Data Dependency in MPEG Audio Frame Decoding Time on a DSP Accelerator

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DSPs as Multimedia Accelerators

DSPs are:

- very powerful
- designed to handle continuous data streams
- able to operate under real-time conditions
- cheap
- (used almost exclusively in embedded systems)
- ideally suited for Multimedia algorithms

Use DSPs as flexible PC-based Multimedia Accelerators ?

Motivation

SPROS - Signal Processing Operating System

- tailored to accelerating host (PC) Multimedia processing
- periodic processing of streams
- essential functionality only: scheduling, communication, task control

Periodicity of complex Multimedia algorithms in DSP implementations ?

Example: MPEG Audio

Experimental Environment

Host:

- Pentium MMX, 166 MHz
- 64 MByte RAM
- 512 kBytes 2nd level cache
- Linux

DSP Subsystem:

- TMS320C44, 50 MHz
- 128 kBytes local and global SRAM
- AMCC S5933 PCI controller
- modular board, TIM size

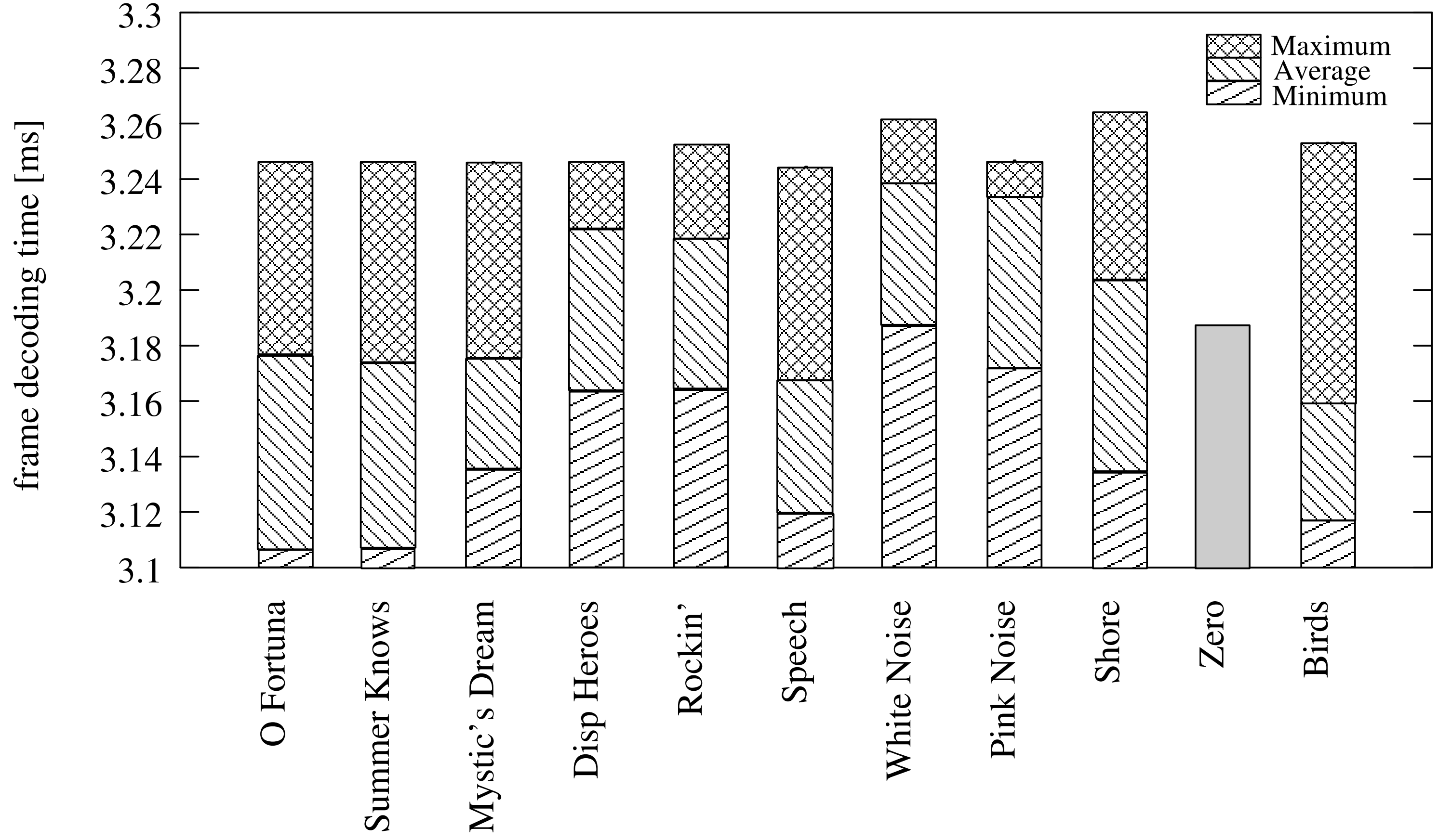
DSP MPEG Audio Decoder:

- Layer I, II
- works in real time
- highly optimized
- assembler-only

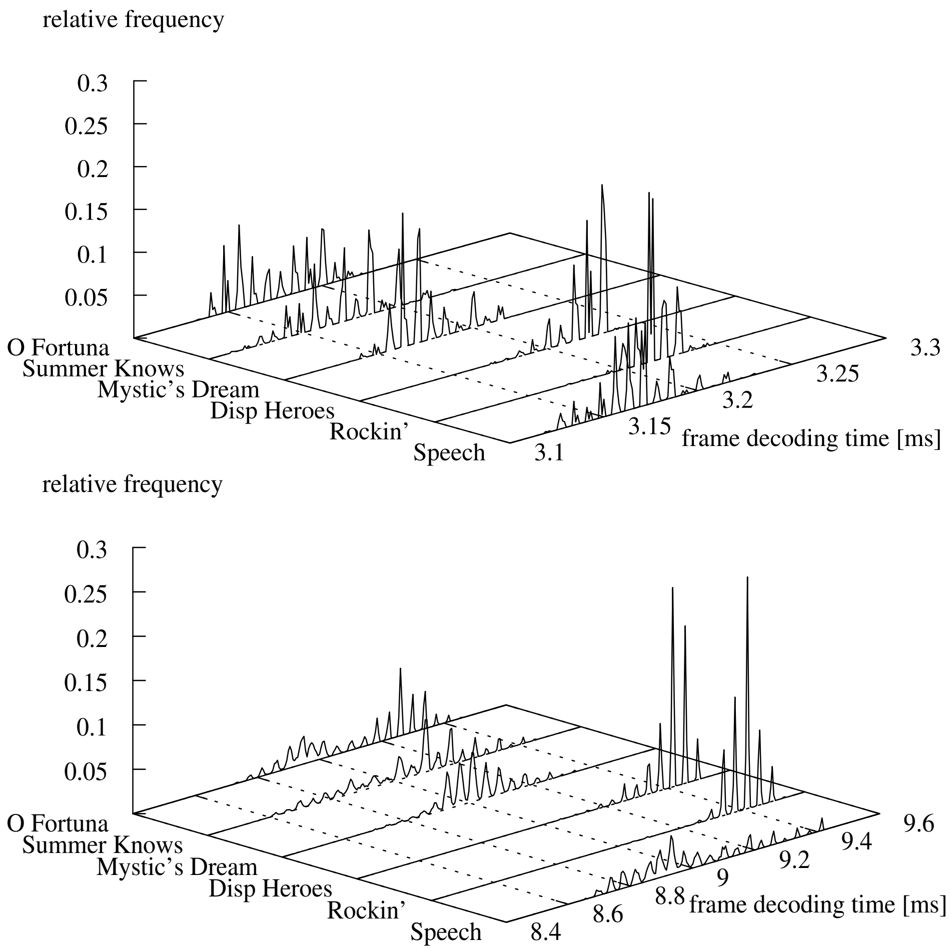
Analyzed Audio Streams

Name	length [s]	Characteristic
O Fortuna	120	classical music, highly dynamic
Summer knows	120	guitar, female voice, quiet
Mystic´s Dream	120	choir, female voice, quiet
Disposable Heroes	120	Heavy Metal, fast, loud
Rockin´in a free world	120	Rock music
Speech	60	male speech, movie excerpt
White Noise	35	analytical signal
Pink Noise	65	analytical signal
Shore	69	swelling and decaying surf
Zero	30	stream of digital zeros
Birds	75	tweeting birds

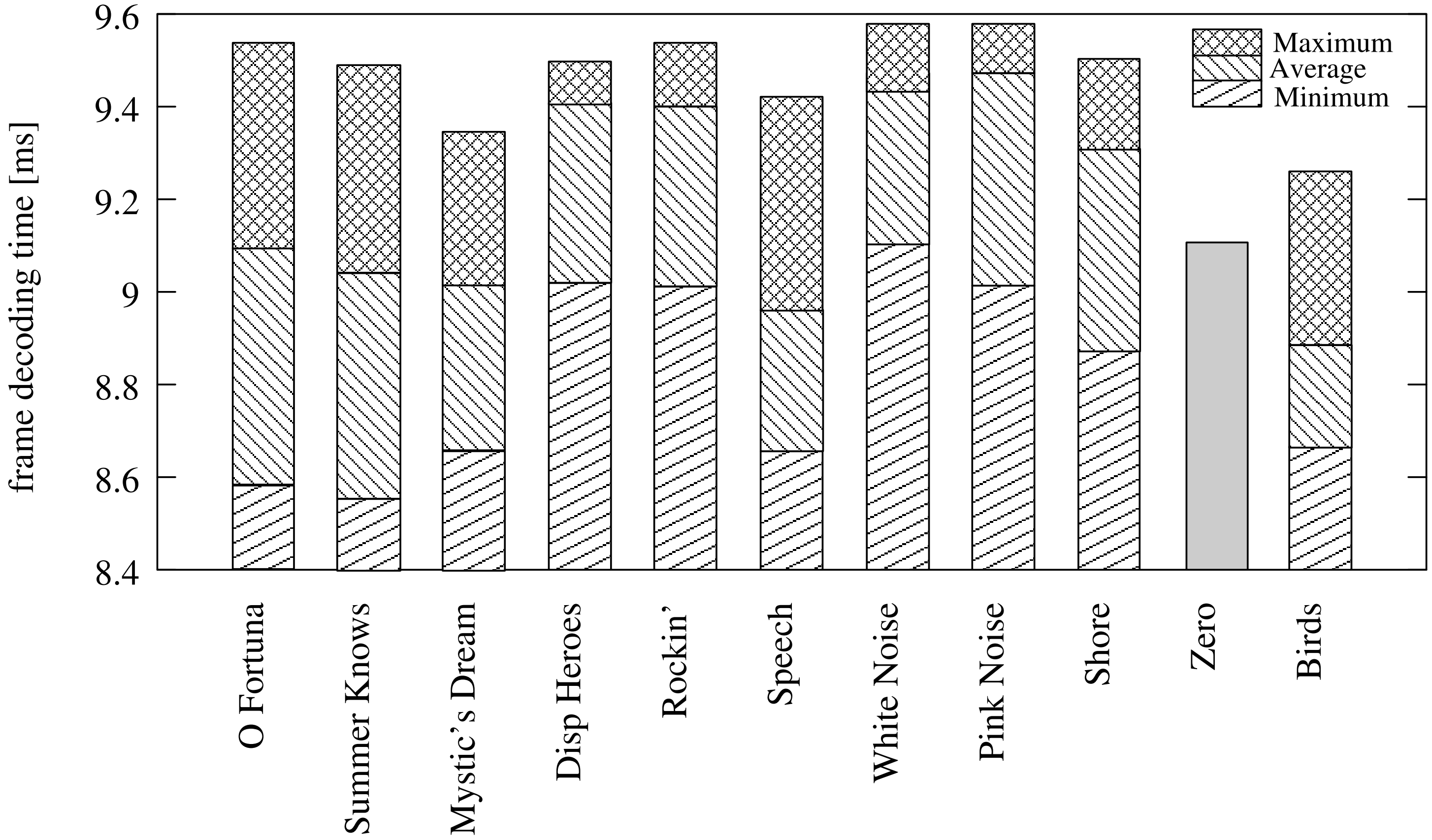
Layer I: Frame Decoding Time



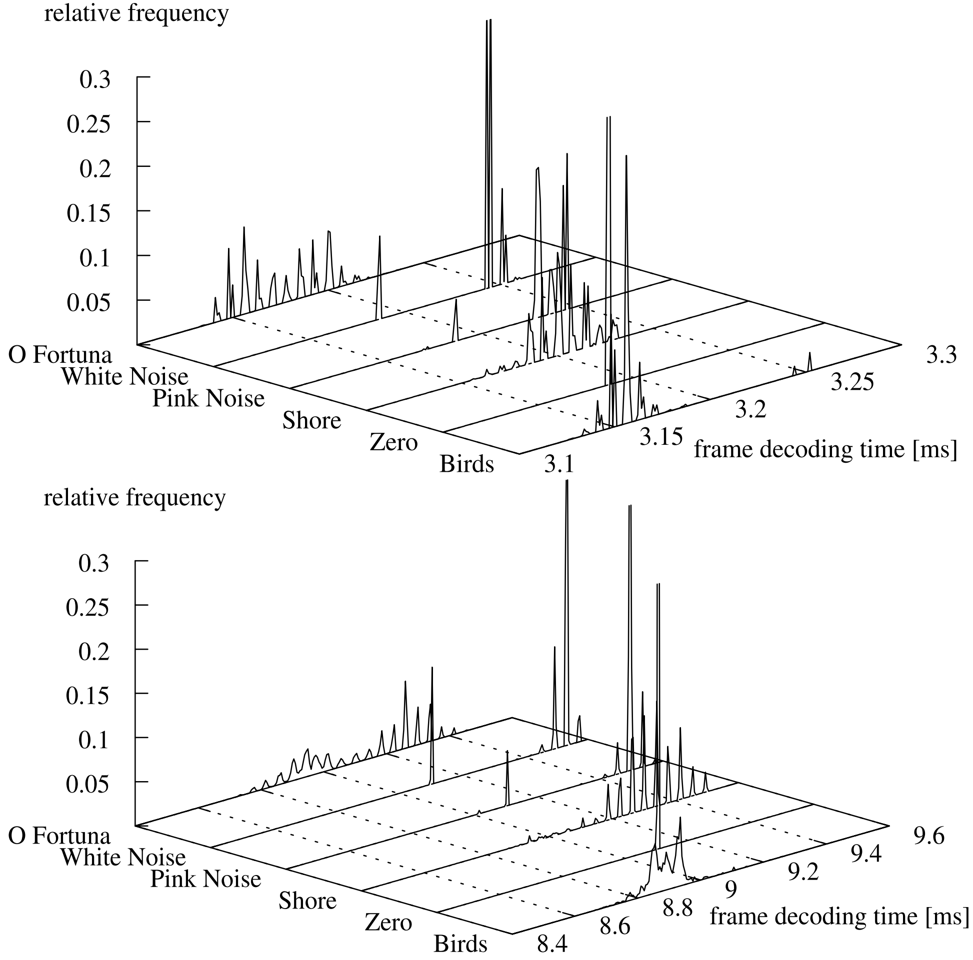
Layer I: Distribution of Frame Decoding Time



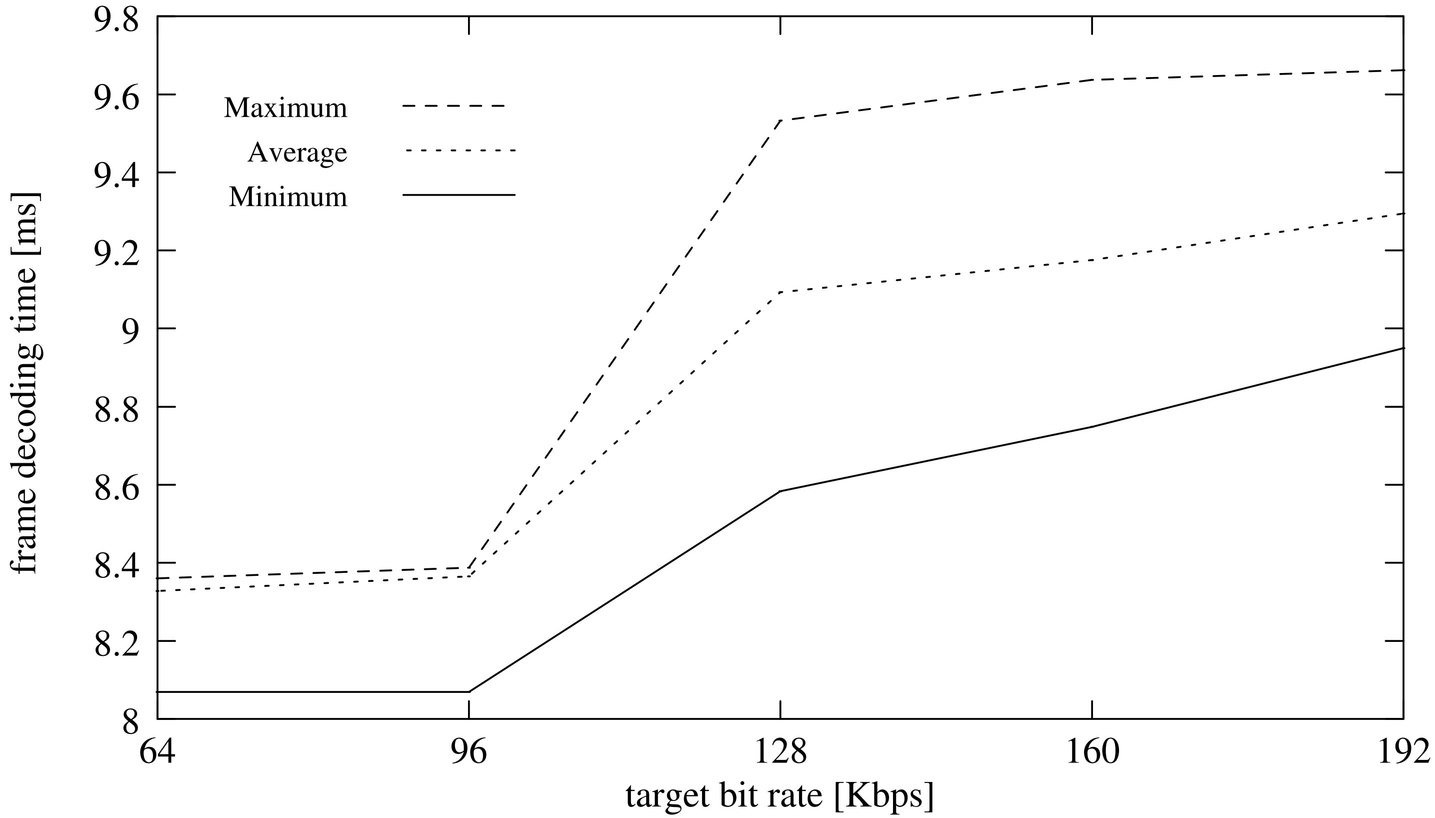
Layer II: Frame Decoding Time



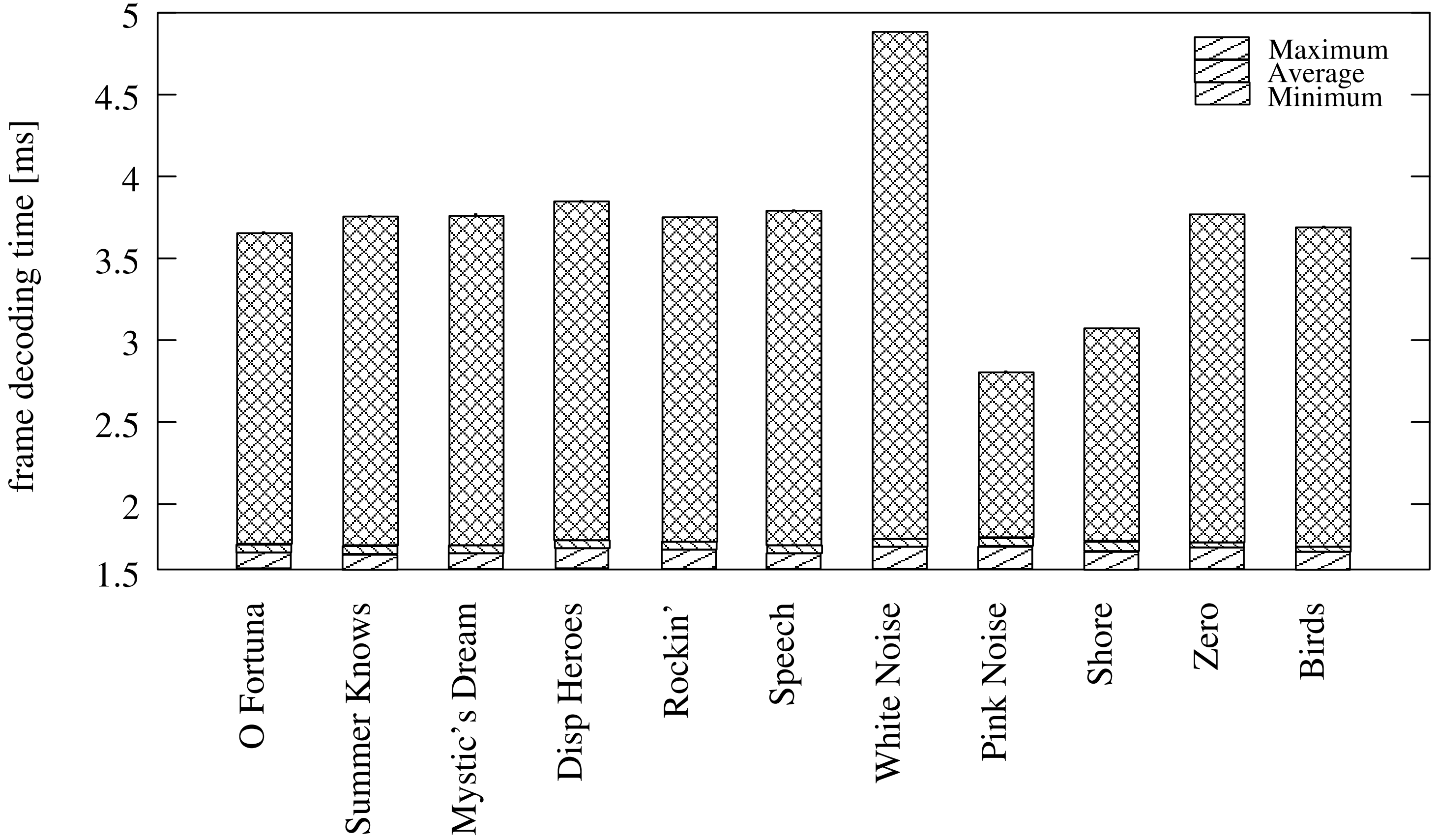
Layer II: Distribution of Frame Decoding Time



Influence of Target Bit Rate



PC Decoder (Layer I)



Conclusions

- Layer I: frame decoding time does not differ significantly between streams
- Variation of Layer II is more significant
- no rule-of-thumb for complexity estimation
- speech does not differ significantly from music
- maximum frame decoding time as decoder deadline: save up to 65% DSP processing time
- parallel DMA processes do not influence execution timing
- variation of frame decoding time on GPP (Intel Pentium) much higher

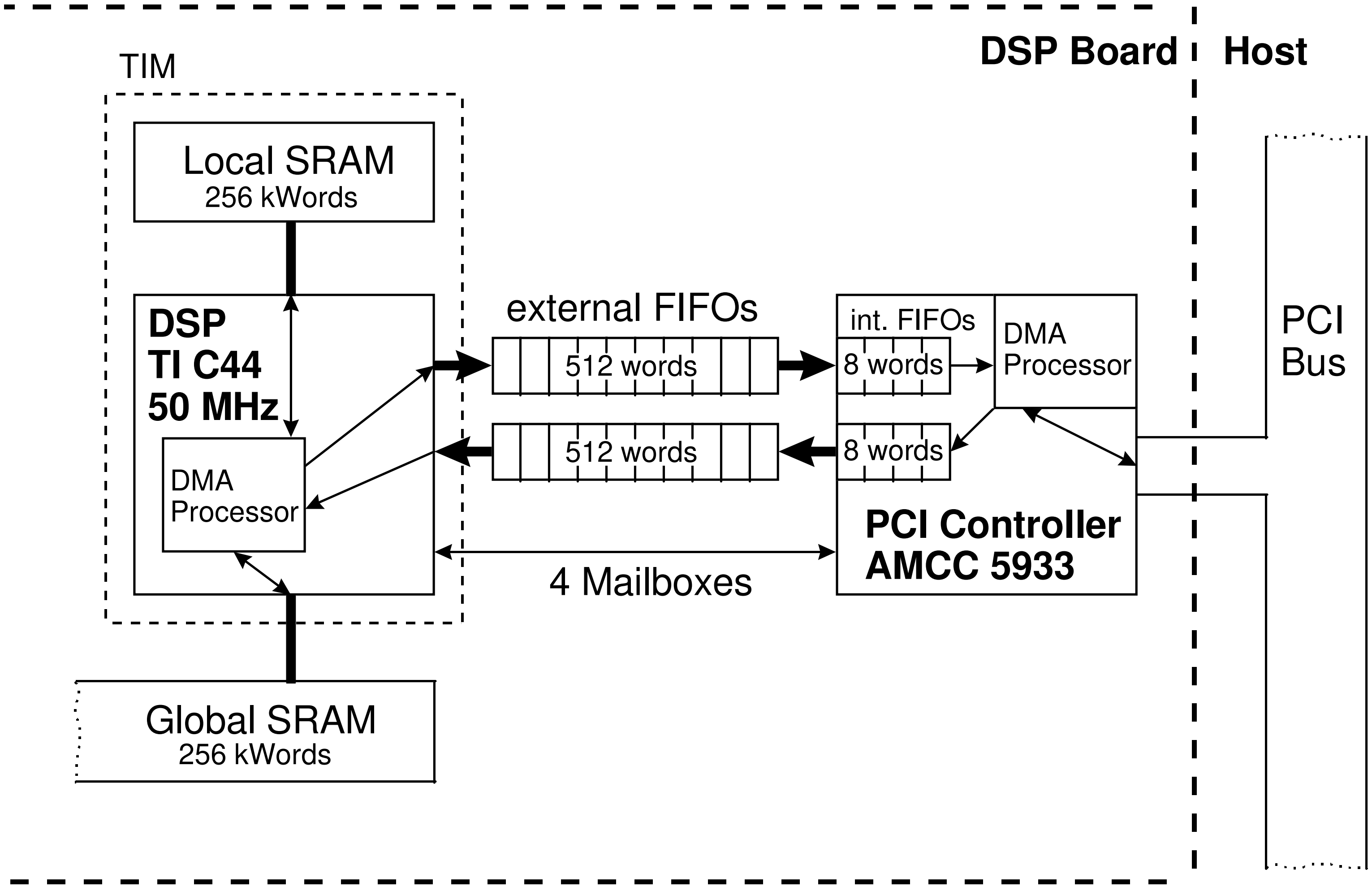
Outlook

- completion of SPROS Kernel
- Host OS: Linux ➛ Microkernel

Universal Multimedia Accelerator for PCs

http://www.inf.tu-dresden.de/~rb2/work.html

Hardware Configuration



- Pentium Pro 200
- 64 MB RAM
- Chipset: Natoma
- PCI

- Linux