Magic Leap Soundfield Audio Plugin user guide for Unity

Plugin Version: MSA_1.0.0-21

Contents

Get started using MSA in Unity. This guide contains the following sections:

Set up your development environment

Software requirements:

- Install Unity 2018.1.X developer version for Lumin SDK 0.15.0 or newer from the Unity website
- Download the matching MagicLeap-0.XX..0.unitypackage from the Magic Leap Package Manager

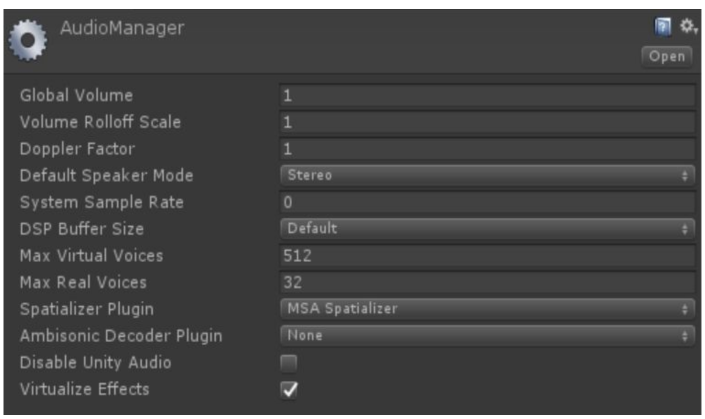
- The download includes a demo scene that you will explore in this guide.

Create a new Unity project and import the Magic Leap Unity Package

1. Open Unity and create a new **3D** project.
2. Select **Assets** > **Import Package** > **Custom Package**.
3. Select the `MagicLeap-X.XX.X.unitypackage` file that you downloaded.
4. In the **Importing Package** dialog, click **Import**. Accept any API upgrades if prompted.

Configure your Unity project to use MSA

1. Use **Edit** > **Project Settings** > **Audio** to open the AudioManager settings.
2. Select **MSA** as the **Spatializer Plugin**.



Try out the MSA demo

The Unity software package includes a simple demo scene in which you look at a Red Leaper that is hovering in a static position in front of you

1. In the **Assets** folder select **MagicLeap > MSA > Examples** > **Scenes > MSADemo.unity**

2. Make sure to wear headphones to experience the spatialized audio. Click **Play** in the Unity Editor. You should hear the leaper sound played back in the scene.
3. To test the scene on a Magic Leap Device go to Build Settings and set your platform as Lumin
4. Hit Build and Run with your device or virtual device plugged in to experience the MSA demo

What to Expect

The example displays a floating Leaper that is emitting a speech sample. On device or using the Magic Leap Remote you will be able to hear the sound spatializing with respect to changes in headpose or listener movement. You will also be able to hear source directivity and environmental reflections and reverb in the environment surrounding.

MSA components

The MSA SDK for Unity includes the following components for rendering spatial audio.

Component / Prefab name	Description
MSAListener	● Extends Unity's AudioListener features by introducing additional parameters related to global spatialization and room properties such as global room gain, etc ● Requires a Unity AudioListener in the same game object.
MSASource	● Enhances Unity's AudioSource features by introducing additional optional parameters such as radiation patterns. ● Requires a Unity AudioSource in the same game object.

Add MSA components to your scenes

MSA components enhance the features of Unity's built-in audio components.

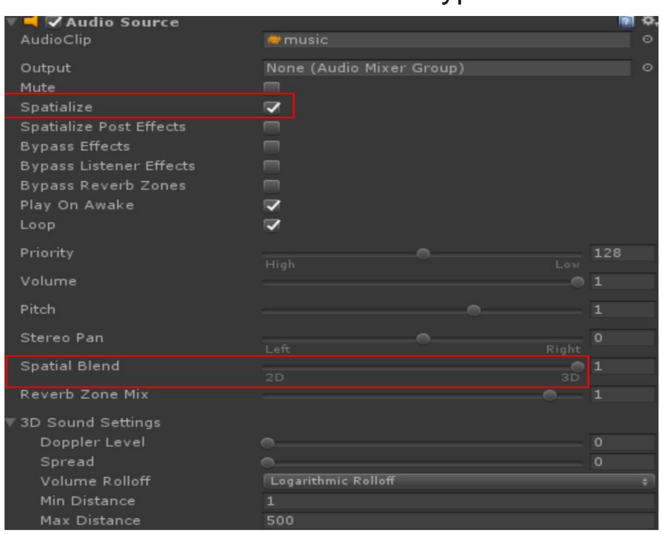
Add an audio listener to your scene

Add an `MSAListener` to your `AudioListener` gameobject. This is a required component for spatial audio processing in Unity.

1. Attach a new `MSAListener` component to the same game object that has your Unity `AudioListener` component. Typically, this is the `Main Camera`.

Add a spatialized sound source to your scene

1. Add an `MSASource` to a game object in your scene. If the game object does not already contain an `AudioSource` component, one will be created automatically.
2. Set the following `AudioSource` properties in order to allow MSA to spatialize this audio source:
   - Select an `AudioClip`.
   - Set the **Spatial Blend** slider to **3D**.
   - Enable **Spatialize** checkbox. Note that, this checkbox is only visible when you've configured your project to use the MSA spatializer plugin.
   - If AudioSource effects are desired then **Spatialize Post Effects** must be checked or the effects will be bypassed.



3. Note that if you add a `MSASource` to a game object without adding an `AudioSource` first, Unity adds an `AudioSource` automatically to the game object.

Compatibility with the Unity Mixer:

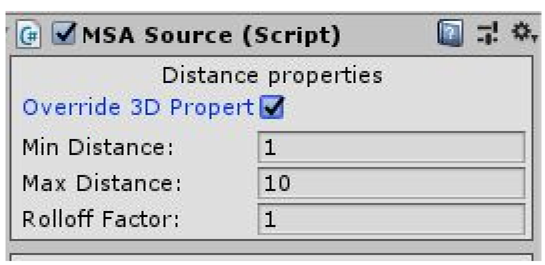
MSA is designed with a highly optimized internal bussing structure in order to allow for a large number of sources with low-CPU overhead, ideal for the Magic Leap One. As a result, MSA is not compatible with the Unity Mixer system.

For more information seethe MSA Component Reference section.

Configure Distance Properties

MSA contains a set of distance properties that simulate the natural attenuation of a sound wave.

In the physical world when a sound wave propagates from a point outward in all directions, as the emitted wave gets farther from the source it is spread out over an area that is increasing in proportion to the square of its distance from the sound source. As a result its intensity is inversely proportional to the square of its distance from the sound source. This is known as the inverse square law. MSA implements this attenuation by default in all MSA Sources.



In MSA when **Override 3D Properties** is checked with the default distance properties. MSA bypasses all the **3D Sound Settings** in the default Unity Audio Source component with an exception of **Doppler Level**. MSA then applies the inverse square law during runtime to calculate the resulting attenuation of the sound source based on the location of the listener.

When the MSA Listener is at the **Min Distance** and closer, the gain defined in the Per-Source Offset section will be applied to the sound.

When the listener is beyond the **Max Distance** the sound will no longer attenuate and remain at the attenuated gain calculated for **Max Distance**.

When the listener is between **Min** and **Max Distance**, MSA uses the inverse square law to calculate the resulting gain offset. This gain calculation can be scaled using the **Rolloff Factor** parameter. By setting the Rolloff Factor to be less than 1.0, the attenuation can be tuned to be more gradual, and by increasing the **Rolloff factor** above 1.0 the attenuation can be tuned to be more dramatic. When the **Rolloff factor** is set to 0, there is no distance based attenuation applied to the sound source.

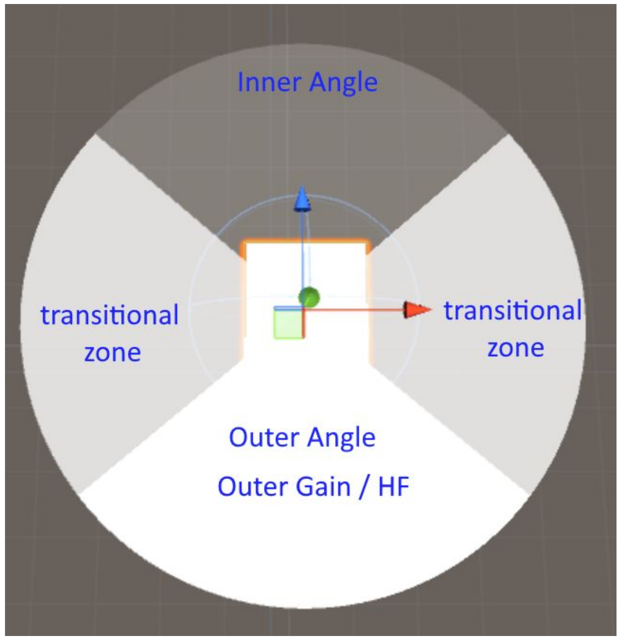
Compatibility with the Unity 3D Sound Settings:

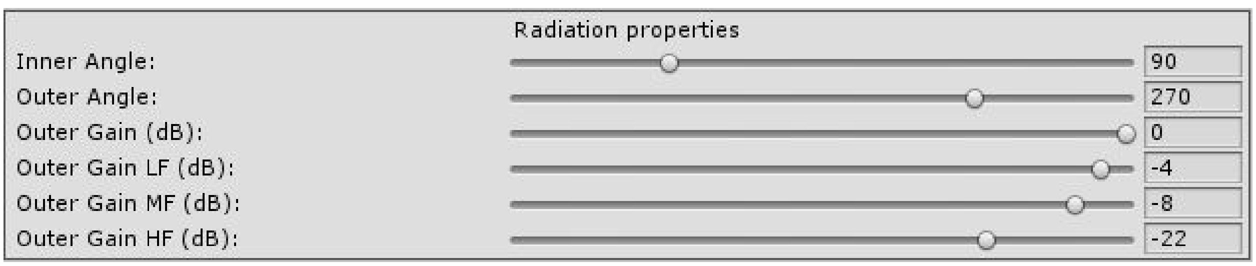
Currently **Doppler Level** is the only property compatible when MSA is being used for spatialization. Unity's rolloff curves, spread, and spatial blend settings are not compatible with MSA.

Configure Source Radiation Properties

Using source directivity allows for simulation of physical sound source behaviors thus increasing realism and presence of the audio experience. For example in the physical world the sound of a human voice sounds different depending on whether the person is facing in your direction or turned around in the other direction. This behavior is known as source-directivity or radiation.

When used, the direct sound component will be automatically attenuated and filtered when the sound source is not pointing to the listener, and this effect will be automatically updated according to the sound source orientation and the listener position. Additionally, making the source more directive will produce a natural attenuation of the reverberation for this source. When a game object that has an `MSASource` component is selected it will draw a visual representation of its directivity in the scene window (the `MSASource` gizmo option must be enabled).



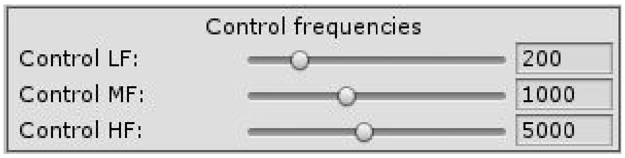


There are three zones defined: the inner cone, the outside zone, and the transitional zone in-between. The angle dependent gain for a directional source is constant inside the inner cone with respect to the user defined gain of the source at minimum distance. The gain of the source changes over the transitional zone to the value specified outside the outer cone. Source gain is automatically applied for the inner cone zone, while the outer gain is user-defined for the outer zone of the game object. In the transitional zone linear interpolation between the compounded source and outer gains is applied. Furthermore a frequency dependent radiation can be set using the exposed LF, MF, and HF gains for the outer angle.

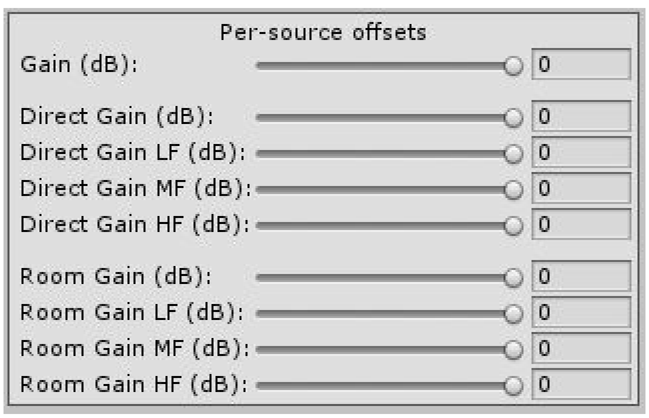
Note: Both Inner Angle and Outer Angle are defined from the forward direction of the source.

Configure MSA Filter Effects

On the MSA Listener control frequencies can be set for a 3 band parametric equalizer on the MSA Listener Component



Based on the control frequencies set on the listener, each MSA source has gain offset sliders for the overall gain and each frequency band set in the MSA Listener. The defined frequencies on the listener apply for the filters exposed on the Direct Gain, Room Gain, and Outer Gains.



For more information see the MSA Component Reference section.

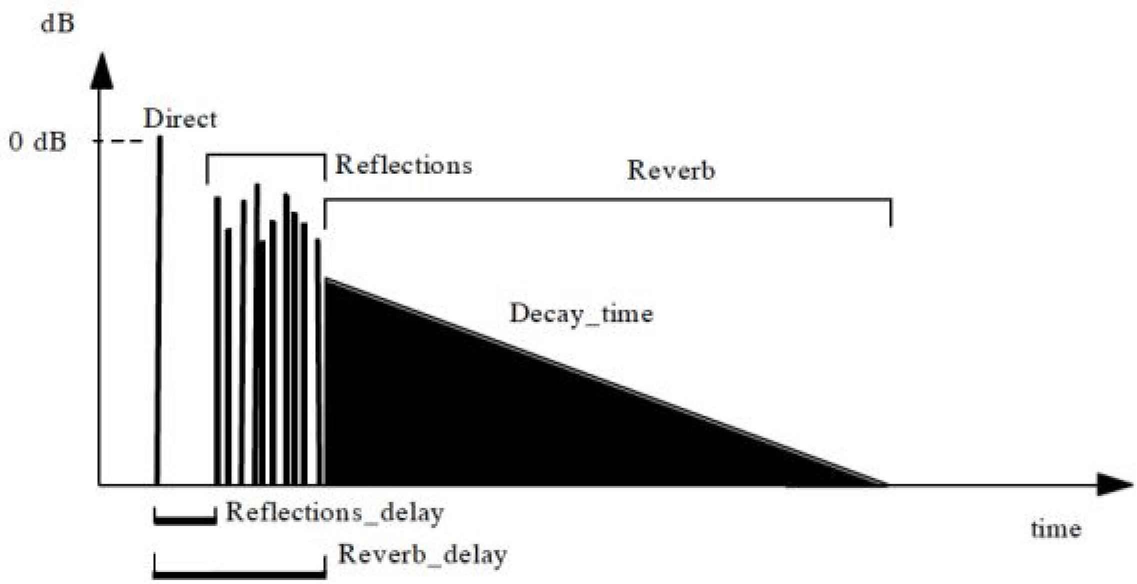
Configure MSA Room Effects

The MSA listener component has settings for a default global reverb that can be applied to all sources. Each source has the ability to control their own frequency dependent gain offsets to customize room effects at the source level.

MSA Room Model

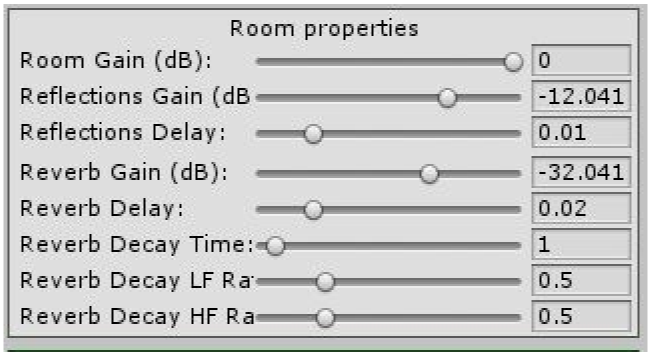
The MSA room model is defined by the response shown in Figure 1. MSA breaks down the components of the room into three temporal parts. The first, the direct signal is controller by MSA Source and MSA Listener and is unaffected by any room properties. The environment portion of the room is broken down into two parts, the reflections and reverbs.

1. The Direct Signal - controller by the MSA Source unaffected by room model
2. The MSA Room
    a. The Reflections
    b. The Reverb



Room Properties

The Room properties are applied to both the Reflections and Reverb portions of the signal and are global controls on the non-direct sound. On the listener the global room parameter exposed is the overall room gain. On each source the frequency dependent Room Gain offsets affect both its reflections and its reverb. See MSA Filter properties section.



Reflections properties

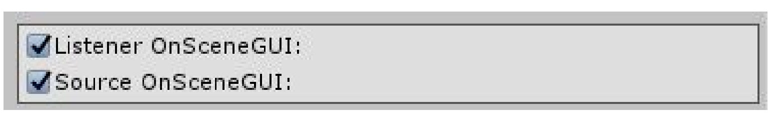
In the MSA Listener room properties you can control the reflections gain and its delay value where the delay represents the time in milliseconds from the direct signal.

Reverb properties

Three parameters affect late reverberation in the MSA Room. Globally the gain, delay, decay time, and decay HF and LF values can be set to create the late reverb properties of a room.

For more information see the [MSA Component Reference section](#).

MSA Scene GUI Functionality



The MSA Listener component contains functionality to enable and disable various stats about the MSA listeners and sources from displaying on the scene GUI. This information is useful for authoring and debugging audio but can also crowd a Unity Scene editor.

About window

This window displays the MSA library and Unity plugin versions.

In this about window the core library version is 1.0.0 and the unity plugin version is 21.

MSA Component Reference

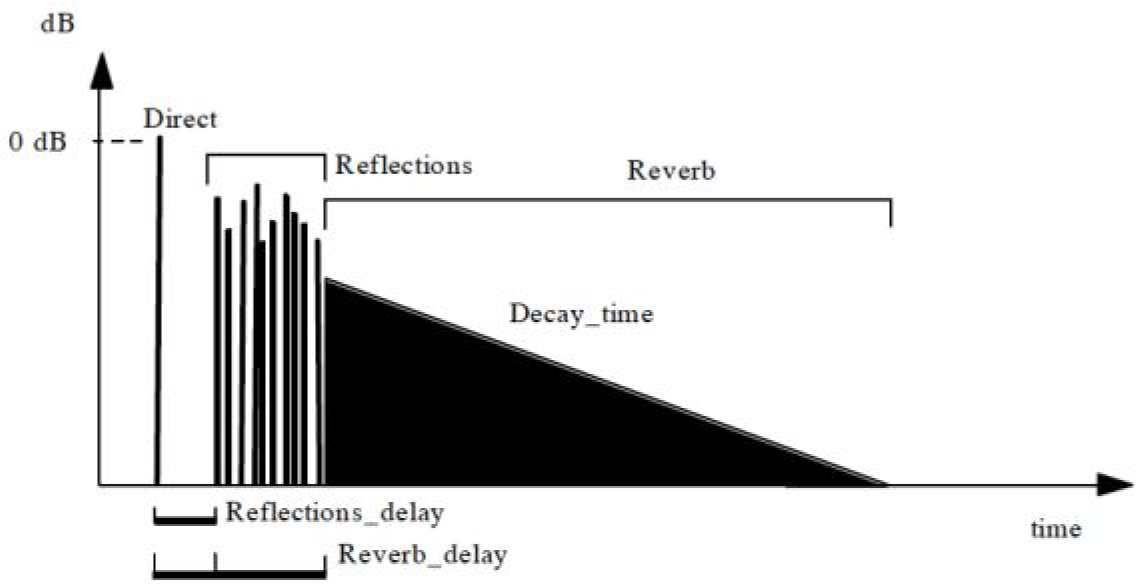
This document reviews the control parameters of the Magic Leap Soundfield Audio (MSA) plugin and provides a reference for the MSA Plugin Support API applying across game engines and middleware environments (Unity, Unreal, Wwise, FMOD).

Control frequencies

Inspector Parameter	Description
Control LF	Reference frequency for all 'LF' controls (default: 200 Hz).
Control MF	Reference frequency for all 'MF' controls (default: 1 kHz).
Control HF	Reference frequency for all 'HF' controls (default: 5 kHz).

Room properties

The set of parameters listed in this section define the reflections and reverberation processing applying for a source when its distance to the listener is equal to the Min Distance parameter setting for this source (see the MSA Source section below).



Inspector Parameter	Description
Room Gain (dB)	Sets the global room gain (which affects both Reverb and Reflections as a global offset).
Reflections Gain (dB)	Early reflections gain adjustment. 0.0 dB means that their combined energy is the same as the input sound energy when the source is within Min Distance.
Reflections Delay	Delay time of the first reflection relative to the direct-path sound arrival, in seconds (see room response graph above).
Reverb Gain (dB)	Represents the total energy of the reverb when the listener and the source are collocated. Measured in decibels.
Reverb Delay	Delay time of the reverb relative to the direct-path sound arrival, in seconds.
Reverb Decay Time	Reverberation decay time, in seconds.

Reverb Decay LF Ratio	Relative decay time multiplying factor for low frequencies.
Reverb Decay HF Ratio	Relative decay time multiplying factor for high frequencies.

MSA Source

Distance properties

These properties define the calculation of a distance-based gain offset (attenuation) that is automatically applied to the source's direct sound component, as a function of source-listener distance.

Min Distance	Minimum Distance for this sound source. When a source is closer than Min Distance, the gain offset is the same as at Min Distance (default: 1 meter).
Max Distance	Maximum Distance for this sound source. Max Distance must be greater than or equal to Min Distance. When a source is farther away than Max Distance, the gain offset is the same as at Max Distance.
Rolloff Factor	Rolloff factor for this sound source. This determines how steeply the gain rolls off from Min Distance to Max Distance. The roll-off follows the "Inverse Distance Clamped" model: ● If distance < Min Distance, the gain is unaffected. ● If Min Distance <= distance <= Max Distance, the attenuation is specified by the formula: Gain = MinD/(MinD + Rolloff * (distance - MinD)). ● If Rolloff Factor is set to 0.0, the gain is unaffected.

Radiation properties

These parameters specify the directivity of the sound source, so that the direct sound component will be automatically attenuated and filtered when the sound source is not pointing to the listener. This effect will be automatically updated according to the sound source orientation and the listener position. Additionally, making the source more directive will produce a natural attenuation of the reverberation for this source.

Inner Angle	Inner cone angle in degrees. Range: 0 to 360. Defined symmetrically around the forward vector of the source.
Outer Angle	Outer cone angle in degrees. Range: 0 to 360. Defined symmetrically around the forward vector of the source.
Outer Gain	Gain outside the outer cone. Range: -96dB to 0dB
Outer Gain LF	Low Frequency gain offset outside the outer cone (dB).
Outer Gain MF	Mid Frequency gain offset outside the outer cone (dB).
Outer Gain HF	High Frequency gain offset outside the outer cone (dB).

Per-source offsets

The set of parameters listed in this section enable fine tuning the direct-path and the room reflections and reverberation response at Min Distance for each sound source. This is typically not necessary if Min Distance is left at its default setting (1 meter) for all sound sources.

Inspector Parameter	**Description**
Gain	Set the overall gain for a source. This gain affects all paths: Direct, Reflections, and Reverb (dB).
Direct Gain	Direct-path gain offset (dB).
Direct Gain LF	Direct-path relative gain offset for low frequencies (dB).
Direct Gain MF	Direct-path relative gain offset for mid frequencies (dB).
Direct Gain HF	Direct-path relative gain offset for high frequencies.
Room Gain	Room-path gain offset (dB, affects reflections and Reverb).
Room Gain LF	Room-path relative gain offset for low frequencies (dB).

Room Gain MF	Room-path relative gain offset for mid frequencies (dB).
Room Gain HF	Room-path relative gain offset for high frequencies (dB).

Version History

- 6/17/18- JMJ: Major Feedback round for SDK 15 Release
- 6/14/18- Kedar: Major update for version 1.0.0-20 for release
- 5/29/18- Kedar: Merged in component reference from soundfields api document
- 5/24/18 - Kedar: Created sections to describe attenuation properties
- 5/23/18- Kedar: Updated for version 32.17 and SDK process
- 4/29/18 - Kedar: Wording adjustments, moving Version history to the end
- 4/25/18 - Kedar: Updated All sections to reflect major plugin v15 updates
- 4/6/18 - Kedar: Revamped reverb section, moved component reference from Plugin API doc to the bottom of the document
- 4/2/18 - Kedar: Migration guide moved to new document, small fixes & cleanups
- 3/26/18 - Initial Round of Feedback provided by JMJ
- 3/12/18 - Kedar: Initial Revision 1 of docs created for MSA_18_Unity_12.5
- 2/28/18 - Kedar: Documentation Created for Plugin modeled after GRA docs