OpenXR BOF
Empowering Cross-Platform Immersive Experiences

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NVIDIA
What is OpenXR?

A royalty-free, cross-platform, cross-vendor open standard for high-performance access to Augmented Reality (AR) and Virtual Reality (VR) - collectively known as XR - devices and platforms

Empowering Cross-platform Immersive Experiences
OpenXR Cross-Platform Portability

Before OpenXR: Applications and engines needed separate proprietary code for each device on the market.

OpenXR provides a single cross-platform, high-performance API between applications and all conformant devices.

Applications and engines can portably access any OpenXR-conformant hardware
# Conformant OpenXR Devices

<table>
<thead>
<tr>
<th>HoloLens and Mixed Reality Headsets. Hand and eye tracking extensions</th>
<th>Rift S, Quest 3, Quest 2 and Quest Pro</th>
<th>Vive Focus 3, Vive Cosmos, Vive XR Elite, Vive Wave Runtime</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Valve Index</strong></td>
<td>All Varjo Headsets are fully compliant XR-3, XR-4</td>
<td>MREAL X1</td>
</tr>
<tr>
<td>Valve Deprecated OpenVR APIs for OpenXR</td>
<td>Mate Deprecated own API for OpenXR</td>
<td></td>
</tr>
<tr>
<td><strong>Magic Leap 2</strong></td>
<td>XREAL Air 2, Air 2 Pro, Air 2 Ultra</td>
<td>Qualcomm Snapdragon Spaces XR Development Platform</td>
</tr>
<tr>
<td><strong>Spatial Labs Display Series</strong></td>
<td>Neo 3 and Pico 4</td>
<td>Spatial Reality Displays</td>
</tr>
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The OpenXR Story So Far...

Vendor Proprietary API fragmentation
Clear industry demand need for a cross-platform XR open standard

Vendor Proprietary API fragmentation

Establishing baseline XR functionality
Though industry consensus and contributed designs

OpenXR 1.0 specification drafted

OpenXR Working Group Formed

2017

OpenXR 1.0 Released

2019

OpenXR 1.1 Released

April 2024

OpenXR 1.1
Consolidates multiple extensions to streamline application development and reduce fragmentation
Adds new functionality with spec improvements

Empowering Cross-platform Immersive Experiences

OpenXR achieves wide industry adoption
OpenXR is foundation for experimentation
New functionality introduced through extensions

Increased focus on regular core spec updates
Balancing the need to ship new functionality AND consolidate widely proven technology

Leverage OpenXR’s flexible design to explore new use cases
e.g., body tracking and advanced spatial computing

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## Engines, Browsers, and Libraries with OpenXR

<table>
<thead>
<tr>
<th>Engine/Library</th>
<th>Support Status</th>
<th>OpenXR Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unreal Engine</td>
<td>4.24. UE 5.0 supports OpenXR</td>
<td>Open-source OpenXR Implementation</td>
</tr>
<tr>
<td>Unity</td>
<td>Unity’s OpenXR plugin available since 2020 LTS</td>
<td>A lightweight XR Meta XR Simulator to Speed Unity OpenXR Development</td>
</tr>
<tr>
<td>Godot</td>
<td>Godot provides OpenXR support since March 2023 (Core 4.0 Alpha 4)</td>
<td>Open-source mixed reality library for building HoloLens and VR applications</td>
</tr>
<tr>
<td>Autodesk VRED Library</td>
<td>OpenXR supported since VRED 2023.4</td>
<td></td>
</tr>
<tr>
<td>NVIDIA Omniverse</td>
<td>NVIDIA Omniverse and CloudXR Platforms</td>
<td></td>
</tr>
<tr>
<td>NVIDIA CloudXR</td>
<td>WebXR in Chrome, Edge, and Firefox uses OpenXR as the default backend</td>
<td></td>
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<tr>
<td>Meta</td>
<td></td>
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<tr>
<td>Collabora</td>
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<td>Monoado</td>
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<tr>
<td>Stereokit</td>
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</tbody>
</table>
# OpenXR Games and Applications

<table>
<thead>
<tr>
<th>Blender</th>
<th>Adobe Substance 3D Modeller</th>
<th>Kitware’s Paraview</th>
<th>Meta Horizon Workrooms</th>
<th>OpenBrush</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses OpenXR for native scene inspection in VR</td>
<td>Uses OpenXR for VR support</td>
<td>Uses OpenXR for VR support</td>
<td></td>
<td>Uses OpenXR for Desktop and Quest support</td>
</tr>
</tbody>
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<tr>
<th>War Thunder</th>
<th>Cubism</th>
<th>Vermillion</th>
<th>The Light Brigade</th>
<th>XPlane12</th>
</tr>
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<tr>
<td>Uses OpenXR</td>
<td>Uses OpenXR for VR support</td>
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<tr>
<th>Minecraft</th>
<th>Microsoft Flight Simulator</th>
<th>Zombieland Headshot Fever</th>
<th>Phasmophobia</th>
<th>Beat Saber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses OpenXR for desktop VR support</td>
<td>Uses OpenXR for VR support</td>
<td>Supports over 27 devices thanks to OpenXR</td>
<td>Switched from OpenVR to OpenXR</td>
<td>Uses OpenXR on PC</td>
</tr>
</tbody>
</table>

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Khronos and W3C: Bringing XR to the Web

XR Applications and Engines use an API from both the 3D and XR Stacks

three.js  babylon.js  unity  UNREAL ENGINE  GODOT

Engines

WebGL  WebXR

WebGPU

3D Stack
Driving GPUs to render scenes and augmentations

XR Stack
Handling XR Devices for creating UI
Monado from Collabora

- Open source OpenXR Runtime and Framework
- Framework provides building blocks to simplify XR development
OpenXR Ecosystem Components

OpenXR Specification
Rigorous specification enables multiple implementations for pervasive industry adoption

OpenXR Conformance Test Suite
Open source CTS promotes cross-vendor runtime implementation consistency

OpenXR Developers
OpenXR SDK and Loader
Handles multiple OpenXR driver and API layers
OpenXR API Layers

- Intercept and modify API calls between an application and the OpenXR runtime
  - Modular components for validation, debug, or extended functionality
- Isolate different functionalities into distinct layers without impacting runtime
  - Flexible - add or remove features without altering the core application code
  - Debug or add logging capabilities by intercepting and analyzing API calls
  - Create custom behaviors or extensions layered onto existing APIs
- Notable examples
  - The OpenXR Core Validation API layer
  - UltraLeap OpenXR Hand Tracking Layer
OpenXR 1.1 Launch

Consolidates multiple extensions into OpenXR 1.1 core
Streamlined development and reduced fragmentation

OpenXR 1.1 Feature Enhancements
Additional functionality
Spec clarifications and improvements

Continue leveraging OpenXR’s Flexible Design
To foster innovation in developing extensions to explore new use cases

Drive for Immersive Experience Portability
Increased focus on integrating widely adopted extensions into core for cross-platform portability

Today

Ongoing
OpenXR 1.1 Key Extensions Promoted to Core

- **Local Floor Reference Space**
  - Gravity-aligned world-locked origin for standing-scale content
  - Estimated floor height built in
  - Recenter to current user position at the press of a button without a calibration procedure

- **Grip Surface**
  - Anchors visual content relative to the user's physical hand
  - Can be tracked directly or inferred from a physical controller’s position and orientation

- **Stereo with Foveated Rendering for XR headsets**
  - Runtimes MAY optionally expose eye-tracked or fixed foveated rendering
  - Portable across multiple graphics rendering APIs
  - Applications renders quad views (two high-res insets)

- **Additional enhancements**
  - Interaction Profile improvements
  - Spec language cleanup and clarifications
OpenXR 1.1 - April 2024

- 13 new interaction profiles added to the core spec
- 5 extensions promoted to core
- Added notes for application developers:
  - Benefits of foveated rendering
  - Which reference space to use
  - Which pose identifier to use
  - Unified extension error codes
- Runtime clarifications
  - Consistent cross-platform user and developer experience
OpenXR Spec + SDK 1.1.38 - June 2024

• New XR_EXT_composition_layer_inverted_alpha vendor extension
  - Allows runtimes to follow their conventions for transparency

• Specification fixes and clarifications, including...
  - Fix documentation for XrCompositionLayerPassthroughFB
  - Fix specification for XR_EXT_plane_detection
OpenXR CTS 1.1.37 - June 2024

• Tests OpenXR 1.1 functionality by default
  - Supports running in 1.0 mode for 1.0 submissions and to ensure backward compatibility

• New interactive tests:
  - XR_KHR_composition_layer_equirect
  - XR_KHR_composition_layer_equirect2

• Improvements include:
  - Interactive test improvements for haptics tests
  - Action test fixes and message clarifications
  - Grip surface parameter tuning
Coming Soon…

- **Extending hand tracking**
  - To include full body tracking

- **Enhanced handling of spatial entities**
  - Standardized methods to interact with the user’s environment
  - Support for advanced spatial computing applications

- **Expanded haptics support**
  - Support immersive experiences through PCM, vibrotractiles, and transients

- **Controller render models (glTF)**
  - Showing and animating a model of the user’s actual controller
OpenXR and Spatial Entities

• Enhanced handling of spatial entities for advanced spatial computing applications
  - Standardized methods to interact with the user’s environment

• Multiple spatial entity types
  - Planes
  - Objects
  - World Meshes
  - Spatial Anchors
  - Marker Tracking (ArUco, AprilTag, QR code)

• With BROAD development support from all the major players
  - Expecting wide portability
OpenXR Development Resources & Tools

- **OpenXR SDK**
  - Headers, source code, and build scripts
  - [https://github.com/KhronosGroup/OpenXR-SDK](https://github.com/KhronosGroup/OpenXR-SDK)

- **Reference Pages and Reference Guide**
  - Developer documentation

- **OpenXR Tutorial**
  - For creating applications using Android, Linux, Windows

- **Conformance Test Suite**
  - For runtime developers to test, developed as open source
  - Part of the [API Adopter Process](#) to be an official OpenXR runtime requires passing these conformance tests

- **Support & Community Forums**
  - OpenXR on [Discord](#)
  - [OpenXR Forum](#) at Khronos
  - [OpenXR Issue Tracker](#) on GitHub
  - Developing OpenXR Resources? [Let us know!](#)

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Beat Saber’s PC implementation using OpenXR is portable to multiple devices.
Get Involved!

Provide feedback and requirements on GitHub, Discord, or OpenXR Forums
Get questions answered and make suggestions for improvement!

Join Khronos and the OpenXR Working Group
https://www.khronos.org/openxr/
https://github.com/KhronosGroup/OpenXR-Docs