cādence®

Tensilica HiFi DSP Family

Configurable processors for audio, voice, and speech processing

Today's audio, voice, and speech processing applications challenge designers to manage a wide breadth of performance and power requirements to create compelling, interactive, and immersive experiences for their customers. The Cadence® Tensilica® HiFi DSP Family for Audio, Voice, and Speech offers a low-energy, high-performance, highly optimized DSP solution that spans the entire spectrum of audio and voice algorithms and end equipment.

Overview

Audio/voice/speech (AVS) processing covers a very wide range of performance- and power-consumption requirements. On one end of the spectrum is the ultra-low-power "wake-on-voice" processing found in many of today's smartphones and wearables. On the other end, building state-of-the-art voice-controlled digital assistants requires advanced audio digital signal processing capabilities to efficiently run neural network-based speech recognition. At the heart of these new AVS innovations is the desire of OEMs to create more compelling, interactive, and immersive experiences with their devices.

Using different processor architectures to handle the breadth of applications in the AVS domain would be very costly in terms of software development and product management. The Tensilica HiFi DSP family for audio, voice, and speech addresses this broad range of requirements, offering low-energy, high-performance processing for the entire spectrum of audio- and voice-processing algorithms and end equipment while maintaining software compatibility across the portfolio.
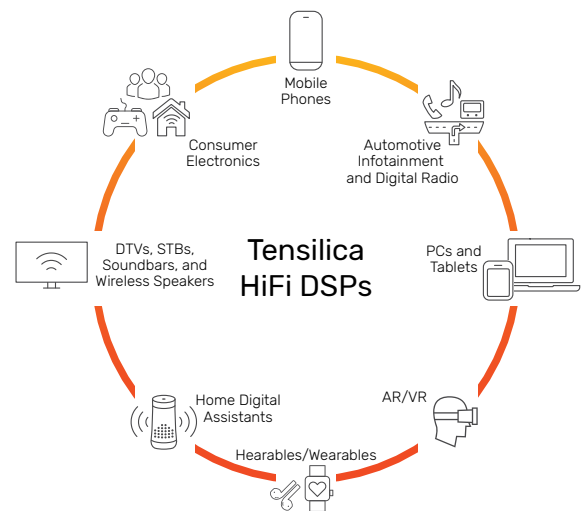

Figure 1: Tensilica HiFi DSP Audio and Voice Applications

HiFi DSPs can be found in SoCs across all major markets including mobile, hearables, wearables, automotive, home audio, television, computing, and gaming (see Figure 1).

Whether you are optimizing to increase battery life, save thermal power, or save costs, there is a compelling HiFi DSP that meets your audio requirements.

With over 125 licensees, over 160 partners, and hundreds of software packages and growing, the HiFi DSP instruction set architecture (ISA) is the #1 DSP architecture for SoC designers.

Tensilica HiFi DSP Family

▸ HiFi 1 DSP – Ultra-low energy for always-listening voice trigger, always-on sensor processing, and Bluetooth codecs including LC3 for true wireless stereo (TWS), hearables, wearables, IoT, PC/laptop, and mobile devices.

▸ HiFi 3 DSP – Optimal balance between energy efficiency and performance for a broad range of applications in mobile, hearables, home, and automotive applications.

▸ HiFi 3z DSP – Highest energy efficiency for super-wideband voice codecs, object audio, and neural network-based voice UI, making it an excellent choice for mobile devices.

▸ HiFi 4 DSP – Elevated performance for high-quality pre- and post-processing, object audio, and neural network-based ASR. Application areas include TWS, smart speakers, DTV, and digital assistants.

▸ HiFi 5 DSP – Performance leader melding AI acceleration with stepped-up DSP capability for the highest quality, feature-rich audio and speech. Ideal for wearables, automotive, home entertainment, digital assistants, and neural network-based ASR.

Low-Power, High-Performance Audio and Voice DSPs

The Tensilica HiFi DSP ISA is highly optimized for AVS applications. By optimizing more than 200 software packages, the HiFi ISA provides the lowest energy, highest performance DSPs for audio and voice. This performance scales across the entire DSP product family, from the ultra-low-power dual 32x16 HiFi 1 DSP, to the energy-efficient 32x16 quad MAC HiFi 3 DSP, to the high-performance 32x32 octa MAC HiFi 5 DSP.

Tensilica HiFi DSP Family Specifications

Features		HiFi 1	HiFi 3	HiFi 3z	HiFi 4	HiFi 5
VLIW Slots		2	3	3	4	5
Fixed-Point MACs per Cycle	32x32	1	2	2	4	8
	32x16	2	4	4	up to 8	16
	16x16	4	4	up to 8	up to 8	16
Accumulator		64-bit	64-bit	64-bit	64/72-bit	64/72-bit
FPU (optional)		Integrated 2-way SIMD Vector FPU (VFPU)	Integrated 2-way SIMD VFPU	Integrated 2-way SIMD VFPU	2 integrated 2-way SIMD VFPU	2 integrated 4-way SIMD VFPU
ITU Intrinsic Support		Yes				
Circular Buffer Support		1	1	1	2	3
Bitstream VLE/VLD Support		VLD	Yes	Yes	Yes	Yes
User-defined instructions		Yes	Yes	Yes	Yes	Yes
Additional features		Special NN acceleration ISA				32 MACs/cycle NN MACs (optional) half-precision FPU

Audio and Voice Software and Ecosystem

OEMs continue to look to AVS as a means to differentiate their products and provide a compelling user experience, adding features such as voice trigger and advanced voice recognition to their products. In the home audio and voice market, this could mean supporting the latest object-based audio decoder or the latest 3-D and AR/VR positional audio post-processing suites.

By choosing Cadence's Tensilica HiFi DSP family, SoC designers can ensure that the broadest set of codecs and pre-/post-processing software is immediately available to their customers. Currently more than 300 different software packages are available as part of the largest audio and voice ecosystem of any DSP in the market. This means that all of the newest and most innovative audio and voice IP are always available with HiFi DSPs.

Flexibility

The Tensilica HiFi DSPs are highly configurable, giving the SoC designer control of numerous pre-defined functions and features, including the memory subsystem, debug, floating point, and many others.

In addition to configuration options, the SoC designer can choose to further improve performance and reduce energy for any given application by adding custom instructions and more I/O bandwidth. This is possible because all HiFi DSPs
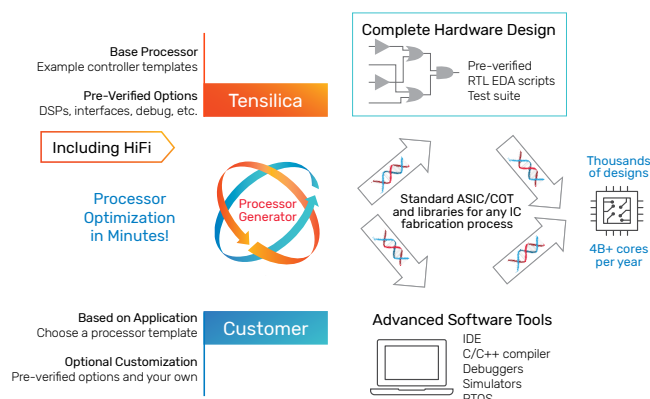

Figure 2: Tensilica Processor Development Flow

are based upon the Cadence Tensilica Processor Generator, which allows designers to add value through additional customization while retaining complete compatability with the HiFi software ecosystem (see Figure 2).

Ease of Programming

A key advantage of the Tensilica HiFi DSPs is their simple programming model. Software developers can write audio and voice applications completely in C using efficient and optimized audio and voice APIs, matching or surpassing the performance of the same applications built with hand-code assembly.

Additionally, Cadence offers comprehensive highly optimized DSP and AI libraries that dramatically speed up the development of very efficient algorithms.

At the system level, Cadence offers XAF, a framework that allows customers to easily create and execute a variety of audio and AI processing chains on HiFi DSPs. The framework offers a very simple API for integrating audio components and modules and includes support for RTOS (Cadence XOS or FreeRTOS).

Customers can also leverage Audio Weaver from DSP Concepts. Audio Weaver is a drag-and-drop graphical UI with real-time tuning and debugging capabilities that enables users to create, tune, and productize their audio and voice processing features quickly and effortlessly.

Cadence Services and Support

▸ Cadence Tensilica application engineers can answer your technical questions and provide technical assistance and custom training.

▸ Cadence-certified instructors teach a series of courses on Tensilica IP and bring their real-world experience into the classroom.

▸ Internet Learning Series (iLS) online courses allow you the flexibility of training at your own computer via the Internet.

▸ The Cadence Tensilica IP support site gives you 24x7 online access to a knowledgebase of the latest solutions, technical documentation, software downloads, and more at ip.cadence.com/support.

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