OpenXR Specification
Release
GDC, March 2019

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VP Developer Ecosystems, NVIDIA
President, Khronos
Khronos Mission

Khronos is an open, member-driven industry consortium developing royalty-free standards, and vibrant ecosystems, to harness the power of silicon acceleration for demanding graphics rendering and computationally intensive applications.

Khronos members are industry leaders from around the world that join to safely cooperate - to advance their own businesses and the industry as a whole.
Active Khronos Open Standards

Parallel Computation, Vision, Machine Learning and Inferencing

High-performance access to AR and VR platforms and devices

3D Asset Authoring and Delivery

High-performance 3D Graphics
XR = AR + VR

Virtual Reality

Augmented Reality
OpenXR - Solving XR Fragmentation

**Before OpenXR**
XR Market Fragmentation

**After OpenXR**
Wide interoperability of XR apps and devices

* OpenXR 1.0 is focused on enabling cross-platform applications. Optional device plugin interface will be supported post V1.0
OpenXR Win-Win-Win

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

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

XR ISVs
Can easily ship on more platforms for increased market reach
# OpenXR Specification Released Here at GDC!

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High-performance access to AR and VR platforms and devices

OpenXR 0.90 Provisional Specification Released
Enables industry review and feedback
First prototype implementations shipping

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Companies Publicly Supporting OpenXR

OpenXR is a collaborative design
Integrating many lessons from proprietary ‘first-generation’ XR API designs
Engine and Platform Support

Vinay Narayan, vice president, platform strategy, HTC
“HTC VIVE is committed to creating a viable ecosystem for the XR industry which is why we are proud to support OpenXR. Bringing the community together to help define standards and best practices, allows all of us to move forward, together.”

Tim Sweeney, founder and CEO of Epic Games
“Epic believes that open standards like OpenXR are essential foundations for a vibrant, multi-platform VR and AR industry in the coming years. Epic plans to continue supporting OpenXR in Unreal Engine 4.”

Nate Mitchell, Oculus Co-founder and head of VR product, Facebook
“Facebook and Oculus continue to believe in the value the OpenXR standard delivers to users and developers. We plan to provide runtime support for apps built on OpenXR 1.0 on the Rift and Quest platforms later this year.”

Alex Kipman, technical fellow, Microsoft
“Microsoft believes that for mixed reality to thrive, it must be open for everyone: open stores, open browsers and open developer platforms. We’re dedicated to supporting the launch of OpenXR this year on Windows Mixed Reality and HoloLens 2. To help developers provide feedback, we’re releasing today a developer preview of our OpenXR runtime with support for Windows Mixed Reality headsets.”

Philippe Kalaf, CEO, Collabora
Collabora is excited to announce Monado, an open source implementation of the newly released OpenXR spec. More than just a vendor SDK, Monado is an open source project and codebase to harness and focus wider community effort around XR technologies.
Khronos APIs for XR

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

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

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

OpenXR does not replace XR Runtime Systems!
It enables any XR Runtime to expose CROSS-PLATFORM APIs to access their functionality

Cross-platform XR
Apps and Engines

OpenXR
API

XR Vendor
Runtime System
Distortion Correction and Display Output
Coordinate System Unification and Prediction

OpenXR
Device Plugin Interface*

Vendor-supplied
Device Drivers

Cross-platform XR
Devices

Outgoing Requests
Pre-distortion image to display
Haptics

Outgoing Requests
Post-distortion image to display
Haptics

* OpenXR 1.0 is focused on enabling cross-platform applications. Optional device plugin interface will be supported post V1.0
First Cross-Platform VR at SIGGRAPH 2018

Demo runs portably across StarVR and Microsoft Windows Mixed Reality headsets through the OpenXR APIs via an Unreal Engine 4 plugin

https://www.youtube.com/watch?v=FCAM-3aAzXg&t=17250s
Input and Haptics Abstraction

• Apps use abstracted Input Actions
  - E.g. “Move,” “Jump,” “Teleport”

• Input Actions bound to Device Events
  - For the specific system in use

• Interaction profiles group device controls for ease of use

• Many Advantages
  - Content can use new devices with no code changes
  - Future-proofing for innovation in input devices and form factors
  - Easily enable accessibility devices by rebinding actions to controls

Input and Haptics

Create action and action spaces

```
xrCreateAction
  name = "teleport"
  type = XR_INPUT_ACTION_TYPE_BOOLEAN

  name = "teleport_ray"
  type = XR_INPUT_ACTION_TYPE_POSE

xrCreateActionSpace
  action = "teleport_ray"
```

OpenXR separates the application actions such as Move, Jump, and Teleport from the input device: Trigger, Thumbstick, and Button. This simplifies support for different or future input devices and maximizes user accessibility.

Set up interaction profile bindings

```
xrSetInteractionProfileSuggestedBindings
  /interaction_profiles/oculus/touch_controller
    Action "teleport"
      -> /user/hand/right/input/a/click
    Action "teleport_ray"
      -> /user/hand/right/input/pointer/pose

  /interaction_profiles/htc/vive_controller
    Action "teleport"
      -> /user/hand/right/input/trackpad/click
    Action "teleport_ray"
      -> /user/hand/right/input/pointer/pose
```

Interaction profiles identify a collection of buttons and other input sources in a physical arrangement to allow applications and runtimes to coordinate action to input mapping. Interaction profiles for well known XR systems are included in the specification.

Get action states

```
xrGetActionStateBoolean ("teleport_ray")
if (state.currentState) // button is pressed
{
  xrLocateSpace (teleport_ray_space, stage_reference_space);
}
```
OpenXR View & Form Factor Configurability

- Applications can:
  - Query for runtime-supported View and Form Factor Configurations
  - Applications can then set the View Configurations and Form Factors that they plan to use
  - Select and change their active configuration over the lifetime of the session

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<th>Projection CAVE-like</th>
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<td>(future support)</td>
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Bringing XR to the Web

Native XR Apps

Web XR Apps

Native 3D Engines

Web 3D Engines

The Web will Evolve into the Metaverse

Lifting OpenXR functionality into the Web stack

Close cooperation between WebXR and OpenXR

WebXR

three.js

WebGL™

Khronos provides the foundation for native and Web-based 3D/XR
Resources and Industry Call to Action

- OpenXR Landing Page - Specification, Reference Pages, Sample Code, Overview
  - https://www.khronos.org/openxr

- OpenXR Forum and Slack Channel
  - Forum: https://khr.io/openxrfeedback
  - Discussion: https://khr.io/slack

- Detailed specification overview and SIGGRAPH session videos

- Vendor prototype runtime implementations
  - Collabora: open source OpenXR Runtime for OpenHMD-compatible Headsets on Windows and Linux: http://monado.dev
  - Microsoft: OpenXR runtime for Windows Mixed Reality headsets https://aka.ms/openxr

- Khronos GDC Sessions - including OpenXR Presentation and demos
  - https://www.khronos.org/events/2019-gdc

Developers are invited to provide feedback on the OpenXR 0.90 Provisional Specification and prototype implementations!