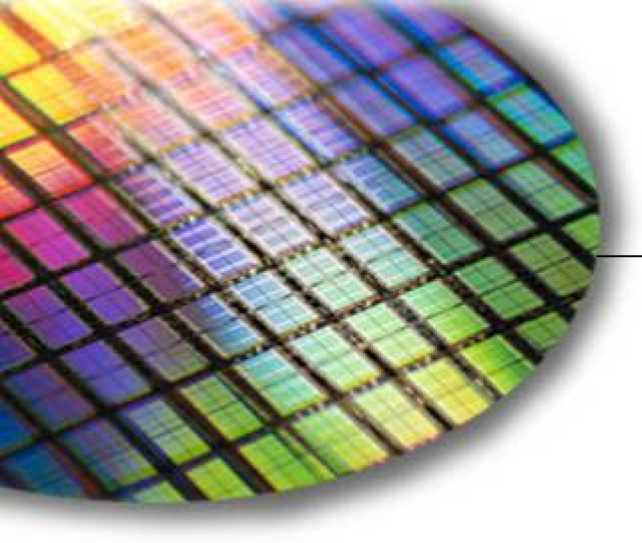

The World Leader in High Performance Signal Processing Solutions

Introduction to VisualAudio

Presented by:
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Analog Devices CPSG

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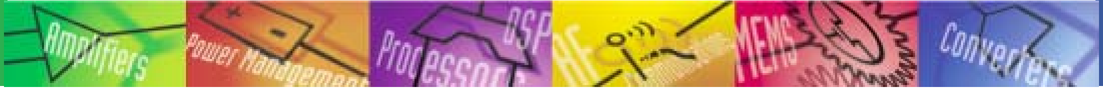
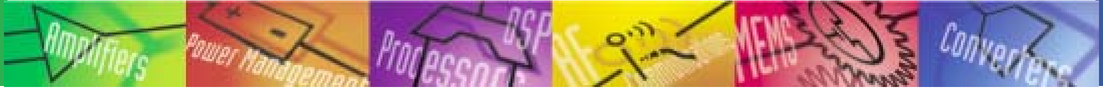


About this Module

- This module gives an overview of VisualAudio, a tool for rapid development of audio processing software. Examples and demonstrations will be based on the ADSP-BF533 EZ-KIT. You will learn about:
  - The primary features of VisualAudio and how the tool can accelerate product development
  - How to design audio processing layouts using the graphical editor
  - The underlying DSP software architecture
- Target Audience
  - Embedded product developers
  - Some experience with audio
  - Some familiarity with Blackfin processors and the VisualDSP++ development environment
- A separate module – aimed specifically at audio algorithm developers - discusses VisualAudio's advanced features in more detail



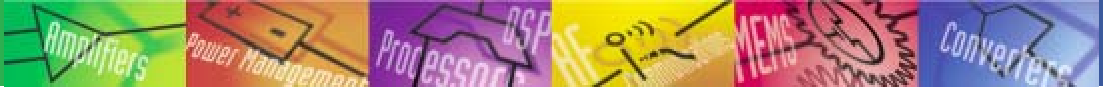
Module Outline

- VisualAudio Overview
- Live Demonstration
- DSP Software Architecture
  - Relationship to VisualDSP++
  - The audio module library
  - Real-time platforms
- Conclusion

VisualAudio Overview

What Is VisualAudio?

- A tool for streamlining audio product development
- Consists of:
  - The VisualAudio Designer - graphical audio processing design application
  - Audio Module Library - commonly used audio functions
  - Example Platforms - real-time frameworks with audio I/O
- Designed for product development engineers
- Provides most of the standard software components found in audio products
- Generates MIPs and memory optimized code



Supports Both Blackfin and SHARC Processor Families from ADI

- **Blackfin**
  - 2x16-bit SIMD fixed-point DSP (VisualAudio uses 32-bit fixed-point for all audio)
  - Rich set of microcontroller features
  - Full external memory interface
- **SHARC**
  - 32-bit floating-point DSP with SIMD capabilities
  - External memory support varies among processor versions
- **Both architectures come in a variety of models with integrated audio peripherals**
  - Serial ports
  - S/PDIF transceiver
  - Hardware sampling rate converters
- **Both processor families are supported by similar platforms, and complementary sets of audio modules and decoders.**

Blackfin vs. SHARC Selection Guide

- The SHARC is ideal for products whose primary function is audio or if there is a significant amount of audio processing
  - Audio/video receivers
  - Professional audio systems
  - High-end automotive audio systems

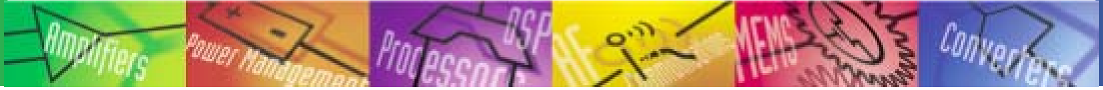
- The Blackfin is ideal for products that have functions in addition to audio
  - Portable media players
  - Automotive head units & telematics
  - Networked media nodes
  - Mass market pro audio
  - Mid-end automotive amplifiers

- As a rule of thumb, the SHARC is 3 to 4 times as efficient as the Blackfin in processing audio, per MIP

EZ-KIT Evaluation Hardware Supported by VisualAudio

- ADSP-21262 EZ-KIT
  - 2-in 8-out analog I/O
  - 1 S/PDIF input
- ADSP-21364 EZ-KIT
  - 2-in 8-out analog I/O
  - S/PDIF input and output
- ADSP-21369 EZ-KIT
  - 2-in 8-out analog I/O
  - S/PDIF input
- Audio extender card is coming soon which provides 8-in and 16-out analog I/O

- ADSP-BF533 EZ-KIT
  - 4-in 6-out analog I/O
- ADSP-BF537 EZ-KIT
  - 2-in 2-out analog I/O
- ADSP-BF537 EZ-KIT with audio extender card
  - 8-in 16-out analog I/O
  - S/PDIF input and output



Key Benefits

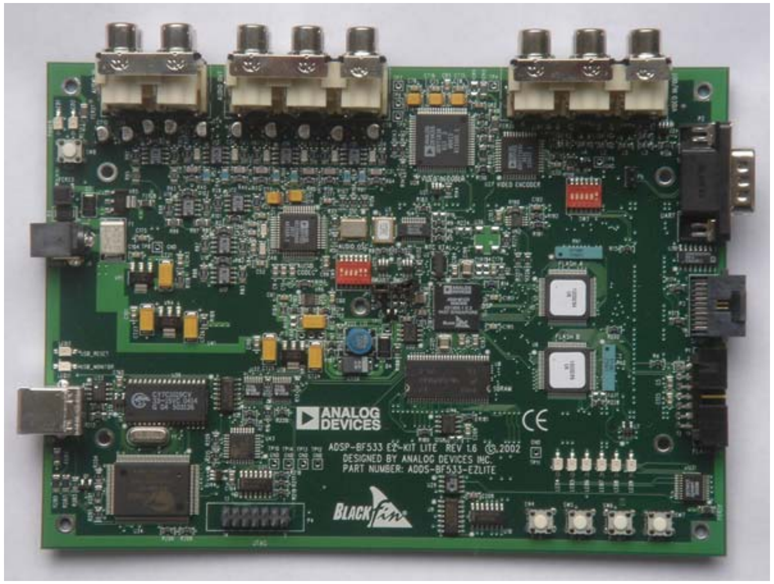
- For product developers
  - Provides a starting point and methodology for audio product development
  - Reduces development time, cost, and risk
  - Allows engineers to focus on *differentiating* their products rather than implementing standard features
  - Provides access to audio IP in a consistent format
- For IP developers
  - Streamlines IP development
  - Serves as a demonstration platform
  - Provides a consistent format to deliver audio IP

Live Demo

- Creating a New System
- Designing the Layout
- Generating Code
- Building the Executable
- Real-time Tuning

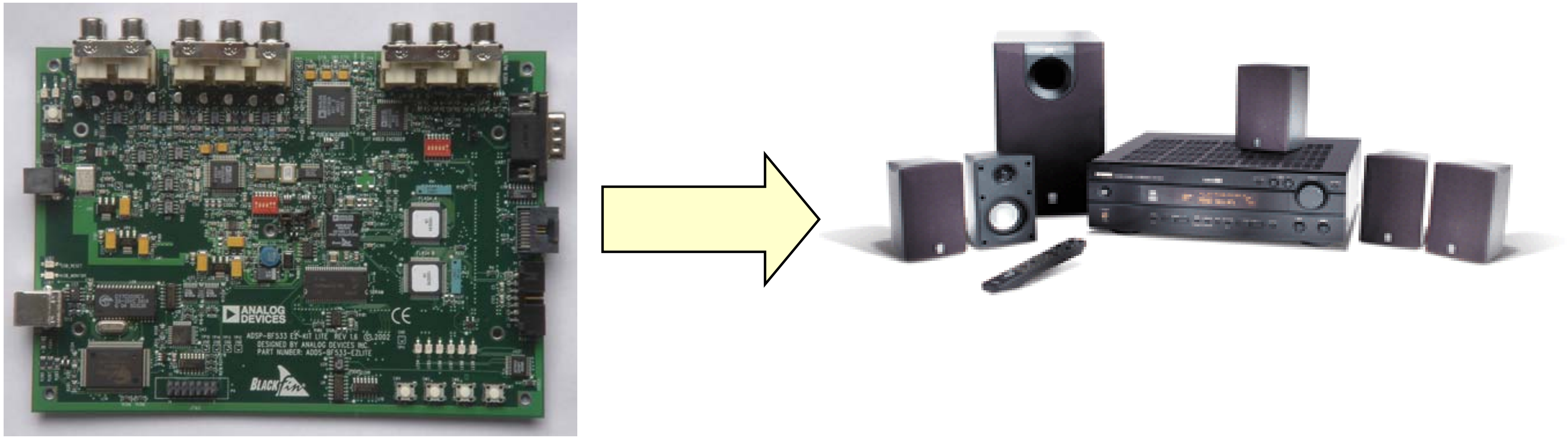
Demo Overview

- **Hardware Setup**
  - BF533 EZ-KIT
  - HPUSB emulator (recommended, but you can use the built-in USB emulator)
  - Line-level audio source
  - Powered speakers
- **Software Setup**
  - VisualAudio
  - VisualDSP++
- **Steps**
  - Create an audio processing design using the graphical editor
  - Generate code
  - Build and run the executable on the EZ-KIT
  - Tune the system in real-time


ANALOG DEVICES
ADSP-BF533 EZ-KIT LITE REV 1.6 ©2002
DESIGNED BY ANALOG DEVICES INC.
PART NUMBER: ADDS-BF533-EZLITE
BLACKfin

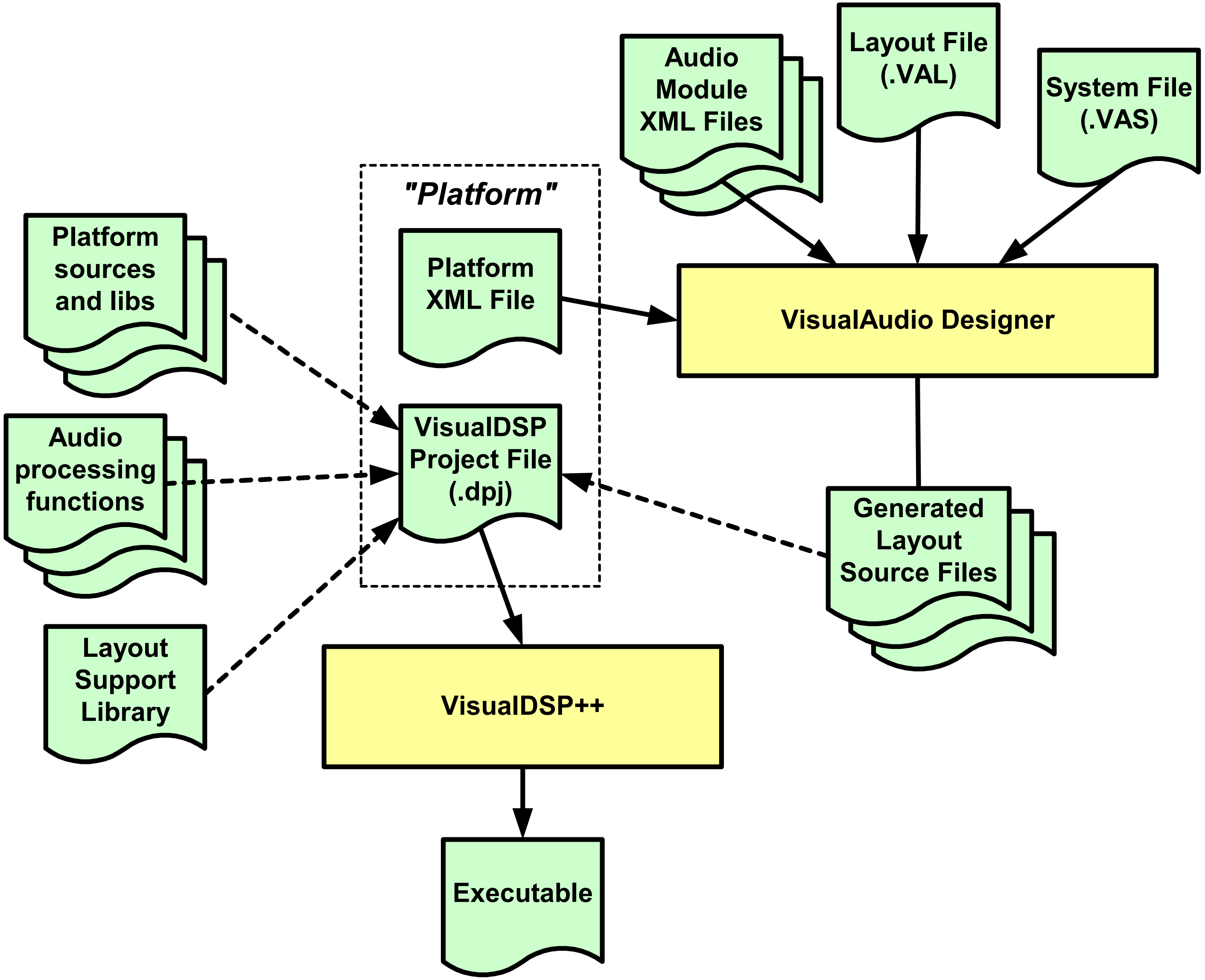
Migrate to Your Target Hardware

- Begin with a reference platform – source code provided
- Write drivers for your target hardware
- Create a platform file that describes your hardware to VisualAudio
- Continue to use VisualAudio on your target hardware



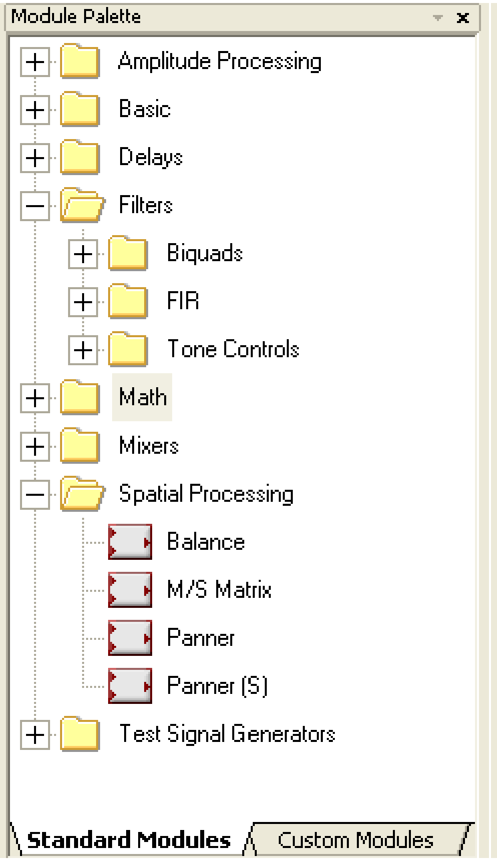
DSP Software Architecture

VisualAudio and VisualDSP++



Audio Module Library

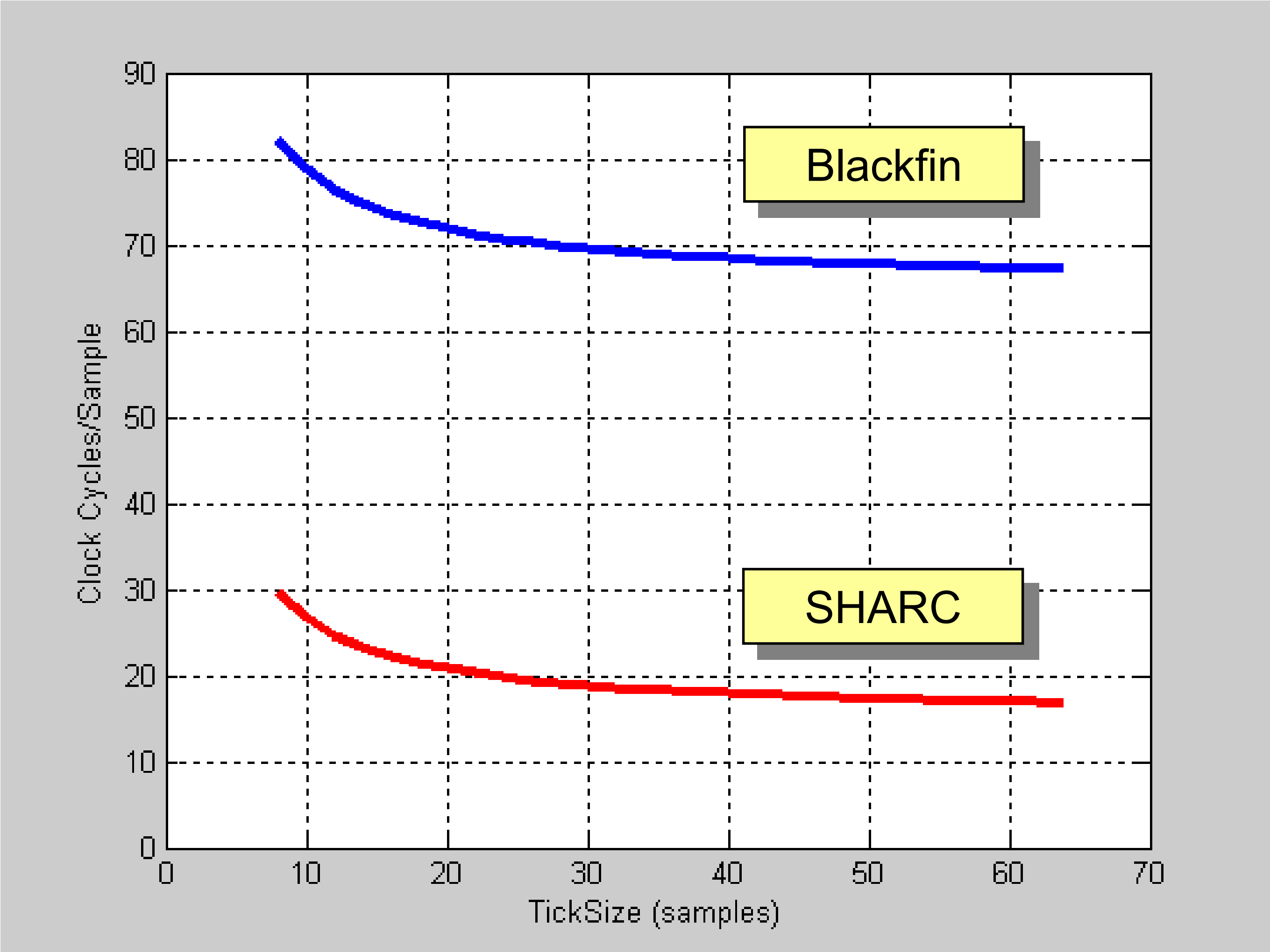
- Subroutines for processing PCM audio
- 89/(94) “standard” modules provided in the current Blackfin/(SHARC) release:
  - Mixers
  - Filters
  - Delays
  - Tone controls
  - Basic math
  - Faders / balance
  - Volume controls
  - Compressor
  - Limiter
  - Etc
- Optimized for SIMD execution
- Some have separate versions for mono and stereo inputs
- Source code provided
- Customers can write their own modules as well



Block Processing

- Each audio module operates on a block of data – rather than sample-by-sample
- The number of samples per block is fixed and is called the “TickSize”
- All modules operate at the same TickSize.
- The TickSize is adjustable through the User Interface
- Block processing is a natural fit for audio decoders which output blocks of data (e.g., Dolby Digital outputs 256 sample blocks)
- Block processing yields an efficient implementation

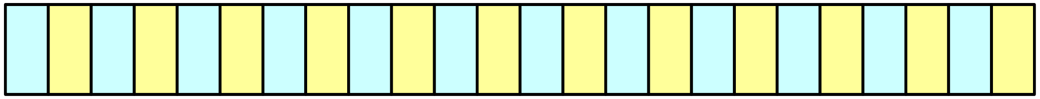
Example Computation
10th order IIR filter



Audio Module Interconnections / Wires

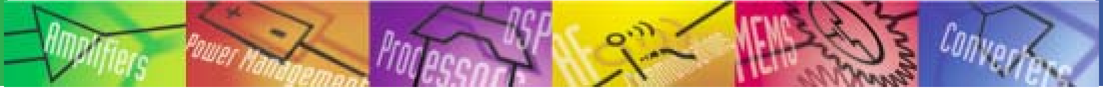
- Mono wires contain TickSize audio samples

- Stereo wires hold interleaved data and contain 2*TickSize audio samples



- Control wires contain a single value

- 4 frequency domain wire types
  - Real half spectrum
  - Complex half spectrum
  - Real full spectrum
  - Complex full spectrum

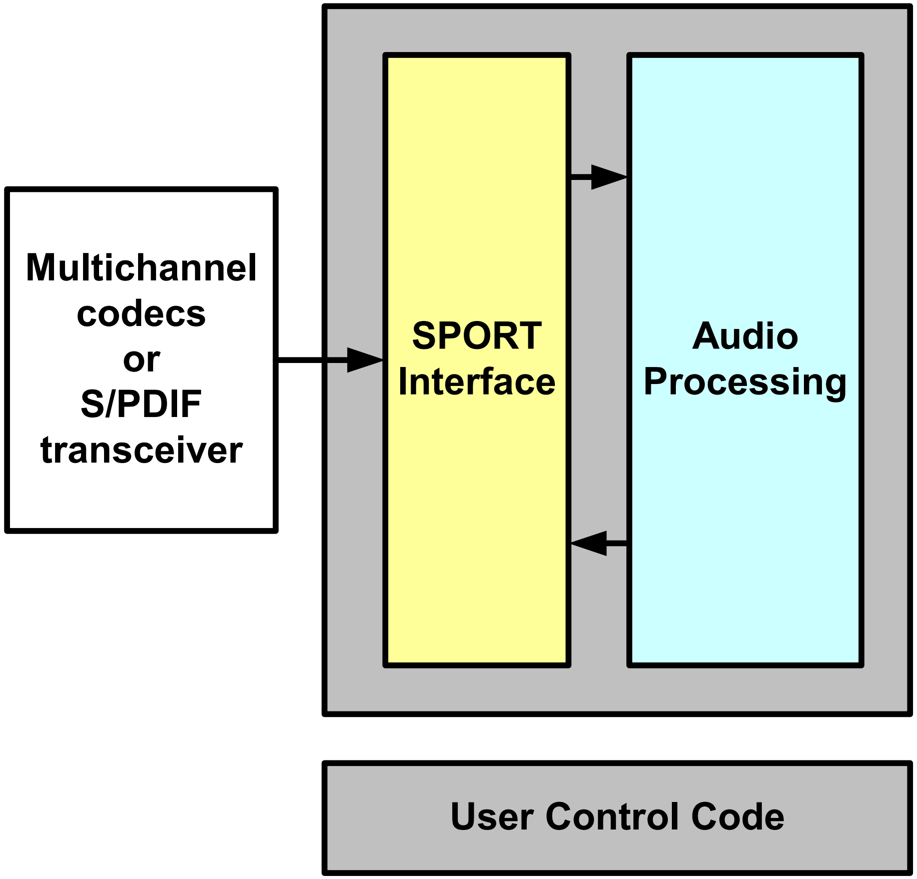


VisualAudio Platforms

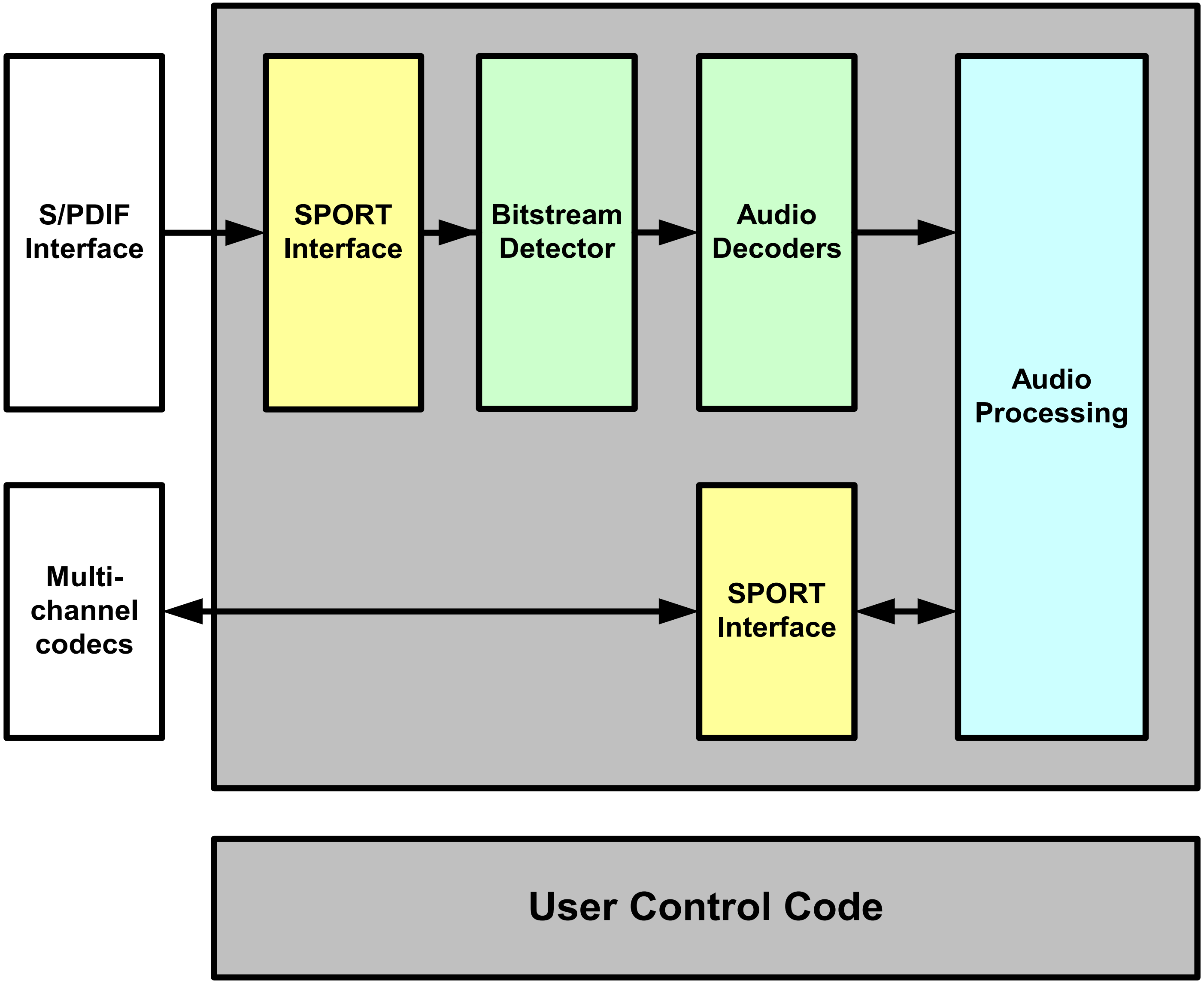
- Lightweight interrupt driven real-time frameworks
- Platforms provide
  - Double-buffered DMA-driven audio I/O
  - An interface to VisualAudio generated audio processing
  - A separate non-real-time control thread
  - Tuning
  - Communication with a host micro-controller (if any)
- Several application-specific variants
  - “Basic” - General purpose, PCM I/O
  - AVR (for home theater products with decoders)
  - Automotive

"Basic" Platform

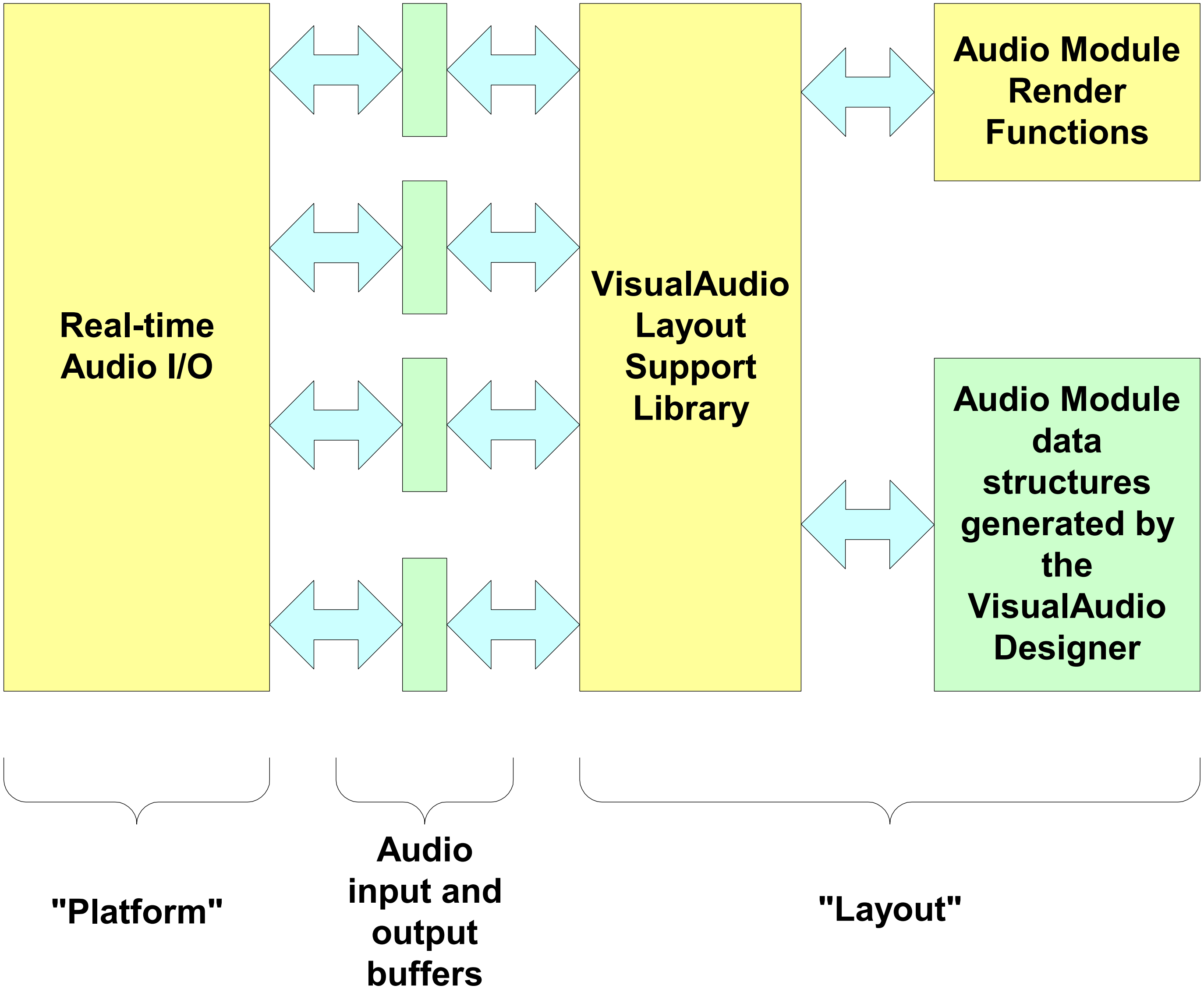
- Targeted at PCM-based audio products without decoders
- Platform divided into
  - A common core framework
  - Platform specific drivers
- Double-buffered DMA-driven block-based audio I/O
- Layout executes at interrupt level
- Tuning, host communication and user control code execute at non-interrupt level



“AVR” Platform



Platform / Layout Interface



Conclusion

- VisualAudio accelerates the development of embedded audio applications
- An intuitive graphical user interface allows audio processing to be easily designed and configured
- Supports both the Blackfin and SHARC families of processors and many different EZ-KIT development platforms
- Generates efficient code

- A separate training module covers the VisualAudio environment in more depth
  - Advanced user interface features
  - Writing custom audio modules
  - Interfacing to external design applications

For Additional Information

- A free download is available at the VisualAudio product page
  - http://www.analog.com/en/prod/0,2877,VISUALAUDIO,00.html
- Additional examples and tutorials can be found at the VisualAudio Developer’s Web site:
  - www.visualaudiodeveloper.com
- Specific technical questions can be sent to:
  - visualaudio.support@analog.com
- Click the “Ask A Question” button