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W3C Web Audio API Overview

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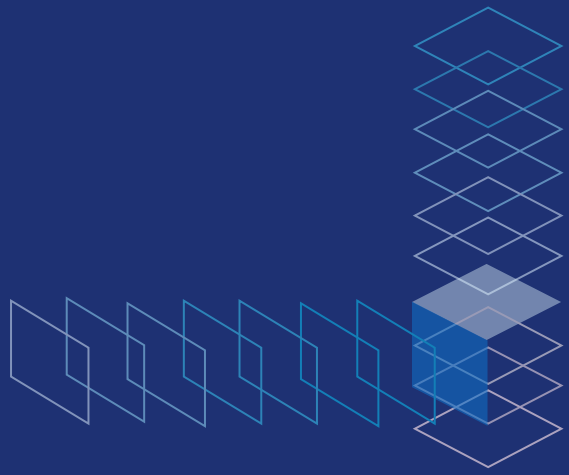

W3C Web Audio API Overview

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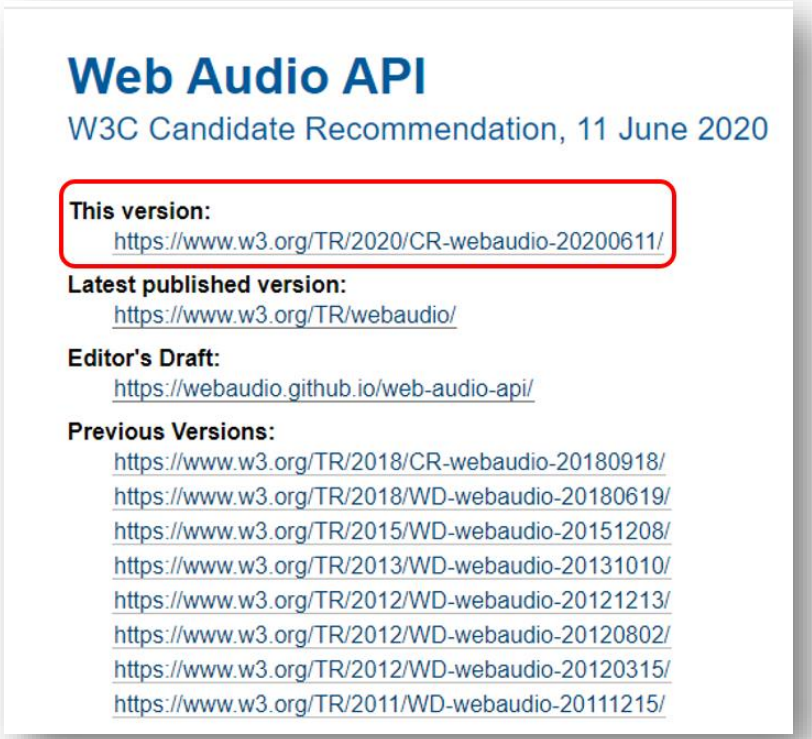
Overview

- Web Audio API- Introduction
- Web Audio API – Concepts
- Web Audio API – Workflow
- Web Audio API Step by Step
- Web Audio API Interfaces (General/ Sources/ Effects – Filters/ Destinations/ Visualisation/ Split & Merge/ Spatialization)
- Spatialized Sound Analysis
- Conclusion

Web Audio API - Introduction

- This specification is the collective work of the W3C Audio Working Group
- Web Audio API is a high-level JavaScript API, which can be used to synthesize audio in web applications
- It is characterized as an extremely powerful tool for controlling audio in the browser and tends to become a de facto standard in modern browsers



Web Audio API

W3C Candidate Recommendation, 11 June 2020

This version:
https://www.w3.org/TR/2020/CR-webaudio-20200611/

Latest published version:
https://www.w3.org/TR/webaudio/

Editor's Draft:
https://webaudio.github.io/web-audio-api/

Previous Versions:
https://www.w3.org/TR/2018/CR-webaudio-20180918/
https://www.w3.org/TR/2018/WD-webaudio-20180619/
https://www.w3.org/TR/2015/WD-webaudio-20151208/
https://www.w3.org/TR/2013/WD-webaudio-20131010/
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https://www.w3.org/TR/2012/WD-webaudio-20120802/
https://www.w3.org/TR/2012/WD-webaudio-20120315/
https://www.w3.org/TR/2011/WD-webaudio-20111215/

	Desktop					
Element	Google Chrome	Microsoft Edge	Mozilla Firefox	Internet Explorer	Opera	Safari
Web Audio API	✓	✓	✓	✘	✓	✓

	No Desktop					
Element	Android Web View	Chrome For Android	Firefox For Android	Opera For Android	Safari on iOS	Samsung Internet
Web Audio API	✓	✓	✓	✓	✓	✓

Web Audio API – Concepts

- **audio context**

is the place where audio is operated

- **audio nodes**

are basic elements of audio

- **modular routing**

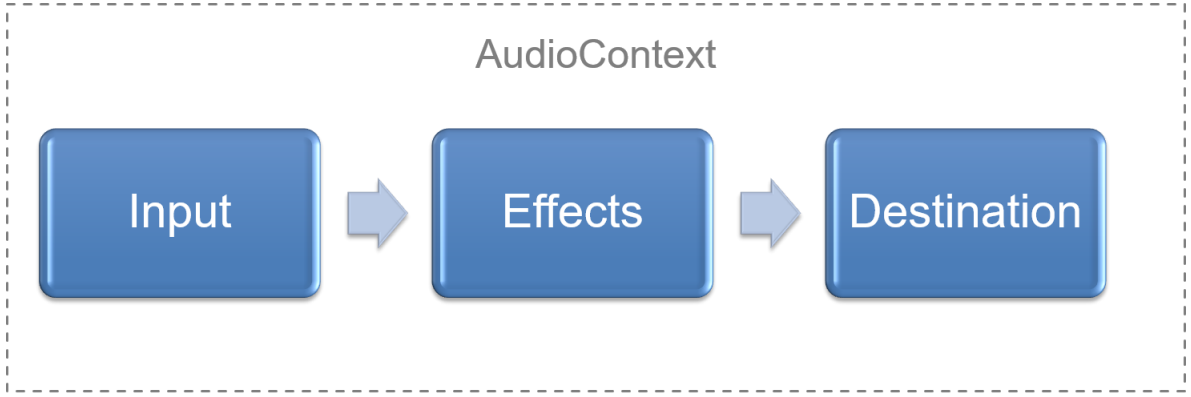
connects nodes with each other

- **audio routing graph**

the network of audio nodes

Web Audio API – Workflow

- Web Audio API involves handling audio operations inside an audio context (AudioContext node) and has been designed to allow modular routing
- Particularly, the approach of Web Audio API is based on the concept of audio context, which presents the direction of audio stream flows, between sound nodes (AudioNode)
- A simple, typical workflow for web audio API:



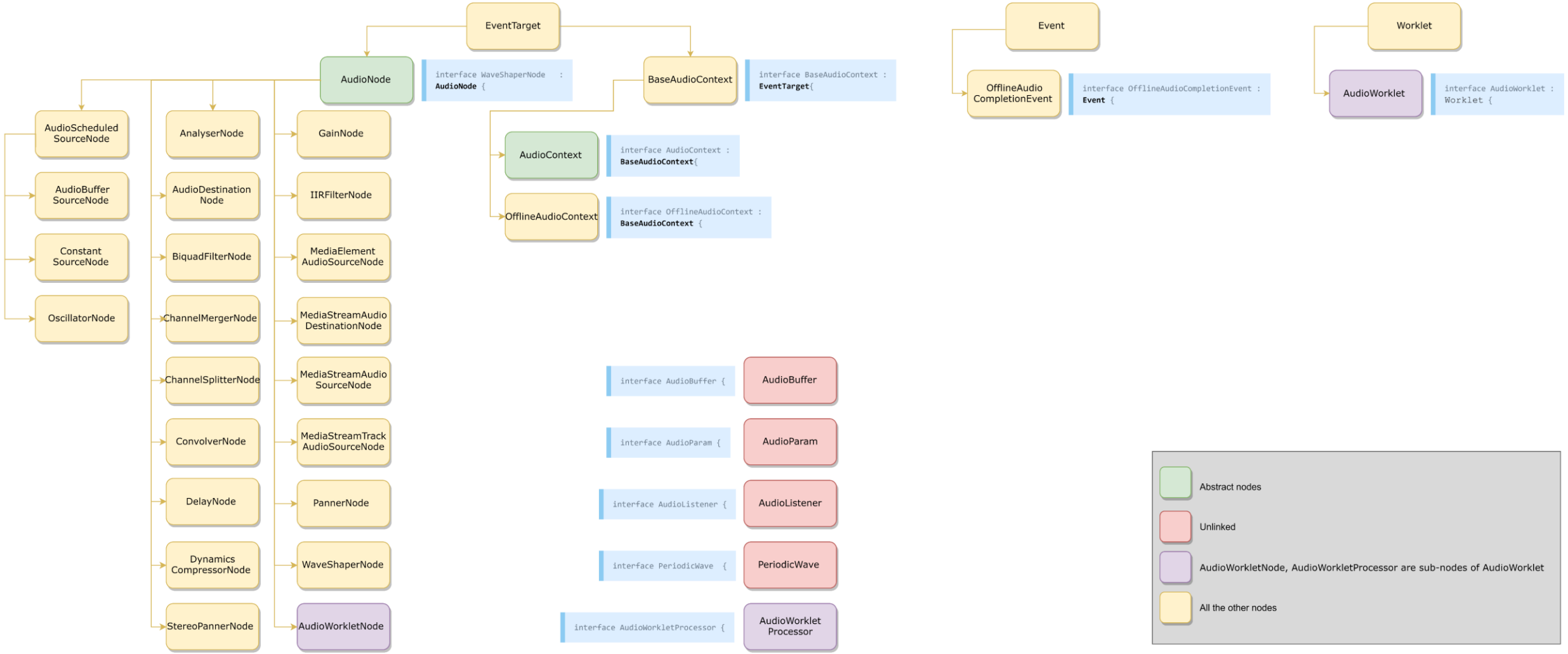
Web Audio API Step by Step

- create audio context
- inside the context:
  - create source
  - create effects nodes
- choose destination of audio: speakers
- connecting audio graph

Code Example

```
// Create the audio context
var context = AudioContext();
// Create the source.
var source = context.createBufferSource();
// Create the gain node.
var gain = context.createGain();
// Connect source to gain, gain to destination.
source.connect(gain);
gain.connect(context.destination);
```

Web Audio API Interfaces – Structure



Web Audio API Interfaces - General

- AudioContext is an audio-processing graph of audio modules
- AudioNode is a generic interface for representing an audio processing module
- AudioParam interface represents an audio-related parameter, usually a parameter of an AudioNode (such as GainNode.gain)

Web Audio API Interfaces - Sources

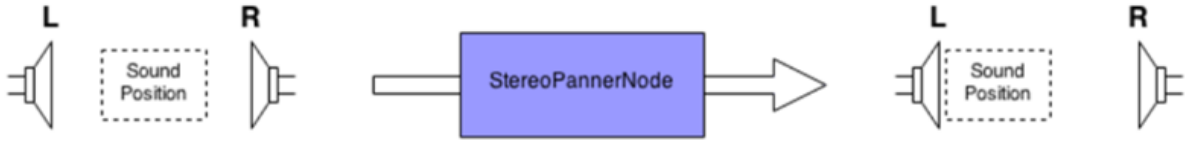
Web Audio API makes a clear distinction between buffers and source nodes

Taking a record player analogy, buffers are like records and sources are like playheads, except in the Web Audio API world, you can play the same record on any number of play-heads simultaneously

- AudioBuffer short audio residing in memory (loading a sound file)
- AudioBufferSourceNode audio from AudioBuffer
- OscillatorNode represents a periodic waveform, a sine wave with frequency (synthesize our own sounds)
- MediaElementAudioSourceNode represents an audio source consisting of an HTML5 <audio> or <video> element
- MediaStreamAudioSourceNode operates as an audio source whose media is received from a MediaStream (microphone, WebRTC)

Web Audio API Interfaces – Effects/Filters

- BiquadFilterNode represents different kinds of filters, tone control devices, and graphic equalizers
- ConvolverNode linear Convolution (reverb effect etc.)
- DelayNode delay between the input and output
- DynamicsCompressorNode prevent clipping etc
- GainNode change in volume
- StereoPannerNode left | right



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- WaveShaperNode non-linear distorter, warmer sound
- PeriodicWave may shape the output of an OscillatorNode

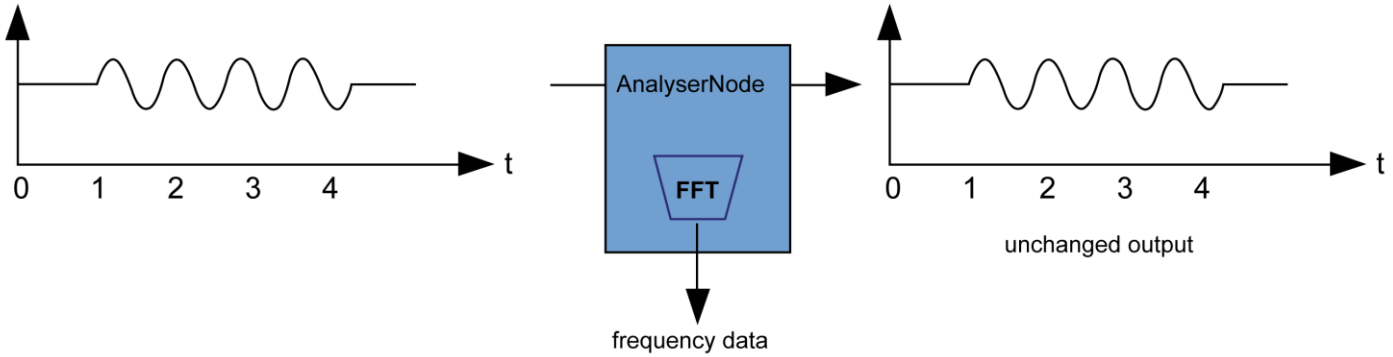
Web Audio API Interfaces – Destinations

- AudioDestinationNode represents the end destination of an audio graph in a given context — usually the speakers of your device, has no output and one input

- MediaStreamAudioDestinationNode represents an audio destination consisting of a WebRTC

Web Audio API Interfaces - Visualisation

- AnalyserNode represents a node able to provide real-time frequency and time-domain analysis information, passes the audio stream **unchanged** from the input to the output, but allows you to take the generated data, process it, and create audio visualizations



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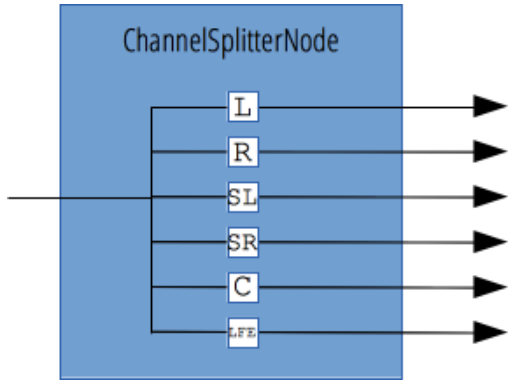
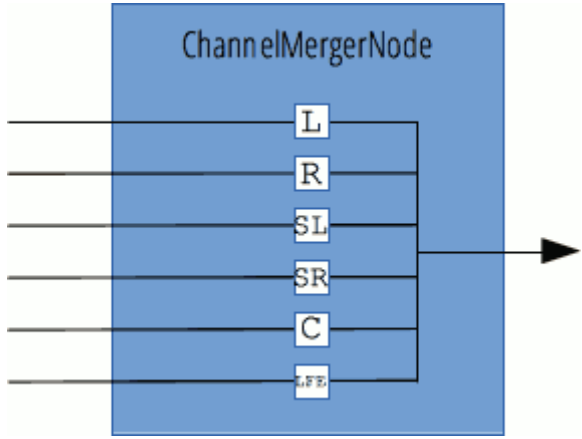
*FFT (Fast Fourier Transform), Fourier analysis converts a signal from its original domain (often time or space) to a representation in the frequency domain and vice versa

Web Audio API Interfaces - Split & Merge

- ChannelSplitterNode separates the different channels of an audio source into a set of mono outputs



- ChannelMergerNode reunites different mono inputs into a single output



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Web Audio API Interfaces – Spatialization

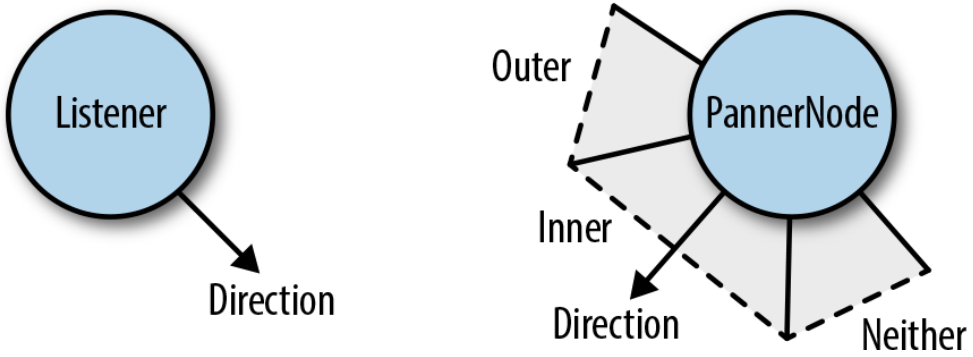
- AudioListener the position and orientation of the unique person listening to the audio scene
- PannerNode signal in space, moving with velocity vector using a directionality cone

There is a single listener (AudioListener) attached to the Web Audio API context that can be configured in space through position and orientation. Each source can be passed through a panner node (PannerNode), which spatializes the input audio. Based on the relative position of the sources and the listener, the Web Audio API computes the correct gain modifications

Spatialized Sound Analysis (1)

Taking into account relative positions and orientations, each source has a configurable audio cone. There are specified an inner and outer cone, as a result a separation of space into three parts:

- Inner cone
- Outer cone
- Neither cone



Reprinted from: B. Smus, "Web Audio API". O'Reilly Media, Inc, 2013

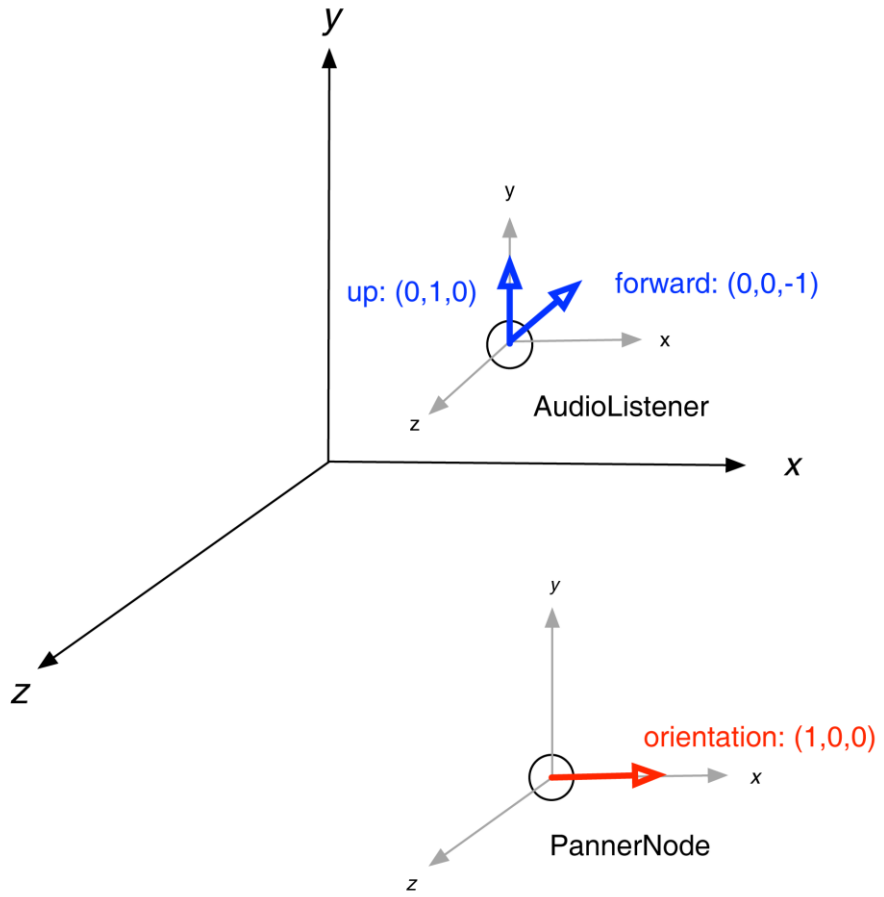
Spatialized Sound Analysis (2)

Using a PannerNode, an audio stream can be spatialized or positioned in space relative to an AudioListener

Both panners and listeners have a position in 3D space using a **right-handed** cartesian coordinate system

PannerNode (representing source) has an orientation vector representing in which direction the sound is projecting

AudioListener (representing a person's ears) has forward and up vectors representing in which direction the person is facing



Reprinted from: https://www.w3.org/TR/webaudio/#Spatialization

Conclusion

Web Audio API:

- is a high-level JavaScript API and is characterized as an extremely powerful tool for controlling audio in the browser
- became attractive for the spatial audio in Web environments
- is open source and be supported from the most browsers
- provides multi-channel audio integrating with Web Real-Time Communications (WebRTC)
- offers high-level sound abilities as filters, delay lines, amplifiers, spatial effects
- the audio routing graph structure using nodes gives it the advantage of compositionality

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