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Fact Sheet

Open Source Software: Intel Engineers are Engaged

Intel engineers maintain and contribute to a variety of projects and communities worldwide that span operating systems, graphics, tools and standards.

At Intel Innovation 2021, the company laid out its developer-first approach that ensures hardware and software are equally important. A key element of this approach includes open source projects that Intel engineers maintain and contribute to from the Linux kernel to cloud orchestration. Software is the ecosystem enabler, and it is developers that bring together hardware and software in unique and inventive ways. Together with developers, Intel will harness the convergence of ubiquitous computing, cloud-to-edge infrastructure, pervasive connectivity and artificial intelligence to deliver world-changing experiences. More information can be found at open.intel.com.

With more than 15,000 software engineers, Intel contributes to more than 100 different open source projects. Here are just some of those projects.

Open Source Projects

- Linux kernel and KVM virtualization: Intel has been the top corporate contributor to the Linux kernel since 2007, contributing 10% of the total changes. Intel is also the top corporate contributor to kernel-based virtual machine (KVM) project, which is a sub-project within the Linux kernel project.
- Linux Kernel Performance – Zero Day: The infrastructure Intel developed to test the Linux kernel is called 0-Day. It is a service and test framework for automated regression-testing that intercepts kernel development at its earliest stages and is available to the worldwide Linux kernel community. This project provides a further "shift-left" by testing key developers' trees before patches move forward in the development process.
- Chromium: The Chromium project is the code base for the Google Chrome browser and the Microsoft Edge browser, which together are around 70% market segment share. It is also widely used in web-based applications including Microsoft Teams and Visual Studio Code. Intel is a leading contributor and engaged in creating and building new standards for web capabilities in the World Wide Web Consortium (W3C). Recent work includes enabling native GPU support in the web platform.
- Web Assembly Micro Runtime (WAMR): Web Assembly Micro Runtime (WAMR) is a standalone WebAssembly (WASM) runtime with a small footprint.

- TensorFlow: TensorFlow is a widely used machine learning framework in the deep learning arena, demanding efficient utilization of computational resources. To take full advantage of Intel® architecture and to extract maximum performance, the TensorFlow framework has been optimized using oneAPI Deep Neural Network Library (oneDNN) primitives, a popular performance library for deep learning applications. The oneDNN optimizations are also available in the official TensorFlow release, enabling developers to seamlessly benefit from the Intel optimizations.
- Node.js: Node.js is an open source, cross-platform, backend JavaScript runtime environment that runs on the V8 (V* is also used in the Chromium-based web browsers) engine and executes JavaScript code outside a web browser. Node.js lets developers use JavaScript to write command line tools and for server-side scripting — running scripts server-side to produce dynamic web page content before the page is sent to the user's web browser. Intel is contributing primarily to the V8 JavaScript engine to deliver the best possible performance on Intel platforms.
- Data Plane Developer Kit (DPDK): This multiarchitecture set of libraries accelerates network-packet-processing workloads within a minimum number of CPU cycles, includes fast-packet capture algorithms and provides the ability to run third-party, fast-path stacks. Some packet-processing functions (built using the underlying DPDK technology) were benchmarked at up to a billion 64-byte packets per second on a single-server platform.
- Zephyr Project: The Zephyr Project is a Linux Foundation hosted Collaboration Project. It's an open source collaborative effort uniting developers and users in building a best-in-class small, scalable, real-time operating system (RTOS) optimized for resource-constrained devices, across multiple architectures.
- Open Edge Insights: Empower the industrial IoT edge ecosystem with differentiated features that facilitate development and deployment of software-defined AI solutions in manufacturing, process automation, energy generation and distribution and supply-chain logistics. This microservice, open source software project accomplishes this work by reducing complexity, providing best-in-class configurations, and optimizing for performance.
- Intel® Extension for Scikit-learn: This package provides a seamless way to speed up a scikit-learn* application. It contains a patching functionality (originally available in daal4py) that provides a machine-learning framework that's well suited for dealing with real-life problems.
- TianoCore: This is an open source implementation of the Unified Extensible Firmware Interface (UEFI). Use a companion product — EDK II, which is based on Intel's recommended implementation of UEFI — as a modern, cross-platform firmware development environment.
- Kubernetes: Intel is building a collection of device plug-ins for Kubernetes that make the hardware capabilities of the platform visible so that containers that use them can be placed on the correct hardware nodes. For example, a container that uses a discrete GPU for an AI application can be placed on a compute node containing the necessary hardware.
- Kata Containers: Adopted by Red Hat and several CSPs as their secure container solution, Kata Containers is an open source community working to build a secure container runtime with lightweight virtual machines

that feel and perform like containers, and also provide stronger workload isolation using hardware virtualization technology as a second layer of defense.

- ACRN: A flexible, lightweight reference hypervisor, built with real-time and safety-criticality in mind, optimized to streamline embedded development through an open source platform used in industrial IoT workload consolidation.
- Cloud hypervisor: A virtual machine monitor for modern cloud workloads. Features include CPU, memory and device hotplug, support for running Windows and Linux guests, device offload with vhost-user and a minimal compact footprint. Written in Rust with a strong focus on security. This project includes collaborators Microsoft and Alibaba, among others.
- Project Celadon: Celadon is an open source Android distribution fully optimized for Intel® platforms. It modifies the Android stack by incorporating critical technologies that allow you to run Android applications in virtual machines and containers. With Celadon, broad workload-consolidation use cases (from edge to cloud) become accessible across different Intel platforms using a single, unified code base.
- Gramine (previously Graphene): Gramine is a lightweight library operating system. The project is designed to run applications in an isolated environment with benefits comparable to running a complete operating system in a virtual machine. The Confidential Computing Consortium just announced its first production-ready version – Gramine 1.0 – to enable protecting sensitive workloads with Intel® Software Guard Extensions (Intel® SGX).

Open Source Tools

- LLVM: The LLVM open source project is a collection of modular and reusable compiler and toolchain technologies supporting multiple processor architectures and programming languages. Intel's active collaborations today include optimization report additions, expanded floating-point model support, and enhanced vectorization. Intel contributes to LLVM projects directly, and we also have a staging area (Intel project for LLVM technology) for SYCL support. The Intel C/C++ compilers have completed the adoption of LLVM. More information found here.
- ControlFlag: ControlFlag is a novel self-supervised machine programming system from Intel Labs that can autonomously detect coding anomalies in source code control structures and work with any programming language that has control structures.
- Machine Inferred Code Similarity (MISIM): This joint project between Intel Labs, Massachusetts Institute of Technology and Georgia Institute of Technology is an automated engine designed to learn what a piece of software intends to do by studying the structure of the code and analyzing syntactic differences of other code with similar behavior.
- Intel Quantum Simulator (Intel-QS): Intel-QS is a simulator of quantum circuits optimized to take maximum advantage of multi-core and multi-nodes architectures. It allows for classical simulation of quantum computers, both for numerical studies of quantum algorithms and for modeling noise and errors, by leveraging the available hardware resources provided by supercomputers, as well as available public cloud computing infrastructure.

Open Source Standards Groups and Foundations

- Linux Foundation: Intel is a platinum member of the Linux Foundation, which was built on the idea of the democratization of code and scaling adoption for all projects equally. Expert legal and governance support programs ensure everyone is on the same playing field. Other Linux Foundation membership groups include:
    - Cloud Native Computing Foundation
    - Linux Foundation Networking
    - Confidential Computing Consortium (founding member)
    - OpenSSF
- Open Infrastructure Foundation: OpenInfra Foundation hosts open source projects that contribute to the advancement of today's infrastructure. From cloud hosting to the driving force behind 5G, these projects are code first and operate under the guiding principles we call the "Four Opens." These projects include OpenStack, Airship, Kata Containers, OpenInfra Labs, StarlingX, and Zuul.
- World Wide Web Consortium: The World Wide Web Consortium (W3C) is an international community that develops open standards to ensure the long-term growth of the Web. Intel is a member of the Advisory Board and the Technical Architecture Group, chairs four working groups and contributes to ten working groups.
- Bytecode Alliance: The Bytecode Alliance is a nonprofit organization dedicated to creating secure new software foundations, building on standards such as WebAssembly and WebAssembly System Interface (WASI).
    - Intel is a founding member of the alliance contributing the WAMR project noted above.