

**Paras Khara,**  
Marketing manager,  
Sitara™ processors

**Adnan Nishat,**  
Senior product manager,  
Embedded connectivity solutions  
Texas Instruments

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# Complete solutions for next-generation wireless connected audio

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## Overview

More consumers are streaming music than ever before – from their smartphones, laptops, tablet computers and other devices to a variety of wirelessly connected audio devices, like portable speakers, connectivity modules, soundbars or audio/video receivers (AVRs). Plus, there's a new openness to streaming technology as designers of the connected audio devices are able to tap into the streaming capabilities of practically any streaming client device from any manufacturer. Consumers are tuning in to new capabilities, like the ability to easily stream music from a phone or tablet while still browsing the Internet. No longer does one exclude the other.

Suppliers of connected audio devices who want to take advantage of this rapidly advancing and expanding marketplace are turning to Texas Instruments (TI) to find what they need:

- Scalable processing solutions that run the gamut of connected device types, from the simplest portable speakers to high-end AVRs.

(continued)

- Robust, feature-rich and high-performance connectivity technology for Wi-Fi® and Bluetooth®.
- Versatile interoperability for connecting to any streaming client.
- Reference designs, development tools and dependable support that accelerate time-to-market.

## Capitalizing on the possibilities

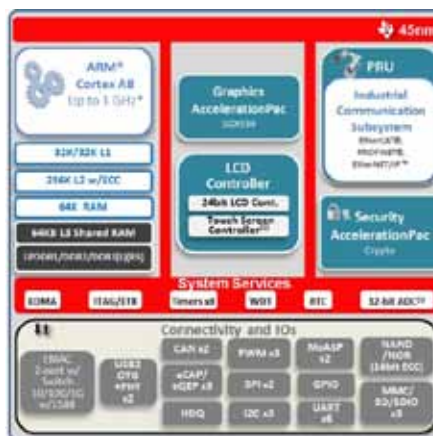
Convenience and ease of use have ignited consumer interest in connected audio devices. Designers are capitalizing on this demand by incorporating new features and capabilities that meet the requirements of users who grow more discerning every day. The ubiquity of Wi-Fi access points and Bluetooth-enabled phones and tablets have seeded the opportunity for the wireless connected audio marketplace. Today, a new generation of more powerful, more capable and exceedingly robust processing and connectivity technologies are spurring another wave of growth.

## Powerful and scalable processor options

To a large extent, the previous generation of connected audio devices has run out of steam. Based largely on ARM9™ cores, processing limitations often hinder the capabilities of legacy connected audio systems. New ARM® Cortex®-A8- and Cortex-A9-based processors like TI's Sitara™ AM335x processor give designers far more powerful solutions, which, additionally, can be closely coupled with a digital signal processor (DSP) when high-end audio processing and top-notch sound quality is required.

As shown in Figure 1 on the following page, TI's Sitara AM335x processor is based on an ARM Cortex-A8 core that's scalable from 300 MHz to 1 GHz. To enable fast development of connected audio devices, the AM335x processor's high-performance capabilities are supported by a full complement of audio-oriented peripherals, including integrated streaming

audio protocol processing for AirPlay, traditional Wi-Fi's DLNA for Windows® and Android™ devices, support for iPod/Android docking devices and others.



**Figure 1: Block diagram of TI's AM335x processor**

To scale upward toward high-end connected audio devices like AVRs and soundbars capable of Dolby 5.1 Surround Sound and other processing-intensive audio algorithms, the Sitara AM335x processor can be readily coupled with TI's Aureus™ high-performance audio DSPs. Together, a Sitara AM335x processor and Aureus DSP deliver unmatched processing capabilities for those demanding sophisticated connected audio applications.

### **Robust, feature-rich and high performance connectivity technology**

In addition to powerful processing, another key requirement of connected audio systems or standalone devices is a robust, feature-rich and high-performance wireless connectivity solution, such as TI's WiLink™ 8 family, the eighth-generation Wi-Fi and Bluetooth combo offering from TI. The WiLink 8 product offering consists of FCC/IC, ETSI/CE and TELEC-certified modules that minimize the required RF expertise and save customers as much as \$50,000 of test cost and test time. It also includes fully validated, mature and stable Wi-Fi driver that is tested extensively for interoperability with numerous commercially available Wi-Fi access points. It also includes a Bluetooth SIG-certified stack that supports many profiles and is tested for interoperability with hundreds of commercially available phones, accessories and other Bluetooth-enabled devices. The vast interoperability and maturity of the WiLink 8 combo solution ensures that wireless speakers and other connected audio devices will be able to receive an audio stream from practically any streaming device.

The WiLink 8 solution's robust Wi-Fi/Bluetooth coexistence capabilities allow products to combine the best of both Wi-Fi and Bluetooth. For example, Bluetooth low energy might be deployed as the interface for remote control while Wi-Fi functions as the channel for streaming audio.

Antenna diversity and 2.4 GHz and 5 GHz dual-band wireless connectivity extend the wireless communications range of the WiLink 8 module and allow it to maintain connectivity even in the most congested RF

environments. Wi-Fi's Maximum Ratio Combining (MRC) functionality gives the WiLink 8 solution the versatility and robust connectivity of two antennas when needed. In addition, by supporting 802.11a, it is able to avoid the congested 2.4-GHz spectrum by connecting over the 5-GHz band.

Advanced Wi-Fi capabilities like Wi-Fi Direct with its multi-channel/multi-role functionality give designers the opportunity to tremendously enhance the user experience for their new generation of connected audio devices. For example, a smartphone might be linked to a connected audio device like a wireless speaker via Wi-Fi Direct while the speaker with the WiLink 8 solution maintains connectivity to the Internet. The result is a greatly enhanced user experience. The smartphone streams music to the speaker, and the user is still able to browse the Internet or pull the music the user is streaming from the cloud, all without connecting to the home access point or cellular network.

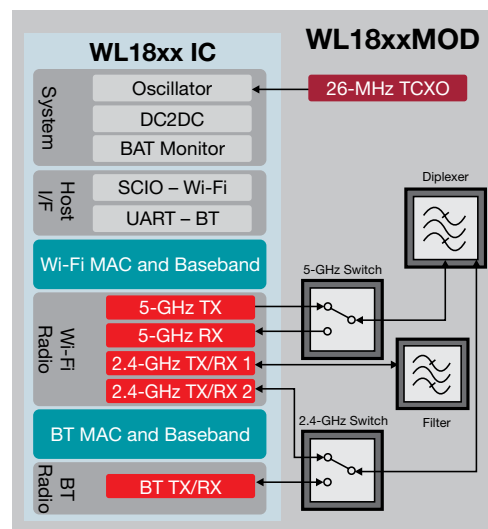


Figure 2: Block diagram of WL18xx (Dual-Band) module

### An integrated solution

Bringing together all of the pieces in a connected audio system design is simplified by the compatibilities integrated into various TI technologies. For example, the interface between the Sitara AM335x processor and WiLink 8 is fully defined and validated. In addition, TI's power management integrated circuits, such as the TPS650250, shorten a new product's time to market by enabling fast and easy development of a power subsystem for the ARM core. Sophisticated power management processes are essential for maintaining high throughput and extended operations in low-power applications such as portable battery-operated devices.

For audio out, low-power codecs like the TLV320AIC3206 with a DirectPath™ headphone amplifier feature extensive register-based control of power, input/output channel configuration, gains, effects, pin-multiplexing and clocks, allowing the device to be precisely targeted to the application.

As shown in Figure 3 on the following page, many of the underlying software modules needed to support such a system have already been integrated by TI. These include all of the software stacks for complete Wi-Fi and Bluetooth connectivity, Linux™ support, Android and various real-time operating systems, a considerable

amount of firmware as well as low-level drivers for an AIC codec, USB and the WiLink 8 module and Sitara AM335x processor. The AM335x processor is also supported by GStreamer, an open-source media framework that supports a variety of audio codecs like FLAC, ACC, MP3 and others. Compatibility with Internet radio services like Spotify, Pandora, Rhapsody and others is also built into the system's software framework.

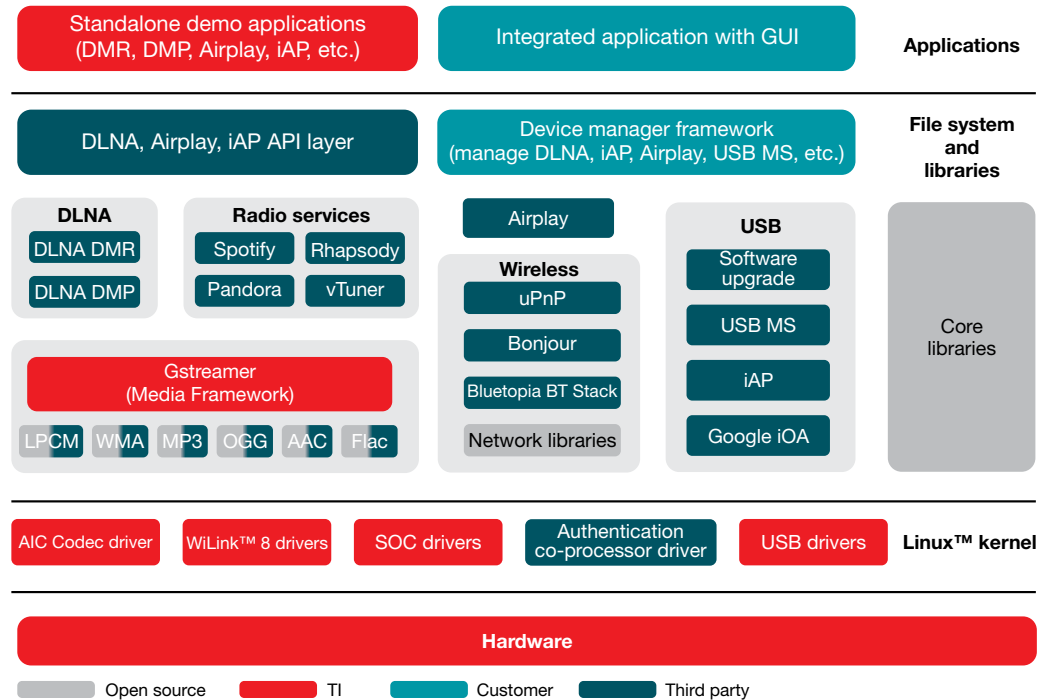


Figure 3: Audio streaming system software

**Conclusions**

Many consumers have discovered the convenience and versatility that wireless connected audio devices and systems have offered. Now, powerful advancements in processing and connectivity technologies, as well as a higher degree of interoperability among connected audio devices and streaming clients is ushering in innovative and exciting possibilities for super-charging the user experience. New, easier and faster connectivity options, improved sound quality, multitasking capabilities and other enhancements will attract the next wave of consumers to the connected audio marketplace and ensure its continued growth.

**For more information** For more information on TI's Sitara AM335x processors, please visit [www.ti.com/pro-arm-audiowp-lp](http://www.ti.com/pro-arm-audiowp-lp)  
For more information on TI's WiLink 8 family, please visit [www.ti.com/pro-arm-audiowp-lp2](http://www.ti.com/pro-arm-audiowp-lp2)  
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For more information on TI's audio codecs, please visit [www.ti.com/pro-arm-audiowp-lp3](http://www.ti.com/pro-arm-audiowp-lp3)

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