Highly-parallel Table-Lookup-Coding with Scalable Architecture using Flexible Multi-Ported Content Addressable Memory

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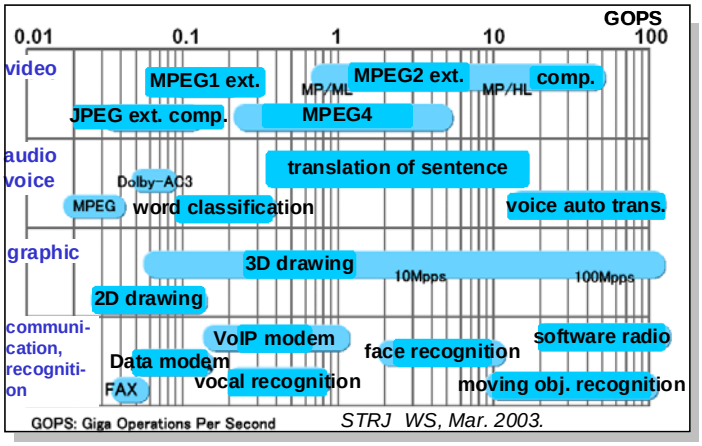
Background & Motivation

End-user can readily make use of high quality and high capacity multimedia data.



required performance of a multimedia LSI

For Fast Processing

◆ **Repeated operation**: arithmetic-logic operations carried out for all data.

parallel processing

◆ **Table-lookup-coding**: coding operation using a code word table
Reading from SRAM and comparing
Coding by CAM or hard-wired logic

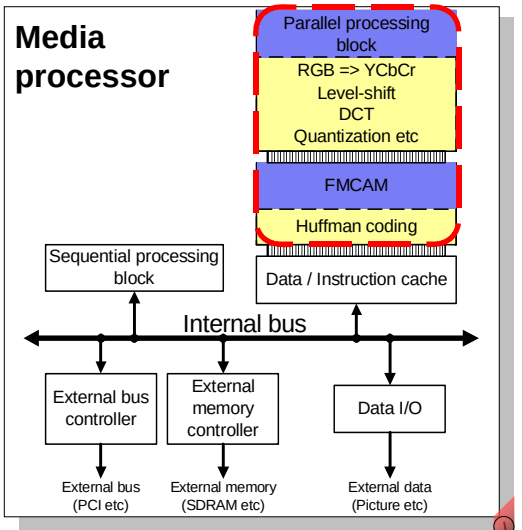
Efficient parallel processing is difficult

Realizing the parallel Huffman encoding

Architecture Concept

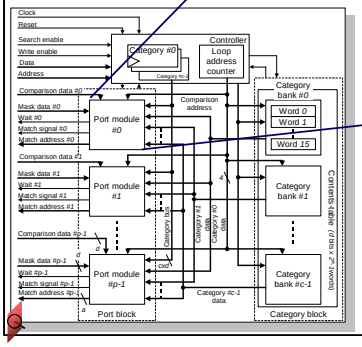
◆ Combining parallel and sequential processing blocks
→ Decreases the frequency of bus conflicts

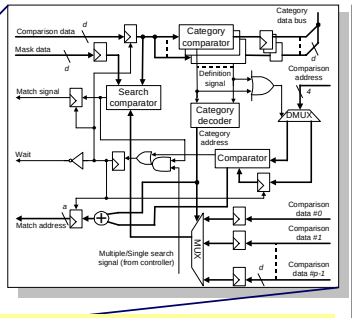
- Saving processing time
- Small area and low power consumption



Adapted Flexible Multi-ported CAM (FMCAM

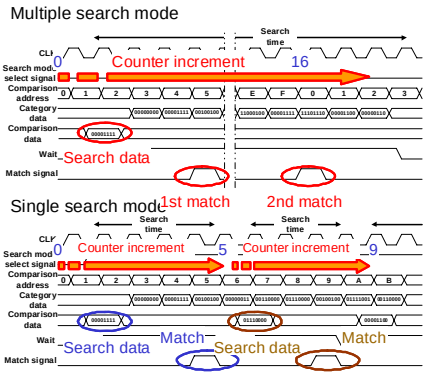
- Bit-Parallel and Block-Parallel (BPBP) search
- Categorization of the stored reference words
- P input/output





- Asynchronous processing at each port
- Multiple/Single search mode
- Counting value setting mode

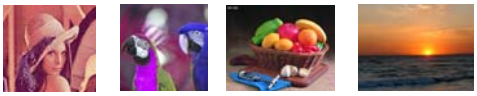
Multiple/Single search mode waveform



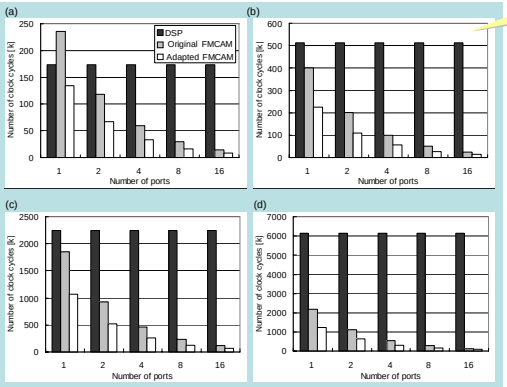
Adapted FMCAM can stop the process immediately after the first matching symbol.

Implementation results for JPEG Applicatio

(a) 154 x 144 (b) 256 x 256 (c) 600 x 480 (d) 1024 x 768



Adapted FMCAM processing clock cycles are 43% less than for original FMCAM and 93% less than for DSP



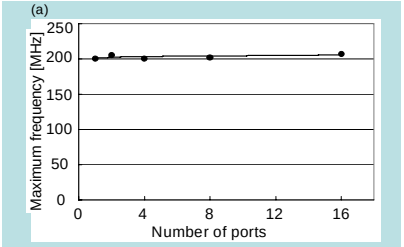
Comparison of clock cycles for Huffman encoding

Comparison of Processing Efficiency

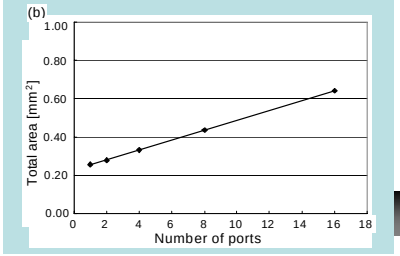
Ports	Maximum frequency		Comparison operation [MOPS]			Total area [mm^2]		MOPS / mm^2		
	Original/ Adapted FMCAM	Parallel DSPs	Original FMCAM	Adapted FMCAM	Parallel DSPs	Original/ Adapted FMCAM	Parallel DSPs	Original FMCAM	Adapted FMCAM	Parallel DSPs
1	200	200	10.55	18.58	25.60	0.26	0.21	41	72	122
2	205	200	21.61	38.11	51.20	0.28	0.42	78	137	122
4	201	200	42.26	74.61	102.40	0.33	0.84	127	224	122
8	202	200	85.18	149.14	204.80	0.44	1.68	195	342	122
16	207	200	174.11	302.92	409.60	0.64	3.36	271	472	122

Performance per area size of adapted FMCAM is 1.7 times higher than for original FMCAM and 3.8 times higher than for DSPs.(for 16 ports)

Implementation Result



Maximum operating frequency is practically not influenced by the number of ports.



The area increases only linearly with just about 9% per port.

Synthesized with the Synopsys Design Compiler for 90nm CMOS technology

Conclusion

- *Multi-ported CAM for parallel coding is proposed as a novel architecture for table-lookup-coding.*
- *In the JPEG application, the clock cycle number of the adapted FMCAM is **up to 93% smaller than for a conventional DSP**.*
- *The efficiency of the adapted FMCAM in MOPS/mm^2 is **up to 3.8 times higher than that of conventional parallel operated DSPs.***