



Why are Standards Needed and How are they Created

Neil Trevett, Khronos President
ntrevett@nvidia.com [@neilt3d](https://twitter.com/neilt3d)

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Topics

- 1. Paths to interoperability: open standards and open source**
2. Principles behind making successful open standards
- 3. Open standards lifecycle**
4. Building industry cooperation around open standards

Khronos Connects Software to Silicon



Open, royalty-free interoperability standards to harness the power of GPUs, multiprocessors and XR hardware

3D graphics, augmented and virtual reality, parallel programming, inferring and vision acceleration

Non-profit, member-driven standards organization, open to any company

Well-defined multi-company governance and IP Framework

Founded in 2000

>180 Members ~ 40% US, 30% Europe, 30% Asia

Standards Make Technology Pervasive

Standards are the basis for ubiquitous infrastructure



- IEC 60038 Standard voltages
- IEC 60228 Conductors of insulated cables
- IEC 60269 Low-voltage power fuses
- IEC 60320 C13 Connectors and C14 Inlets
- IEC 60884 Household Plugs And Socket-Outlets
- IEC 61970 APIs for energy management systems

Widely adopted platforms require multiple standards

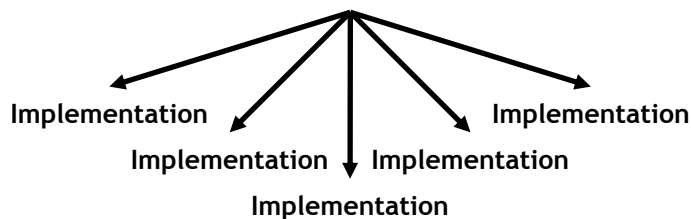


Making a vision such as the pervasive metaverse will involve a constellation of standards!



Open Standards and Open Source

Open Standard = Shared Specification

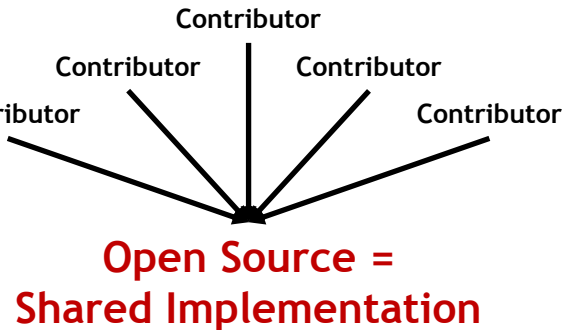


Best When ...

- Competitive advantage in implementation innovation
- Industry needs multiple implementations
- Need a stable design target

But..

- Can take time to generate consensus on a new version
- Conformance testing is vital



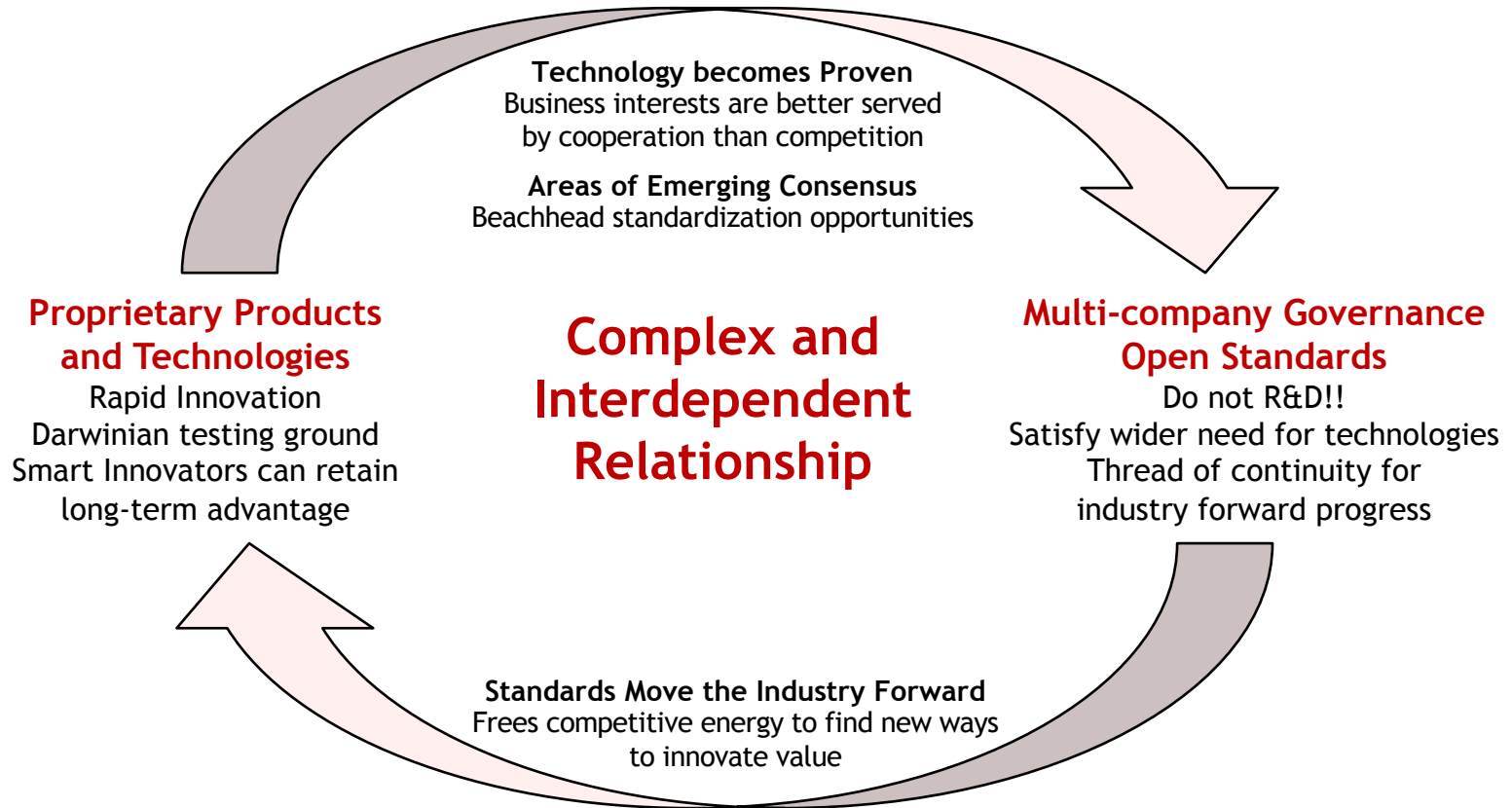
Best When ...

- No competitive advantage in implementation
- Industry consensus to share implementation resourcing
- Need rapid updates

But..

- Can fork and fragment
- Need governance model clarity

Open Standards and Proprietary Technology



Basic Principles for Successful Open Standards

‘Open’ means...

- Open to all who wish to participate in their creation
- Created under transparent, well-defined multi-company governance
- No company has superior voting or ownership rights
- Designs based on technical merit
- No restrictions on who can implement and adopt

‘Free’ means...

- No charge for access to specification documents
- No charge to users of specifications
- Royalty-free patent license to implementors from all involved in creating the specification
- More Member Patents == More Protection

Industry adoption is the measure of a standard’s success

- Voluntarily, market-driven usage throughout the industry
- Adoption needs an ecosystem to enable effective usage of the standard

How Are Open Standards Made



Enabling applications and engines to portably leverage hardware acceleration



3D Graphics
GPU graphics and compute acceleration for native and web platforms



Run-time Optimized 3D Assets
For pervasive deployment and interoperability

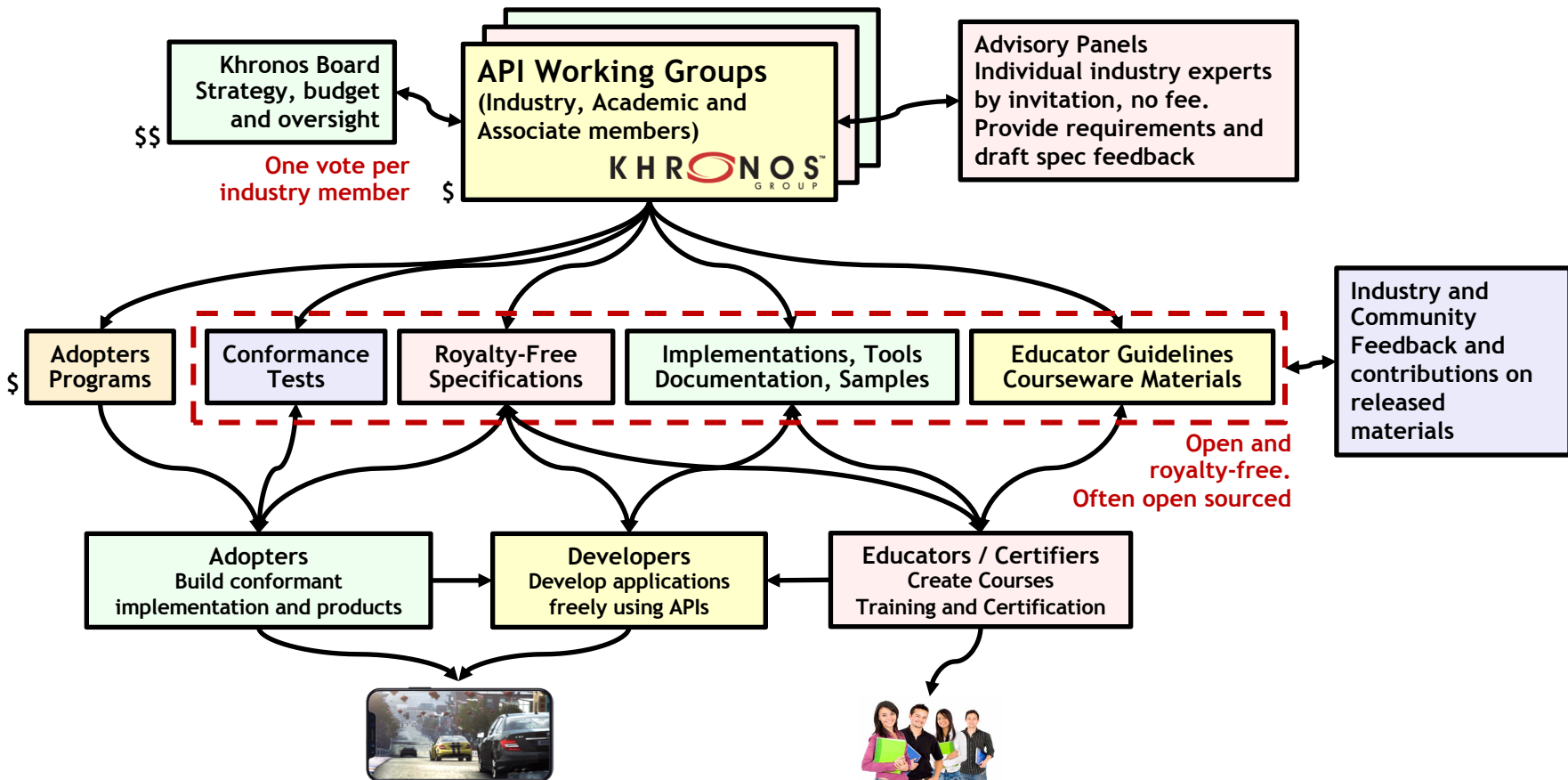


Portable XR
AR and VR runtimes, HMDs and UI



Sensor Processing
Vision and sensor processing, inferencing acceleration

Khronos Cooperative Framework



Open Standard Lifecycle

New Initiatives

How does the industry decide to start new standardization initiatives?

Cooperative Framework

What are the organizational principles that enable effective consensus?

IP Framework

The legal framework to enable pervasive implementation and adoption

Conformance and Adoption

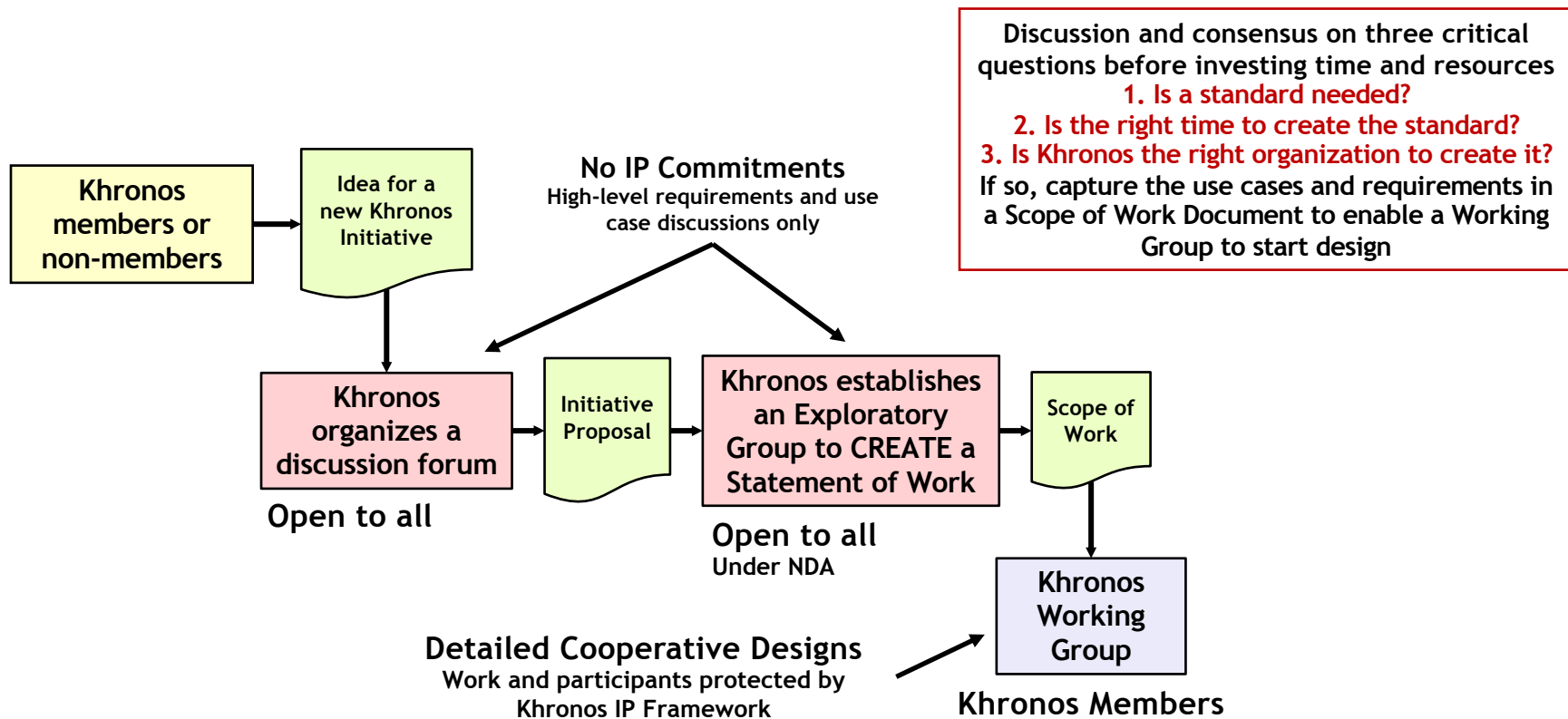
Widespread deployment of consistent and protected implementations

Building Ecosystems

Investing in documentation, tools, education and outreach activities



Khronos New Initiative Process



Khronos Cooperative Framework

Any entity,
commercial or
academic, is
welcome to join



Royalty-free
Specifications

Conformance Tests and
Adopters Programs

Documentation and
examples

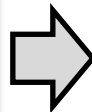
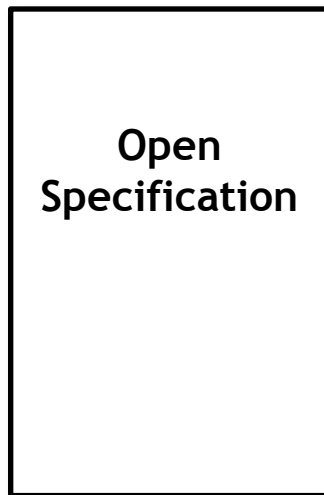
Open-source SDKs
and tools

'Traditional' IP Frameworks

SDO Members

Explicit identification of patent licenses needed by specification implementers

Limits on scope of grant to protect Members' IP portfolios



Implementers

Need clarity on patent license terms from the specification creators to decide whether to adopt

Fewer fees and restrictions encourages wider adoption

Typical Traditional IP Frameworks

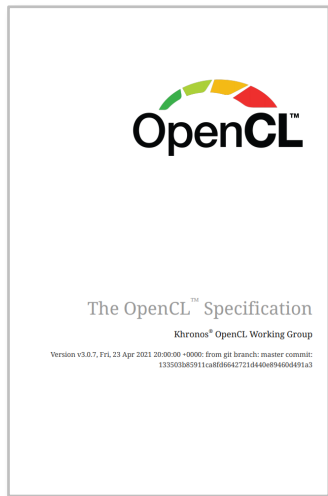
SDO Members are asked to list essential patents they are aware of (with license terms for their own)
Some SDOs allow terms with royalties - but typically must at least be reasonable and non-discriminatory (RAND)
Implementers negotiate licenses with SDO Members individually or through a 'patent pool'

'Modern' IP Framework

Khronos Members

Agree to a ROYALTY-FREE reciprocal license to any essential patents they own for any CONFORMANT implementation of a ratified specification
(fail-safe and no patents need be disclosed)

License covers only the explicit contents of the specification - not other possible implementation technologies
(key to protecting member IP portfolios)



Implementers

Any entity can use a Khronos specification with no trademark or patent licenses at any time

Formal Adopters are enabled to submit Conformance Test Results for trademark license and (optional) reciprocal patent licenses
(no negotiation with Khronos or Khronos Members is needed)

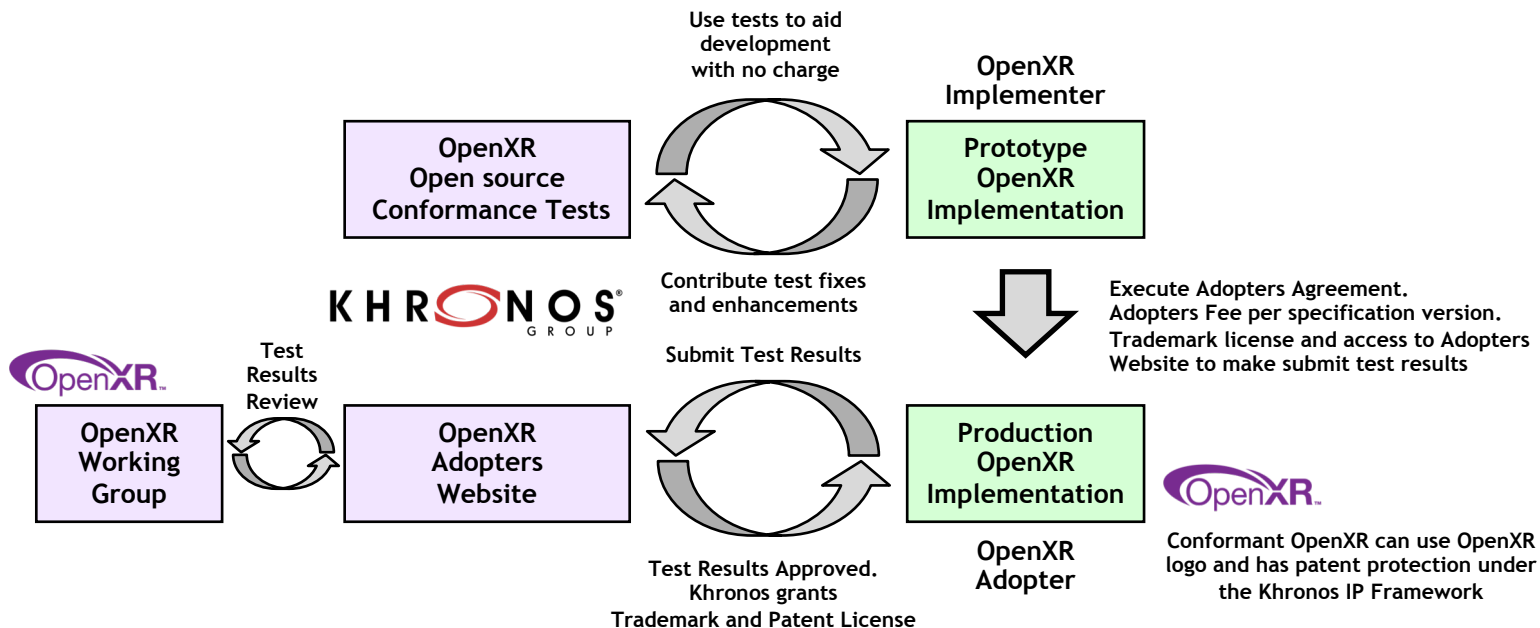
Explicit reciprocal patent license in Membership and Adopter Agreements

Enhances mutual protection and clarity

Builds network of licensing protection for the standard from Members *and* Adopters

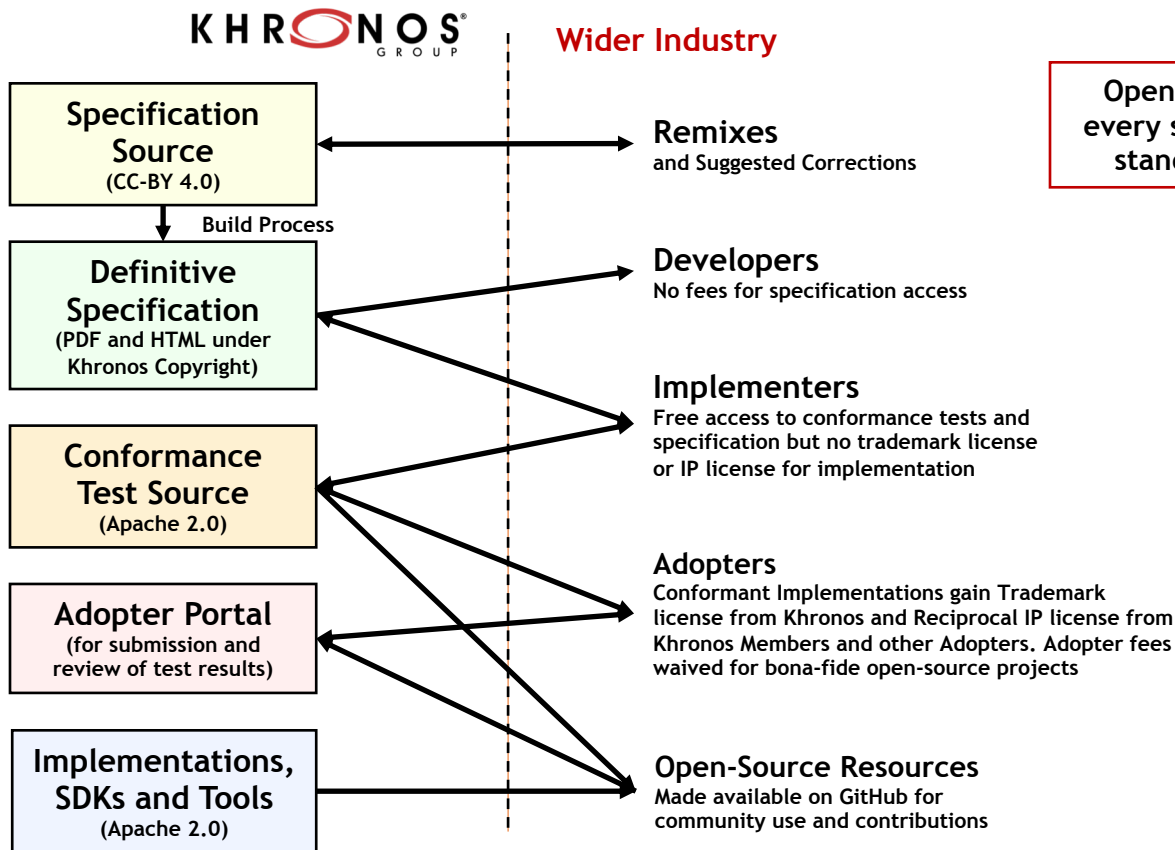
Implementation, Conformance and Adoption

Every open standard needs Conformance Tests and an associated Adopters Programs for defining conformance and ensuring cross-vendor portability



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

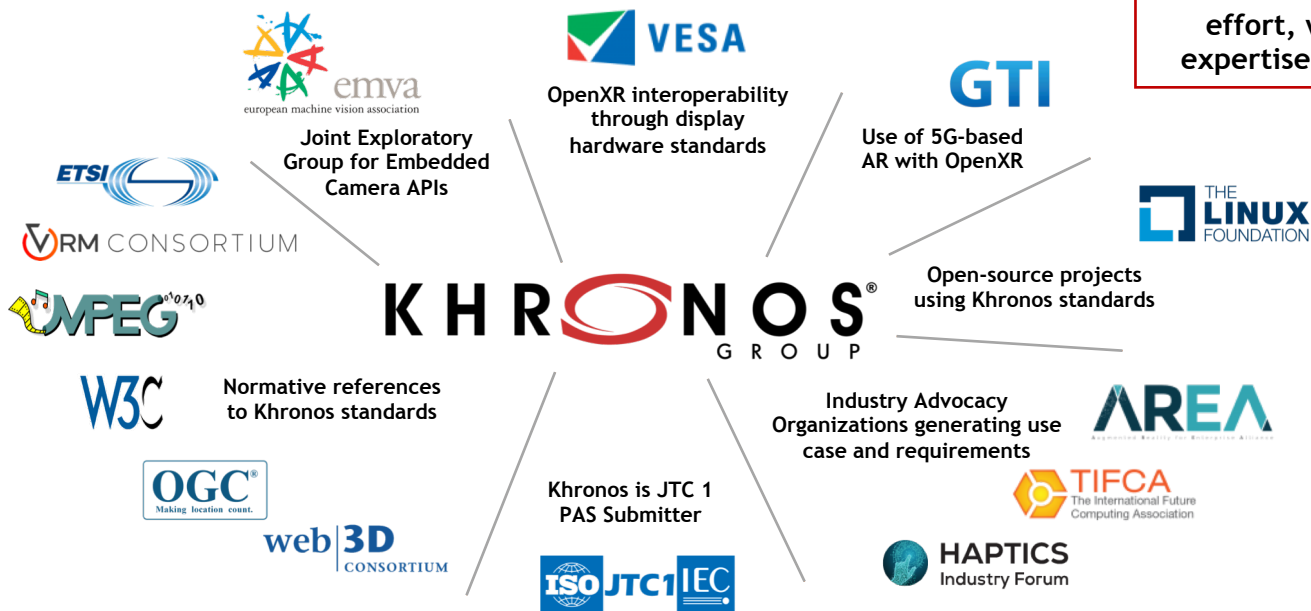
Open Standards and Open-Source Synergy



Open source is a vital tool at every stage of creating an open standard and its ecosystem

Standards Organization Cooperation

Many standards organizations seek liaison opportunities to leverage or influence each other's work, and avoid duplication of effort, while respecting each others expertise, processes and IP frameworks



For example, Khronos's Liaison Agreements are constantly expanding and reflect the diverse ways that industry consortia can productively cooperate

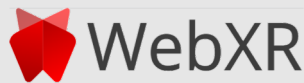
Liaison Example: Bringing XR to the Web

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

three.js



Engines



3D Stack

Driving GPUs to Render scenes

XR Stack

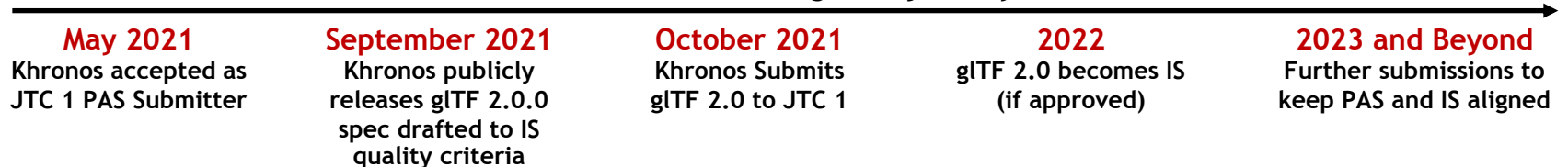
Handling XR Devices for creating UI

International Standards

- **Most standards are created by Standard Developing Organizations (SDOs)**
 - Fast moving industry consortia
- **International Standards (IS) are created by multiple national standardization bodies**
 - Often constitute the regulatory basis for public procurement of IT goods and services
 - Significantly widens the market recognition of a specification
- **ISO/IEC JTC 1 PAS (Publicly Available Specification) Submission Process**
 - Enables the transposition of a widely adopted industry standard into an IS
 - The SDO can remain in control of the PAS and IS to prevent fragmentation
- **Khronos is the most recent SDO to be approved as a JTC 1 PAS Submitter**
 - One of fourteen SDOs globally
 - glTF 2.0 will be Khronos' first PAS Submission



glTF's journey to become an International Standard



Closing Thoughts

No standard ever built itself

Participation is the life blood to creating open standards

Creating Standards takes passion and patience

Of those that see the benefits to the industry and society

Please consider getting involved

You will be made very welcome!

