Unifying Reality: Building Portable AR/VR Experiences with OpenXR
Speakers

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Session Overview

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Unifying Reality: Introduction to OpenXR

Brent E. Insko, PhD
Lead XR Architect at Intel & OpenXR Working Group Chair
Agenda

• What is OpenXR?

• What are the Problems we are trying to Solve

• What are the latest developments with OpenXR?
What is OpenXR?

OpenXR is a royalty-free, open standard that provides high-performance access to Augmented Reality (AR) and Virtual Reality (VR)—collectively known as XR—platforms and devices.
OpenXR handles communication to and from an application and an XR platform.
OpenXR handles communication to and from an application and an XR platform

- Head & hand pose information
- Controller/input state
- Display configuration / form factor
OpenXR handles communication to and from an application and an XR platform

- Image(s) to display
- Audio
- Haptic responses

- Head & hand pose information
- Controller/input state
- Display configuration / form factor
What Problems are we trying to Solve?
Consider just a few of the XR Platforms available...
Cross Platform XR Application Development

Before OpenXR, program to each platform’s proprietary API
Cross Platform XR Application Development

With OpenXR, program to a single, common, high-performance API
OpenXR Philosophies

1. Enable both VR and AR applications
   The OpenXR standard unifies common VR and AR functionality to streamline software and hardware development for a wide variety of products and platforms

2. Be future-proof
   While OpenXR 1.0 focused on enabling the current state-of-the-art, the standard is built around a flexible architecture and extensibility to support rapid innovation in the software and hardware spaces for years to come

3. Do not try to predict the future of XR technology
   While trying to predict the future details of XR would be foolhardy, OpenXR uses forward-looking API design techniques to enable engineers to easily harness new and emerging technologies

4. Unify performance-critical concepts in XR application development
   Developers can optimize to a single, predictable, universal target rather than add application complexity to handle a variety of target platforms
OpenXR in Context

- A Khronos API
  - Developed by a non-profit industry consortium
  - Extensions a key part of the design
  - Conforming runtimes receive patent and trademark license per the IP framework
  - Royalty-free
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
OpenXR in Context

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- OpenXR is rendering-API-neutral
  - Graphics API support in extensions designed to work similarly
OpenXR is used with a 3D API

* 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.
Khronos Standards for XR

Portable access to native XR runtimes

Vision and sensor processing, inferencing acceleration

High-performance, low-latency 3D Graphics

Create and deploy 3D assets and scenes
Structure of an OpenXR App

- Get started
  - Create an Instance
  - Choose extensions, layers, bind to graphics API
- Find out where/how to run
  - Get HMD characteristics - mono/stereo, form factor etc..
- Set up interaction/input handles
  - Bind physical inputs to actions
    grab_object, teleport etc.
- Prepare your immersive experience
  - Create Session
  - Create Swapchain to drive the display
- Participate in the frame loop
  - Update positions
  - Handle input and haptics
  - Manage swapchain to drive imagery to the display
  - Poll for events

Details in next presentation
Latest Developments with OpenXR
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

OpenXR Adopters Website

OpenXR Working Group

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

OpenXR Implementation

Test Results Review

OpenXR Open source Conformance Tests

Test Results Approved.

Conformant Devices

Oculus Quest

Oculus Rift S

HoloLens 2

Windows Mixed Reality Headsets
OpenXR Flexibility

- Android
- Oculus Quest
- Microsoft HoloLens 2
- Windows Mixed Reality
- Oculus Rift S
- Windows 10

All In One

Tethered
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

[Ultradeal developer preview](https://ultraface.developerpreview.com) available

**Eye Tracking**

Eye gaze interaction for intuitive interfaces.

- 2-Step Interaction
- Hand-eye coordination
- Natural aiming

Shipping on HoloLens 2
OpenXR and Open Source

Blender – 3D creation suite

Blender 2.83 integrates OpenXR to deliver native VR scene inspection capabilities

Chromium – browser project

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 and Minecraft

Microsoft has announced that Minecraft’s new RenderDragon rendering engine is building its desktop VR support using OpenXR!
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

Native XR Apps

Native 3D Engines

Web XR Apps

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Web 3D Engines

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

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

Significant industry effort in developing this use case.

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

MG (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.

Generated Augmentations & Scenes.

Display composition.
Summary

- What is OpenXR?
- What are the Problems we are trying to Solve
- What are the latest developments with OpenXR?
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.
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

www.khronos.org/openxr/
Now is the time to get involved with OpenXR!
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Khronos open sources conformance tests and launches Adopters Program

First officially conformant runtimes shipping from Microsoft and Oculus

Preview implementations from Valve, Varjo and Collabora

Hand and eye tracking cross-vendor extensions for advanced UI

OpenXR being used by key games and open source software

Minecraft! Blender! WebXR!

Now is the time for application developers to leverage OpenXR for widespread deployment!