Large Data Block Size

NSIC Discussion

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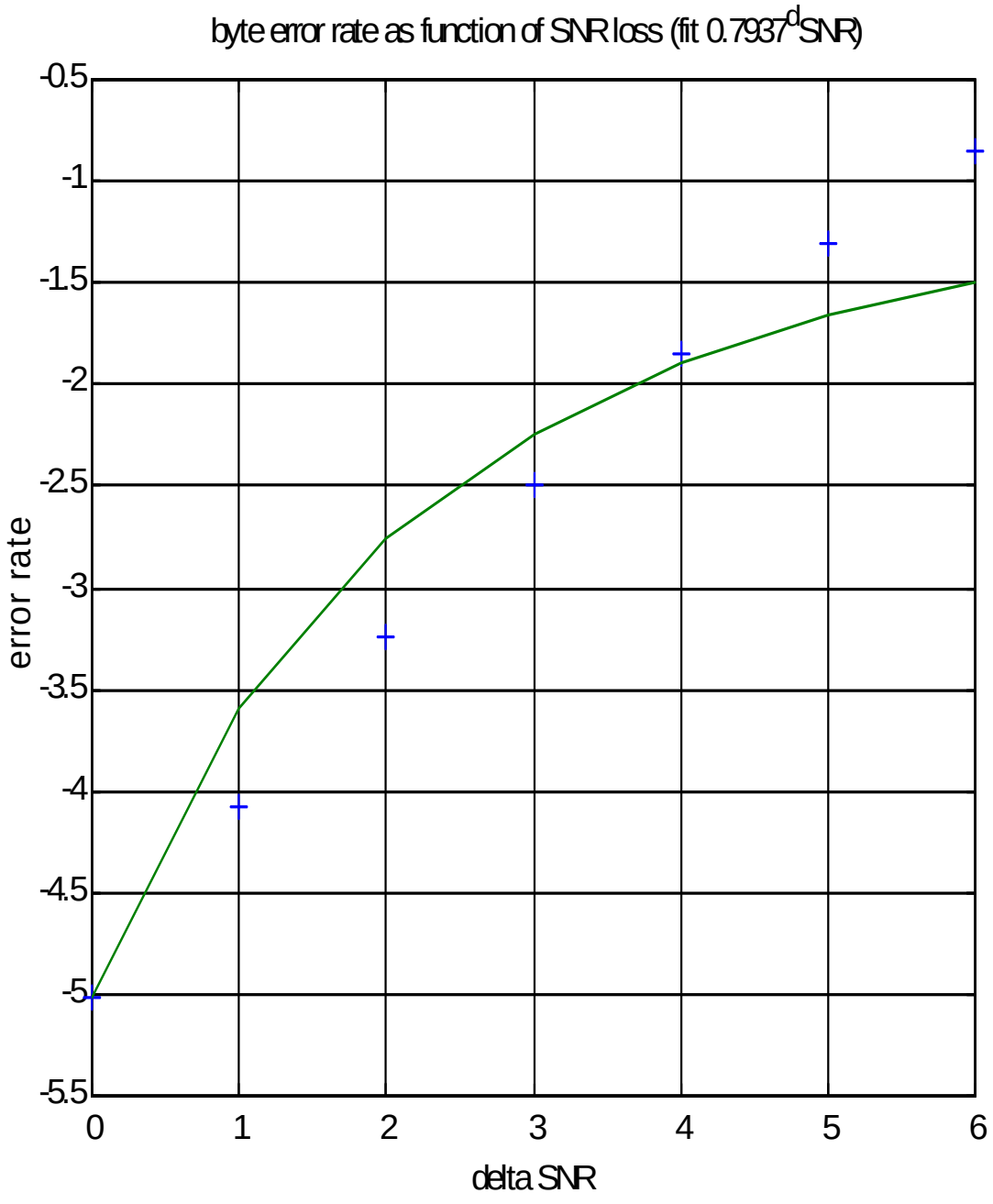
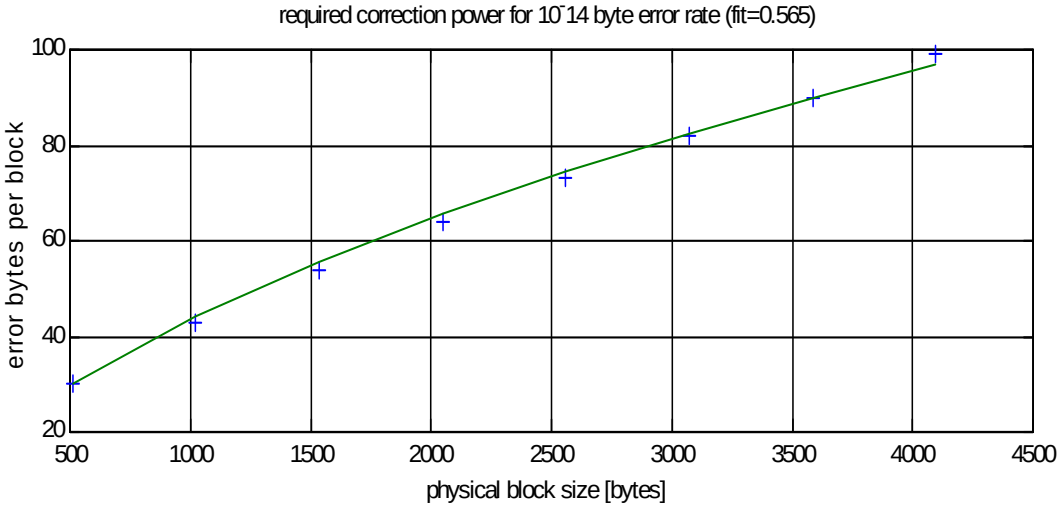
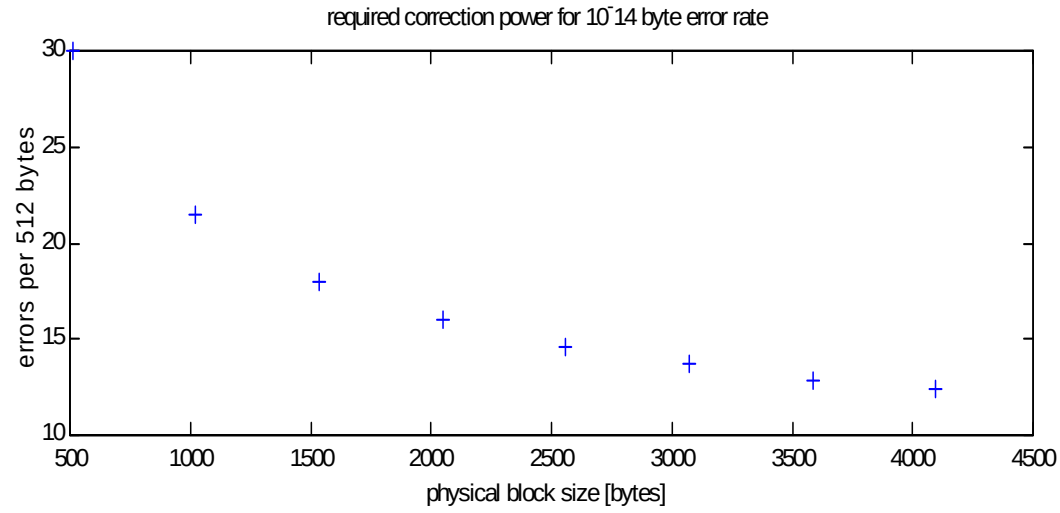
Error rate dependence on SNR
(Square-root approximation)



Error rate dependence on ECC block size





Format assumptions for 100 Gb/in^2:

- **ECC overhead**
  - total loss of 6 dB in SNR
  - future data channel will recover 3 dB
  - strong ECC will regain remaining 3 dB
  - input byte error rate scales with square root per 3dB
  - random error distribution (for current model)
- **bit aspect ratio is 8**
- **Timing recovery overhead**
  - 6 dB loss in SNR
  - length of sync, timing and pad fields scales with linear density
    - (factor of 2 per 3dB)
- **Servo overhead**
  - 6dB loss in SNR
  - servo burst length & frequency scales with linear density
    - (factor of 2 per 3 dB)
  - servo sample frequency scales with square root of TPI
  - spindle speed will increase to 15,000 RPM
  - disk radius will decrease to 84 mm

Formated capacity gain

for 100 Gb/in2 media

(84mm disk @ 15,000 rpm)

Block size	**512B**	**1KB**	**2KB**	**4KB**
Overhead:				
ECC (Bytes)	64	94	140	206
Sync (B)	72	72	72	72
Data cell (B)	674	1216	2286	4400
No. of SIDs	128	128	128	128
SID cell (dibits)	544	544	544	544
Efficiency:				
ECC	0.889	0.916	0.936	0.960
Data (timing)	0.855	0.919	0.957	0.978
Zone	0.917	0.966	0.978	0.978
Servo	0.843	0.843	0.843	0.843
split	1.000	0.999	0.999	0.999
total track	*0.587*	*0.685*	*0.737*	*0.764*
Relative gain	**100%**	**116%**	**125%**	**130%**

Flexible block boundary Proposal

assumptions:

- need migration path from current flexible block boundary scheme to large block size
- commands will work on exceptional basis
- data integrity can't be compromised
- operations should be transparent to customer interface

proposal:

- introduction of a new optional SCSI command for non-even block boundary access
  - would include write/read/verify commands
- detailed implementation would be up to drive vendor

challenges:

- might require non-volatile storage for data integrity
- lower performance

Summary

- **Benefits for Capacity Increase**
  - 30% net gain for 100Gb/in^2 & random distribution of errors
    - main components are: ECC, timing & servo overheads
    - much more gain for real data with bursty error distributions
      - Example of an off-track stress test with 77,000 sectors at 10-2 BER, ***ECC overhead is***
        - **34%** for 3-way interleave 512B sector
        - **14%** for 4KB sector
  - Cost reduction: $/MB improve by same percentage
  - Improvement in large-block data transfer rate
- **Proposal to Software Developers**
  - Software to address 4 KB block size
    - diminishing return for block size greater than 4 KB
    - Alternative: variable size in powers of 2 starting at 512B
  - Define SCSI command to allow transparent operation for legacy code
- **Proposal to Drive Manufafurers**
  - Develop optional SCSI command for backward compatibility with 512B sectors
    - allow transparent operation of legacy software
      - current LBA addressing
      - reduced performance due to R-M-W operation
    - allow native large-block addressing for updated software
- **Proposal for Research by EHDR project**
  - develop realistic error model
  - investigate sync and timing requirements