Thoughts on OpenXR and Cloud-based XR

Bringing to Life the Dream of Portable Native XR

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Khronos Connects Software to Silicon

Open interoperability standards to enable software to effectively harness the power of multiprocessors and accelerator silicon

3D graphics, XR, parallel programming, vision acceleration and machine learning

Non-profit, member-driven standards-defining industry consortium

Open to any interested company

All Khronos standards are royalty-free

Well-defined IP Framework protects participant’s intellectual property

Founded in 2000
>150 Members ~ 40% US, 30% Europe, 30% Asia
Khronos Standards for XR

Create and deploy 3D assets and scenes

Vision and sensor processing, inferencing acceleration

Portable access to native XR runtimes

High-performance, low-latency 3D Graphics
OpenXR provides cross-platform, high-performance access directly into XR device runtimes across multiple platforms.
Widespread Industry Support

Companies publicly supporting OpenXR

OpenXR is a collaborative design that integrates many lessons from proprietary ‘first-generation’ XR APIs to create a new generation API with cutting-edge capabilities and a flexible, extensible, future-proof architecture.
Broadening OpenXR 1.0 Availability

| Significant Community Feedback |
| Improved Input subsystem |
| Game engine editor support  |
| Loader and Layers... |

| Provisional Specification |
| GDC, March 2019 |

| Ratify and Release OpenXR 1.0 |
| SIGGRAPH, July 2019 |

| OpenXR 1.0 Adopter Program Released |
| Enable Officially Conformant Implementations |

| Conformant OpenXR 1.0 for Windows |
| Mixed Reality headsets and HoloLens 2 |
| PLUS extensions to support HoloLens 2 hand tracking, eye tracking, spatial mapping and spatial anchors |

| Conformant OpenXR 1.0 for Oculus Rift and Quest |
| SDK Oculus PC SDK & Android SDK V19 include OpenXR native C/C++ development |
| Developers can now submit their OpenXR apps to the Oculus Store |

| Valve OpenXR 1.0 Developer Preview |
| New SteamVR features will ship through OpenXR, rather than OpenVR |

| ‘Monado’ OpenXR 1.0 open source implementation |
| Supports variety of HMDs, including Project Northstar AR HMD |

| Varjo OpenXR 1.0 Developer Preview |
| For Varjo headsets |

| OpenXR 1.0 plugin for Unreal Engine v4.2.5 |
| Enhanced support for late stage reprojection, mixed reality capture from a 3rd person camera view, optimized rendering by up to 2ms/frame |

| Hand and eye tracking cross-vendor extensions for advanced UI |
| Shipping on HoloLens 2. Ultraleap hand tracking developer preview |
First Conformant OpenXR Devices

OpenXR Implementer

Prototype OpenXR Implementation

Use tests to aid development

Contribute test fixes and enhancements

Submit Test Results

Test Results Approved. Khronos grants Trademark and Patent License

A conformant OpenXR can use the OpenXR logo and has patent protection under the Khronos IP Framework

OpenXR Open source Conformance Tests

OpenXR Adopters Website

OpenXR Working Group

OpenXR Implementer Prototype OpenXR Implementation

Production OpenXR Implementation

Conformant Devices

Oculus Rift S

Oculus Quest

HoloLens 2

Windows Mixed Reality Headsets

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OpenXR Architecture Flexibility

- **All In One**
  - Windows Mixed Reality
  - Microsoft HoloLens 2
  - Oculus Quest

- **Tethered**
  - Oculus Rift S

Platforms supported:
- Windows 10
- Android
Advanced UI Cross-Vendor OpenXR Extensions

Developers can build cross-platform applications that use advanced UI solutions from different technology vendors. OpenXR API layers can be used to implement extensions.

**Hand Tracking**
- 26 unique joints per hand for fully articulated hands visible to the user
- Shipping on HoloLens 2 and [Microsoft Hand Mesh Extension](#) for HoloLens 2 layers over it

**Eye Tracking**
- Eye gaze interaction for intuitive interfaces
- 2-Step Interaction
- Hand-eye coordination
- Natural aiming
- Shipping on HoloLens 2

[Ultradeap developer preview](#) available
OpenXR and Minecraft

Microsoft is excited to announce that Minecraft’s new RenderDragon rendering engine is building its desktop VR support using OpenXR!
Microsoft open source **OpenXR Samples** for Mixed Reality Developers, shows how to use OpenXR to access the full capabilities of HoloLens 2.

**Blender 2.83** integrates OpenXR to deliver native VR scene inspection capabilities.

**WebXR**

Google Chromium 81 uses OpenXR as its default backend for WebXR, enabling Google Chrome and Microsoft Edge browsers to use any OpenXR-compatible hardware.
OpenXR is used with a 3D API

Application or Engine

High-performance, low-latency 3D rendering and composition*
  Multiview
  Context priority
  Front buffer rendering
  Tiled rendering (beam racing)
  Variable rate rendering

Display, composition and optical correction parameters

Cross-platform access to XR
  HMDs and sensors
  XR application lifecycle
  Input device discovery and events
  Sensor tracking and pose calculation
  Frame timing and display composition
  Haptics Control

* OpenXR can be used with other 3D APIs such as Direct3D, OpenGL and OpenGL ES

OpenXR is strongly influenced by Vulkan with a shared spec toolchain and support for API layers. OpenXR is a “lower-frequency” API than Vulkan and is a much smaller spec.
Bringing XR to the Web

Native XR Apps

Native 3D Engines

Web XR Apps

Lifting OpenXR functionality into the Web stack

Close cooperation between WebXR and OpenXR

Web 3D Engines

Khronos provides the foundation for native and Web-based 3D/XR
Cloud XR with 5G and OpenXR

OpenXR will enable AR applications to run portably on edge server architectures

Runtime using 5G implemented across device and server and accessed through OpenXR API

Significant industry effort in developing this use case

MEC (Multi-access Edge Computing) Server
1. Processes sensor data, can include machine learning for environmental lighting, occlusion, scene semantics, object reconstruction and UI
2. Generates imagery from 3D models, can include stereo, foveal rendering, ray-tracing, optics pre-distortion, varifocal processing

Wireless mobile device with display and sensors

Sensor handling

Display composition

Generated Augmentations & Scenes

Low latency Sensor Data
OpenXR Win-Win-Win

XR Vendors
Can bring more applications onto their platform by leveraging the OpenXR content ecosystem

XR ISVs
Can easily ship on more platforms for increased market reach

XR End-Users
Can run the apps they want on their system - reducing market confusion and increasing consumer confidence

Now is the time for application developers to leverage OpenXR for widespread application deployment!
www.khronos.org/openxr/
Thank you!

Working together to enable and promote Cloud XR