UXL Foundation: Drive an Open Standard Accelerator Software Ecosystem
## Agenda

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<th>UXL Foundation introduction</th>
<th>Rod Burns, Steering Committee Chair</th>
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<td>Andy Wafaa, Arm, Open Source Working Group Chair</td>
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<td>Robert Cohn, Intel, Specification Working Group Chair</td>
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<td>Working Groups and SIGs</td>
<td>Penporn Koanantakool, Google Cloud, AI SIG Chair</td>
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What’s happening in the UXL Foundation?  

- Our members

How to contribute  

- Rod Burns, Steering Committee Chair
Solving the Challenge of Diverse Hardware Acceleration

70% of developers target heterogeneous systems that use more than one kind of processor or core

Developer Challenges: Multiple Architectures, Vendors, and Programming Models

Open, Standards-based, Multiarchitecture Programming

Video: What is oneAPI? Overview & Benefits
Commitment to Open, Scalable Acceleration

Linux Foundation governed open industry foundation driving a vendor-neutral software ecosystem for multi-architecture accelerated computing

- oneAPI Specification
- Libraries deliver cross-vendor building blocks for developers

Open, Standards-based, Multi-architecture Programming

Performance  |  Productivity  |  Freedom from Vendor Lock-In

CPU  |  GPU  |  FPGA  |  Other Accelerators
Open Standards Programming for All Accelerators

Mission

- Build a **multi-architecture multi-vendor software ecosystem** for all accelerators
- **Unify** the heterogeneous compute ecosystem **around open standards**
- Build on and expand **open source projects for accelerated computing**
Unified Acceleration Foundation

Steering Members

arm | FUJITSU | Google Cloud | Imagination

intel | Qualcomm | SAMSUNG | vmware by Broadcom

Contributor Members

AKHETONICS | FIXSTARS | AXELERA | CloudsAI

codasip | AXELERA | EMBECOSM | Xiang Dixonian

UXL
UXL Foundation Governance
Using Best Practices

Joint Development Foundation governance

**SIGs:** AI, Hardware, Language, Math, Safety Critical

**Working Groups:** Specification, Open Source

Anyone can participate in SIGs and Open Source Projects. Contributors to the Specification must sign the Membership Agreement or Non-Member Feedback Agreement.
Unified Acceleration Foundation

oneAPI Specification and Projects

- SYCL powers the UXL Foundation libraries
- Heterogeneous, cross-vendor programming model
Building on Strong Foundations

2019-2020
- oneAPI provisional specification
- Technical Advisory Boards established

2021-2022
- oneAPI Specification delivered
- Created additional TABs
- Held oneAPI DevSummits

2023-2024
- Members join the UXL Foundation
- Specification migrated to UXL Foundation
- SIGs and Working Group established to coordinate feedback and work

SPECIFICATION

OPEN SOURCE
- Open source implementations of oneAPI specification made available
- Initial targets for Intel processors

- Nvidia and AMD targets added to oneMKL and oneDNN
- Arm target added to onDNN
- Broad adoption of libraries

- Open Source projects migrated to UXL Foundation
- Arm target added to oneDAL
Projects Adopting UXL Foundation
Using libraries for cross-vendor portability

GROMACS
Project uses oneMKL math library to target multiple architectures

TensorFlow and PyTorch
Projects use oneDNN library for accelerated graph optimization

Ginkgo
Project uses oneMKL and oneDPL for optimized math and ISO C++ routines

US National Laboratories
Projects using oneMKL to deploy big science applications across supercomputers and for exascale

And many more…
Use the UXL Foundation Libraries Today

Download the project binaries via the oneAPI Base Toolkit
Or build the projects from open source
Target AMD, Arm, Intel and Nvidia processors
Building alliances

UXL Foundation

Project Dependencies

Future Collaborations

oneAPI Specification

Defines the specification used by UXL Foundation projects

Integration of UXL projects and demonstrations

THE AUTOWARE FOUNDATION

KHRONOS GROUP

RISC-V

LLVM Foundation

PyTorch

C++

SYCL™

UXL Foundation
UXL Foundation Working Groups

Open Source Working Group
- Adopting Open Governance and Best Practices for Open Source, Security
- Demonstration projects
- CI/CD for multiple architectures
- Migration to UXL Foundation Infrastructure

Specification Working Group
- Forum for issues impacting multiple components
- Adopting best practices for community feedback
- Coordination of release schedules
- Migrating to UXL Foundation Infrastructure

Become a member to join the Working Groups and help shape the projects
**UXL Foundation SIGs**

- **Language**
  - Enabling languages for accelerated computing

- **Math**
  - Optimized operators for commonly used functions

- **AI**
  - Accelerated libraries and frameworks for machine learning and AI algorithms

- **Hardware**
  - Bringing more target processors to the UXL projects

- **Safety Critical**
  - Enable or accelerate integration into safety critical systems, targeting markets such as automotive and avionics.
Fujitsu’s presence in OSS community since 2005, via open-source development in mission-critical systems and in the Supercomputer Fugaku & we are further committed to continuing with this legacy through FUJITSU-MONAKA (2nm Arm CPU).

Optimized and ported the oneDNN DL process library software for the Arm SVE instruction so that it can run at high speed on the Fugaku supercomputer.

Recent success towards porting of oneDAL on Arm to accelerate ML workloads on Arm. This is also one of the first OSS contributions to UXL foundation.
TensorFlow, JAX, and OpenXLA use oneAPI Deep Neural Network (oneDNN) library to accelerate performance on x86 and aarch64 CPUs, and Intel GPUs.

Google Cloud’s Cloud HPC Toolkit includes oneAPI Math Kernel Library (oneMKL).
Imagination
Dave Murray
Unlocking the full potential for accelerated computing requires a cross-platform software ecosystem based on open source and open standards.

Intel contributed projects to UXL for: math, AI, data parallel & distributed computing...

With UXL and LF, we are fully embracing open governance to build strong developer communities for accelerated computing.
Qualcomm

Dr. Vinesh Sukumar
Samsung

Hanwoong Jung

- Parallel programming model for memory-centric computing
  - SYCL extensions for PIM/PNM
- Deep learning compiler/runtime
  - Use oneDNN and unified runtime in oneAPI
- With UXL, we expect the open collaboration will bolster programming models and SW stacks to effectively accelerate AI/HPC applications on NPU, PIM/PNM, and RISC-V CPU/accelerator by Samsung
Open Source and Standardization is a core tenant of VMware culture.

VMware offers customers choice and flexibility through our growing Private AI Ecosystem.

Streamlining interoperability in both hardware and software is key for adoption of new architectures.
# VMware Private AI Open Ecosystem

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<th>Falcon</th>
<th>Llama 2</th>
<th>Mistral</th>
<th>MPT</th>
<th>StarCoder</th>
<th>WizardML</th>
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<td>anyscale</td>
<td>cnvrg.io</td>
<td>DOMINO</td>
<td>DKube</td>
<td>FedML</td>
<td>Hugging Face</td>
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<td>Kubeflow</td>
<td>NVIDIA NEMO</td>
<td>oneAPI</td>
<td>PyTorch</td>
<td>run:ai</td>
<td>Weights &amp; Biases</td>
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<td>watsonx</td>
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<td>AMD</td>
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VMware Cloud Foundation™
Contribute
How to Contribute?

Bring your feedback
• Submit issues
• Join the SIGs
• Join the Working Groups
• Contribute to project RFCs

Contribute to projects
• New features
• Expand hardware support
• Documentation

Contribute resources
• Build infrastructure
• Testing
# Membership

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<thead>
<tr>
<th>Membership Type</th>
<th>Annual Fee</th>
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<tbody>
<tr>
<td>Steering Member</td>
<td>$20,000/year*</td>
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<tr>
<td>General Member</td>
<td>$5,000/year*</td>
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<tr>
<td>Contributor Member</td>
<td>$0/year</td>
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* Linux Foundation Membership required

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<tr>
<td>- Seat on Steering Committee</td>
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<td>- Influence direction</td>
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<td>- Voting Rights</td>
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<table>
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<th>General Member Benefits</th>
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<tr>
<td>- Voting rights in Working Groups</td>
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<td>- Influence project work packages</td>
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<td>- Co-marketing</td>
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<tr>
<td>- Join Working Groups</td>
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<td>- Participate in work packages</td>
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Join Us!
Check out the UXL Foundation & oneAPI specification

- UXLFoundation.org
- oneAPI.io

Join Our Mailing Lists
Join Slack