The EMU10K1 Digital Audio Processor

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PC Audio Subsystem

Host Memory

Driver / API

Applications
Music/Games

EMU10K1

Audio
CODEC

PCI

S/PDIF
The EMU10K1

- Stream Transport and Virtual Memory Manager
- Effects Engine
- 64 Channel WT Synth
- Audio Receivers
- PCI
- S/PDIF
- I²S
- AC97
Virtual Memory Stream Manager

- PCI Bus Master
- True Virtual Memory
- Hardware accesses copy of page table
- Mapping same as in Intel chipset
- All audio dynamically mapped into single logical memory space
- Logical-to-physical translation done inside chip with translation lookaside hardware
The EMU10K1 Wavetable Synth

Format Select: 8/16 bit Mono/Stereo

8 point Interpolating Oscillator

2nd Order Digital Filter

Hardware Envelopes and LFO’s
A Wavetable Synthesis Oscillator

- Loop Start
- Loop End
- Loop during Sustain/Release

- Attack
- Decay
- Sustain/Release
Digital Mixing Fundamentals

IN1 → SRC → * → OUT
IN2 → SRC → * → OUT
IN3 → SRC → * → OUT
INn → SRC → * → OUT
Interpolating Audio

- Consider an Analog Audio Waveform
Interpolating Audio

• The simplest solution - take nearest sample
Interpolating Audio

- Unfortunately, this creates a lot of distortion:
Interpolating Audio

- Linear Interpolation is obvious alternative:
Interpolating Audio

• Linear interpolation still a significant source of distortion:
Interpolating Audio

- “Ideal” interpolation needs complex math
  - More than 380 MIPS for a 20 bit stereo signal
- “Perceptual” approach (like AC-3) needed
  - E-mu patented technology
  - Perceptually based 8th order interpolation
  - Produces professional fidelity at modest cost
Interpolating Audio

- E-mu 8th order interpolation error:
Asynchronous Digital Audio Receivers

Multiple Independent Clocks

EMU10K1

Sample Rate Detector / Converter

Sample Rate Detector / Converter
EMU10K1 Audio Receivers

- Sample Rate Detectors
  - Determine true realtime incoming sample rate
  - Fast locking (typ. 300 ms)
  - Patent applied for

- Sample Rate Conversion to Local Rate
  - Very high order (16 point) interpolators
  - 20 bits of fidelity maintained
Digital Audio Recording

- PCI bus master DMA
- Stereo Down-Samplers to lower rates
  - 8, 11, 16, 22, 24, 32, 44.1, and 48 kHz
  - Very high order (64 point) interpolators
- Multi-channel interleaved record
  - Up to 32 channels
EMU10K1 Summary

- PC Audio Subsystem
- PCI Bus Master
- Digital Mixer
- Hardware Wavetable Synthesizer
- Powerful Audio DSP
- Asynchronous Digital Audio Receivers
- Digital Audio Recorder