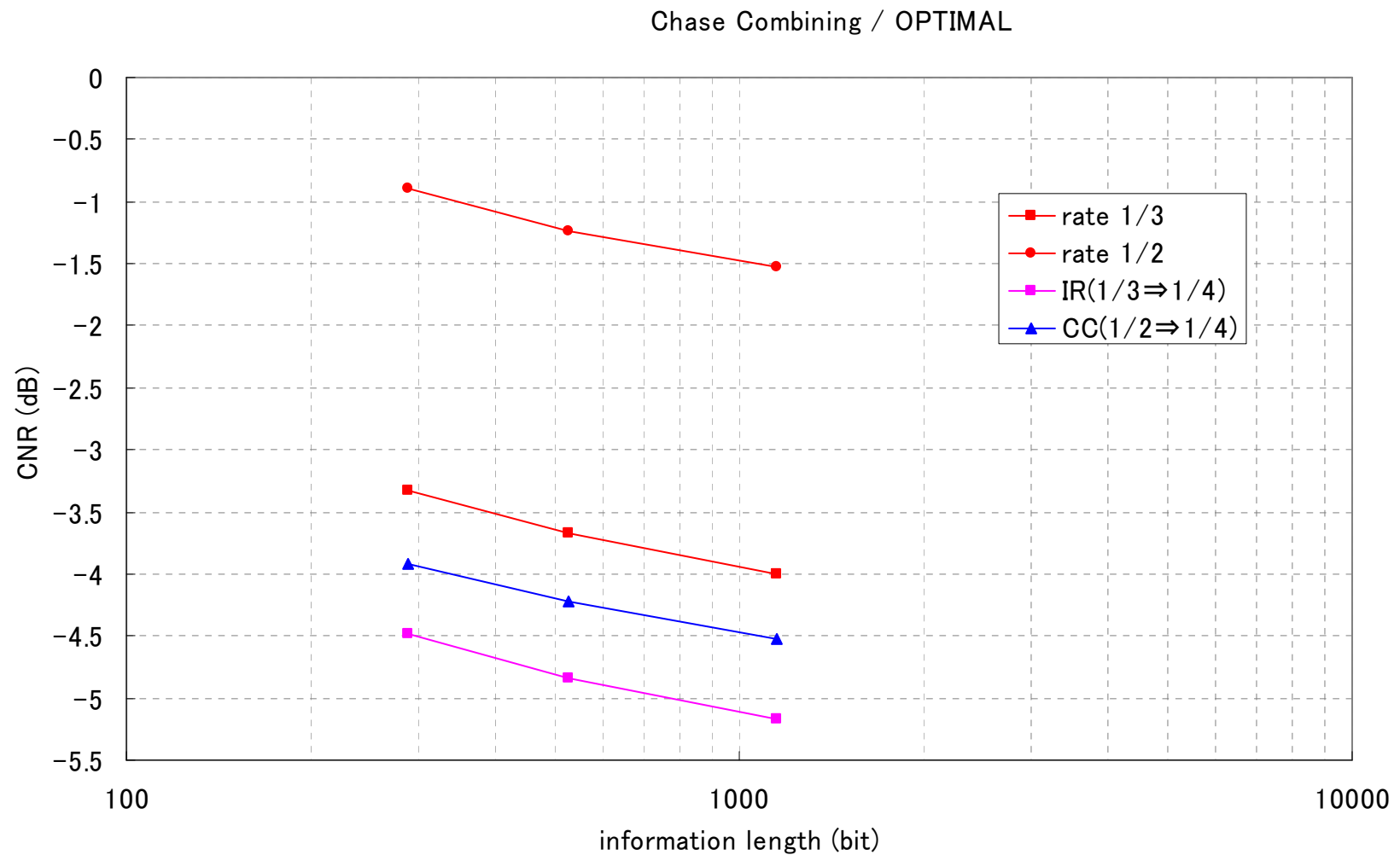
Performance of RC LDPC

Performance for RC LDPC codes based on the 16e LDPC codes

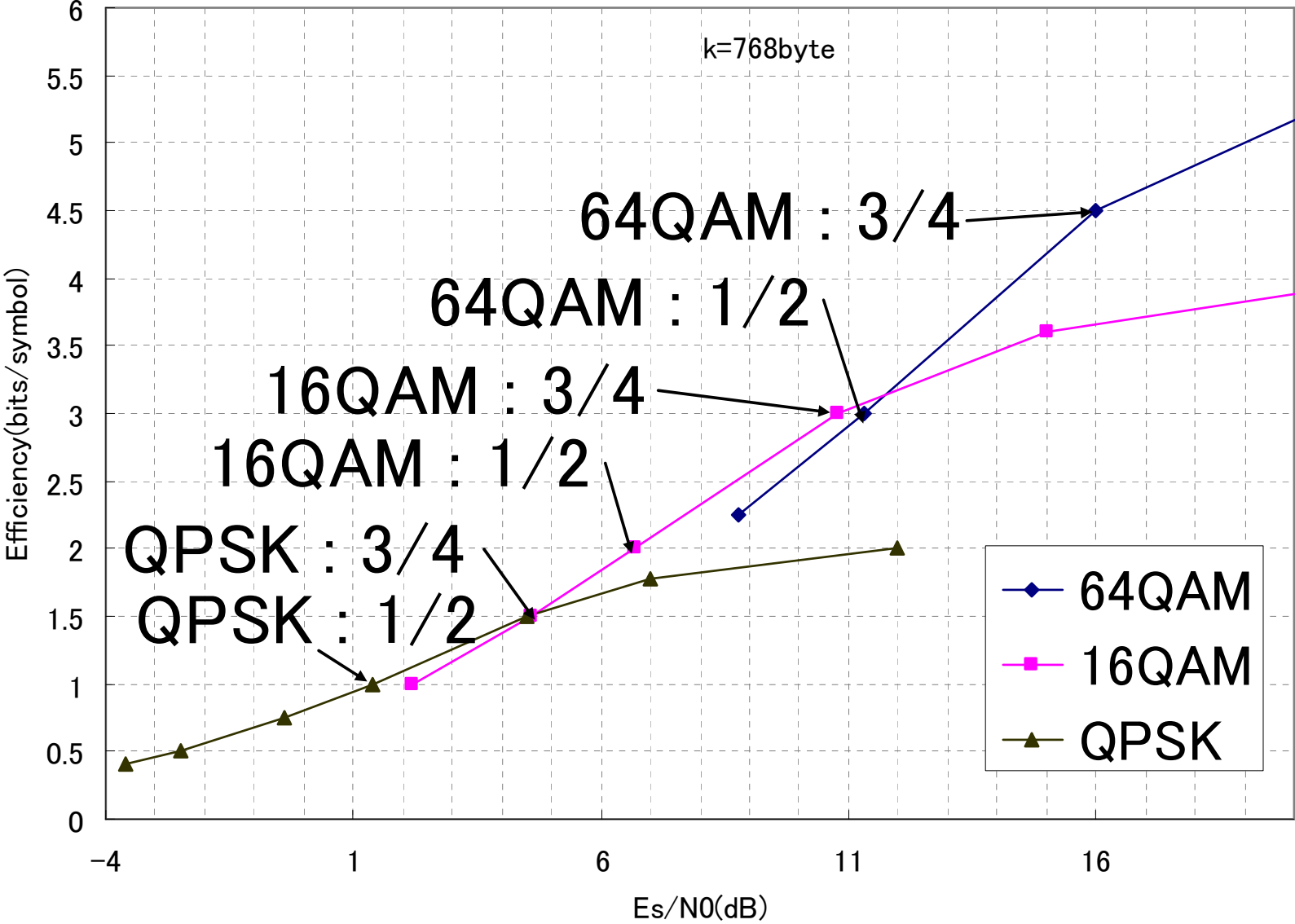


Performance of RC LDPC

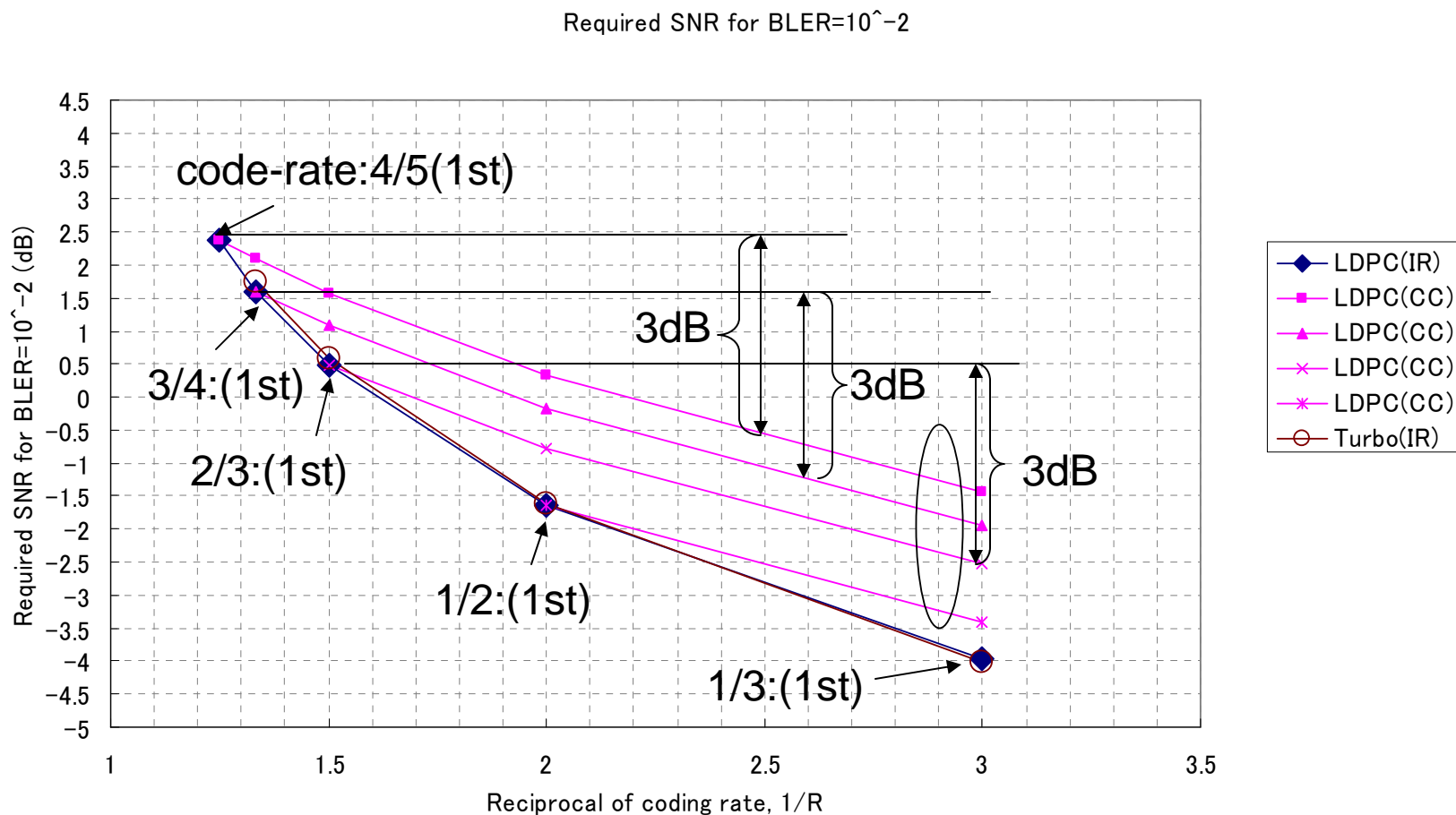
Performance for RC LDPC codes based on the 16e LDPC codes



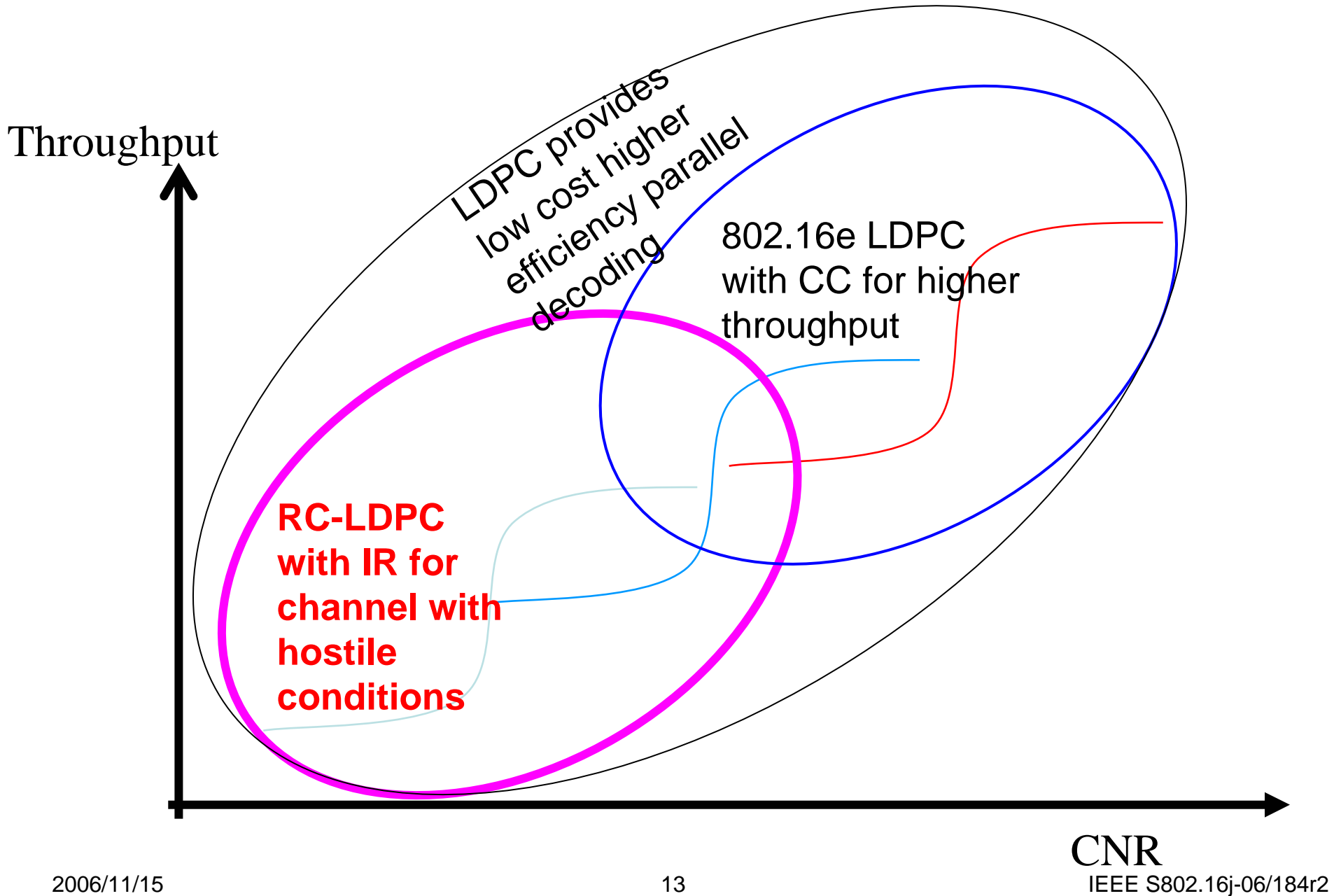
Efficiency Performance of LDPC codes on MCS



Throughput Performance of LDPC Chase Combining and IR HARQ

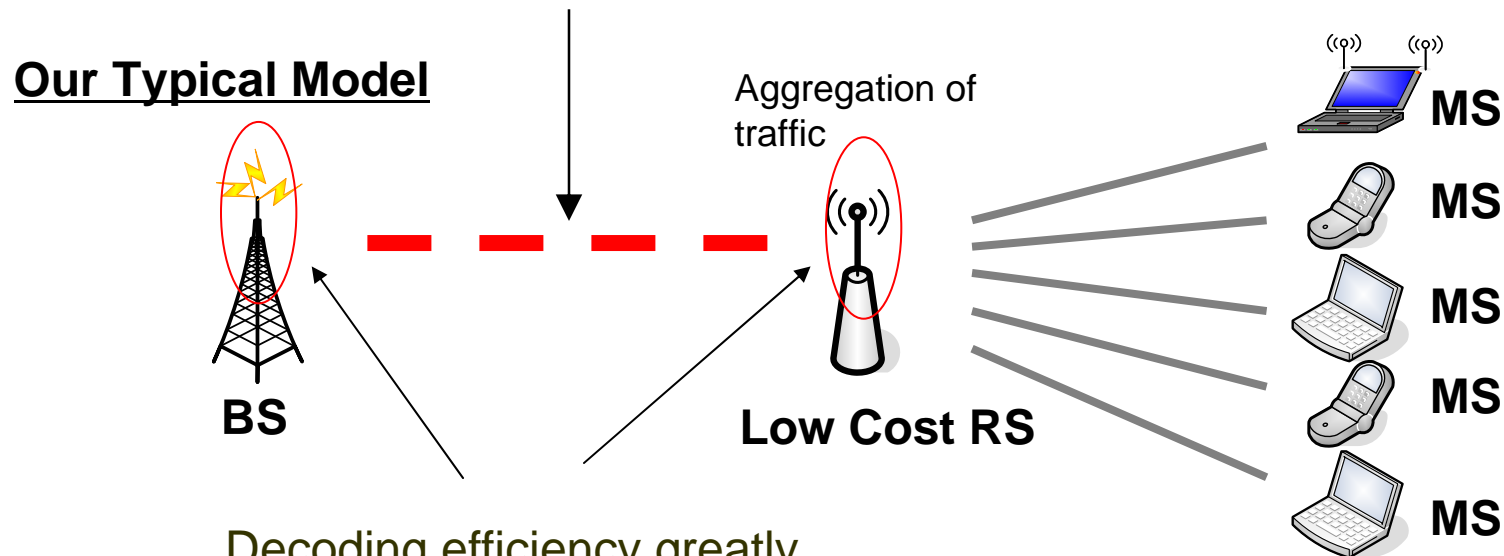


RC-LDPC and 802.16e LDPC



Merits of RC-LDPC and 802.16e LDPC

Improved robustness provided by RC-LDPC low code rate and HARQ IR especially for channels with hostile conditions



Decoding efficiency greatly improved by LDPC and making high throughput and low cost RS/BS possible for UL and DL