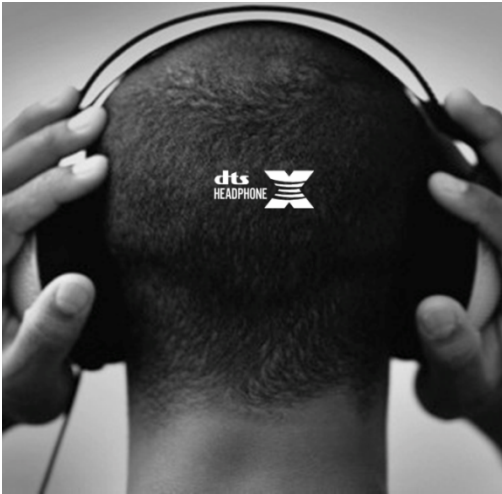


## Mobile Game Developer Overview



### GAMES SOUND BETTER OVER HEADPHONES

The limited performance of mobile device speakers has resulted in a less engaging audio experience for mobile games when compared to a more immersive console experience. DTS believe that headphones give gamers the opportunity to dramatically improve their audio experience, particularly when on the move or in noisy environments. Traditionally though, headphones have presented two problems to game developers;

1. how to recreate a realistic immersive 3D headphone experience, and
2. how to cope with the wide range of audio performance available on headphones ranging from \$10 ear buds to \$500 headphones.

**DTS Headphone:X™** has been designed from the ground up to deliver the best end-to-end headphone experience from the game studio to the consumer's ear. It contains three components that dramatically improve the audio experience over any headphones.

1. Headphone:X contains a highly accurate and customizable 3D audio renderer that provides game developers with increased localization and spatialization. This allows them to deliver the same experience that they get in the mixing studio to the consumer's device.
2. DTS has created a headphone tuning program that allows DTS to optimize the consumer experience for any pair of headphones, ensuring that the consumer gets the best experience possible.
3. Headphone:X allows the consumer to simply modify and save their audio preferences across multiple devices, ensuring they will get a consistent game experience, regardless of the platform.

### FOUR REASONS TO DESIGN FOR HEADPHONE:X

- 1 Hear the game the way you designed it in the studio:** Design in full 3D and know that what you mix in the studio will be reproduced on the mobile device.
- 2 Increase consumer engagement:** A true surround sound experience is known to increase player engagement and, for the right titles, bring a competitive advantage to the player.
- 3 Make the best of the player's headphones:** Headphone:X adjusts the tuning of the player's headphones to get the best out of that device at no cost to the developer.
- 4 Simple to integrate:** All that is required as a game developer is to get creative and design for a multichannel environment. Then simply enable multichannel audio to the device. That's it.

## DESIGNING FOR HEADPHONE:X IN YOUR ANDROID GAME

Headphone:X currently supports devices running Android Kitkat or higher that are powered by the Qualcomm Snapdragon™ family of processors. Headphone:X is designed to run at the device level and so has minimal impact on your audio game pipeline. Integration can be as easy as simply turning on multichannel support in your game.

### Turn on multichannel support

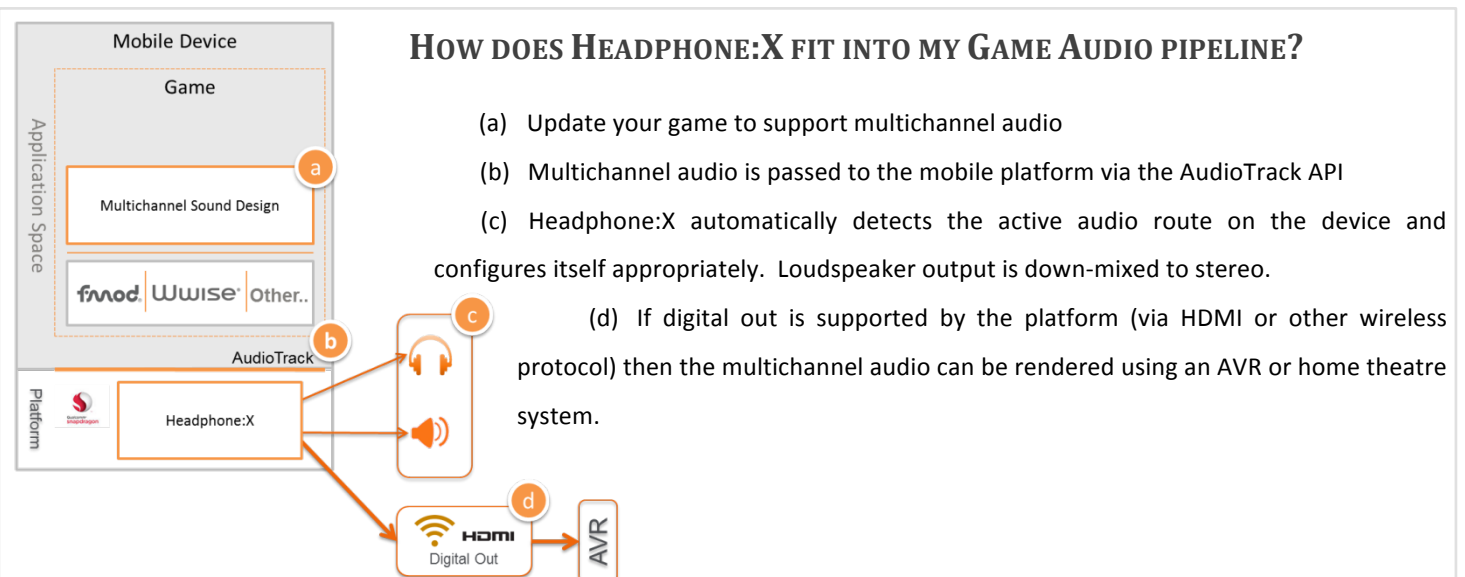
On Headphone:X enabled devices, multichannel audio is transparently transformed into true surround audio over headphones. Since the processing is carried out in hardware, Headphone:X will not significantly impact the processor usage for your game. If the device speakers are in use or the device is connected to an AV receiver, Headphone:X seamlessly takes care of switching between headphones and speakers.

### Get creative with 3D sound design on mobile

For the bulk of 3D-world games, the majority of world-objects can benefit from Headphone:X by a few simple technical changes. However, if you choose to get creative, the new spatial possibilities available with Headphone:X gives you more opportunity to immerse a consumer in your mobile game. Multi-channel assets (such as stereo music) can also be improved by remixing to surround sound. However even if budget or time does not permit remixing your stereo assets, they'll still sound great in Headphone:X.

### Test and Deploy

Today, DTS Headphone:X can be tested by using your current Android device and monitoring the multichannel audio back via an AVR and multichannel speakers. Alternatively, you can monitor the headphone experience directly by using a DTS Headphone:X enabled device or Qualcomm reference platform. Please contact DTS for a list of supported devices and suggested test methodology.



## FAQ

### Enabling Headphone:X in the AudioTrack API

Multichannel audio can be utilized directly in Android API 16 and above using the AudioTrack class in Java. To create a multichannel compatible instance of AudioTrack, initialize it like this:

```
int bufferSize = 48000 /*sample rate*/ * 2
/*sample size*/ * 6 /*channel count*/;
AudioTrack at = new
AudioTrack(AudioManager.STREAM_MUSIC, 48000,
AudioFormat.CHANNEL_OUT_5POINT1,
AudioFormat.ENCODING_PCM_16BIT, bufferSize,
AudioTrack.MODE_STATIC);
```

A 7.1 channel instance can be created using `AudioFormat.CHANNEL_OUT_7POINT1`. Your game should write to the multichannel buffers by placing the content in each channel as appropriate for your game title. Please contact DTS for further guidelines on authoring multi-channel content.

### Enabling Headphone:X in FMOD

Multichannel support in Android is featured directly in FMOD version **4.44.15** and above on Android API 16 or later. To enable Multichannel Audio you must use the AudioTrack API. This can be set in FMOD by calling:

```
System::setOutput(FMOD_OUTPUTTYPE_AUDIOTRACK)
```

You must then enable multichannel panning in FMOD using `System::setSpeakerMode(FMOD_SPEAKERMODE_5POINT1)`. This will ensure that all positional sound sources are correctly panned across the 5.1 channels. The FMOD Studio runtime for Android now also supports multichannel audio.

### Enabling Headphone:X in Wwise

The next release of Wwise is confirmed to support 5.1 in Android. An update to this paper will be released to include details.

### Enabling Headphone:X in Unity

Unity 5.0 is confirmed to include multichannel support for Android platforms. An update to this paper will be released to include details.

### What about devices that don't support Headphone:X?

If the specific platform supports multichannel output, this will result in true multichannel playback. If the specific platform only supports stereo or mono output, Android will automatically down mix this multichannel source into stereo or mono.

### Customising Headphone:X

Once a game developer has enabled multichannel audio in their game, further Headphone:X customization is possible to provide a headphone experience that is unique to that game. Please contact DTS for further details.

### What about other platforms?

Please register with DTS as a developer to understand how Headphone:X can help you develop a more immersive headphone solution across console and mobile platforms.

### Where can I learn more?

Please contact [games@dts.com](mailto:games@dts.com) or visit [www.dts.com/games](http://www.dts.com/games) to register for more information.

### How much does it cost?

Headphone:X is free to all developers on supported Android devices. Register with us as a developer to learn more and to see how you can customize the experience to your needs.

## ABOUT DTS

DTS, Inc. (Nasdaq:DTSI) is a premier audio solutions provider for high-definition entertainment experiences—anytime, anywhere, on any device. DTS' audio solutions enable delivery and playback of clear, compelling high-definition audio, which is incorporated by hundreds of licensee customers around the world, into an array of consumer electronic devices. From a renowned legacy as a pioneer in high definition multi-channel audio, DTS became a mandatory audio format in the Blu-ray Disc™ standard and is now increasingly deployed in enabling digital delivery of compelling movies, music, games and other forms of digital entertainment to a growing array of network-connected consumer devices.