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TC3000
Turbo Product Code decoders

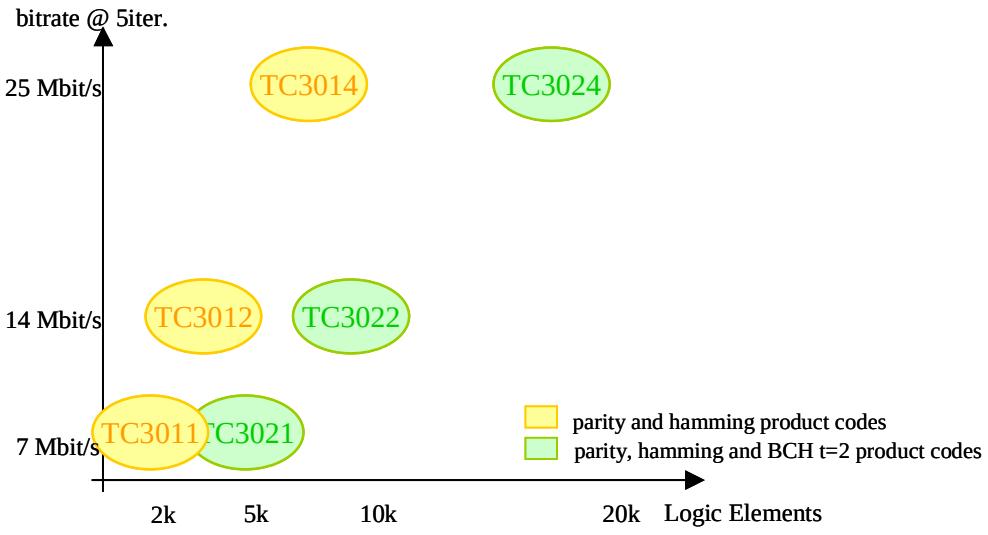
Introducing turbo product codes with BCH “t=2” codes
Customisable bitrate : 7 to 25 Mbits/s

Turbo codes improves a transmission link by an additional gain of 2 to 3 decibels, compared to classical FEC solutions.
TC3000 is a family of IP Cores offering powerful and flexible turbo product codes. TC3000 is the first IP Core implementing Hamming and double-error-correcting BCH product codes. A highly generic approach allows TC3000 to be precisely optimised for a target application.

Features

- Very High FEC performance : **Hamming and "BCH-t=2"** codes
- Bitrate customisable : **7 to 25 Mbits/s** typical @ 5 iterations
- Large block sizes : **up to 65 kbits**
- On-the-fly change of the code
- Shortening facilities to adjust packet size and coding rate
- Single-chip PLD IP Core : Altera APEX, no external memory required
- Latency reduction by bank-swapping
- Two selectable configuration interface

Bitrate/Complexity trade-off



Flexibility

TC3000 family offers 3 levels of flexibility :

TC3000 family member	✓ BCH t=2 code support (YES/NO) ✓ Choice on bitrate
VHDL generic parameters *before synthesis*	✓ Maximum row code length ✓ Maximum column code length ✓ Input Quantization width ✓ 1 or 2 input buffers
On-the fly parameters *from block to block*	✓ Row code ✓ Column code ✓ Shortening values ✓ Max. number of iterations ✓ Stopping feature enabled

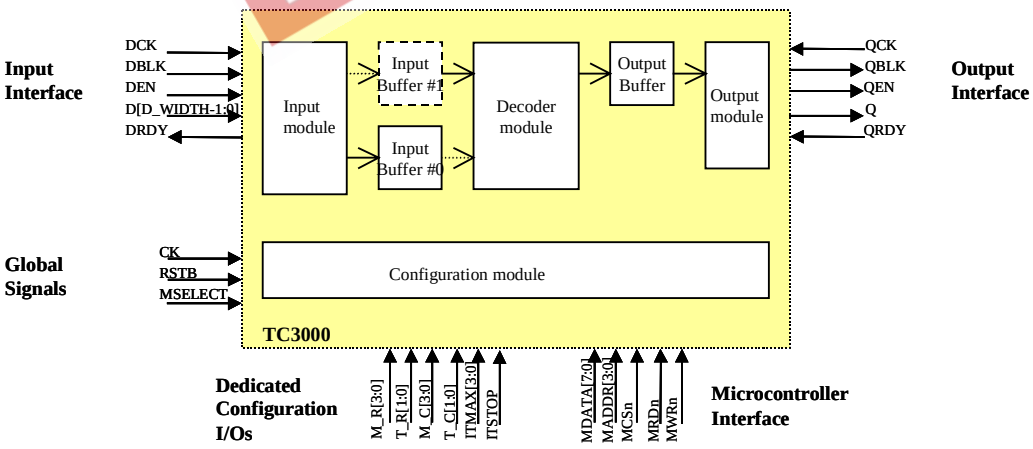
FEC performance

Very high FEC performance are obtained for various block sizes and coding rates. The FEC behaviour of the "BCH t=2" codes makes them particularly attractive for quasi-error free applications.

⇨ Gaussian channel and QPSK modulation. Results given with 5 iterations.

Product Code	Rate	Eb/N0 @BER=10^{-5}	Eb/N0 @BER=10^{-8}
(32,26) x (32,26)	0.660	2.9 dB	3.6 dB
(32,21) x (32,21)	0.431	2.4 dB	N.A.
(64,57) x (64,57)	0.793	3.2 dB	3.6 dB
(64,51) x (64,51)	0.635	2.6 dB	2.9 dB
(128,120) x (128,120)	0.879	3.8 dB	4.2 dB
(128,113) x (128,113)	0.779	3.3 dB	3.4 dB
(256,247) x (256,247)	0.931	4.5 dB	4.8 dB
(256,239) x (256,239)	0.872	4.0 dB	N.A.

Block Diagram



Implementation results

Product	Codes supported		Generic parameter setting				Implementation results				
	Hamming	BCH t=2	Row max. length	Column max. length	Data width	bank swap	LE	ESB	APEX20K device	Fmax MHz	Typical Bitrate @(64,57)², 5 iterations
TC3011	✓		64	64	4	NO	2025	22	200 C7	82	8 Mbits/s
TC3014	✓		64	64	4	NO	6926	36	200 C7	72	25 Mbits/s
			128	128	4	NO	8115	88	400 C7	67	23.5 Mbits/s
TC3022	✓	✓	64	64	4	NO	8932	24	400 C7	79	14 Mbits/s