

Introducing Linaro

July 2022



Linaro accelerates deployment in the Arm Ecosystem

Linaro works with businesses and open source communities to develop software on Arm-based technology.

We bring together domain expertise and a rich ecosystem of industry leaders and collaborators to solve complex technological challenges. We create solutions that drive forward the Arm software ecosystem, enhance standardisation, promote collaboration across industries and contribute to real-world applications.



Member companies Linaro collaborates with



Collaboration spans many technologies, helping enable new markets on Arm Architecture

Automotive, IoT & Edge Devices



Open standards for Automotive, IoT & Edge solutions

Linaro works with member companies on developing open standards and interfaces which will help accelerate and secure deployment of their Automotive, IoT and Edge solutions.



Linaro IoT & Embedded Group



Linaro Edge & Fog Computing Group

Client Devices



Advancing the Android Ecosystem on Arm

Linaro works with member companies to achieve the optimal user experience on Android and/or Windows by helping upstream new features, reduce technical debt and detect regressions.



Linaro Consumer Group



Linaro Windows Group

Cloud Computing & Servers



Making Arm a first class citizen on servers

Linaro, together with its member companies, is working on making key open source projects enabled for Arm-based servers. We refer to this as making Arm a first class citizen.



Linaro Datacenter & Cloud Group

Core Technologies

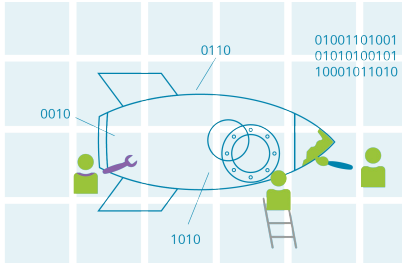


Accelerating time to market through collaboration

Member companies collaborate with Linaro and other industry leaders on tools, frameworks, testing and security in order to share engineering resource, leverage Linaro expertise and accelerate time to market.

Companies may also partner with Linaro to work on a one-to-one basis on their project

Leverage our Arm expertise



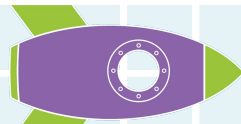
As part of Linaro, Developer Services has some of the world's **leading Arm Software experts**. All of this expertise and experience is made available to you for your project.

Secure your product



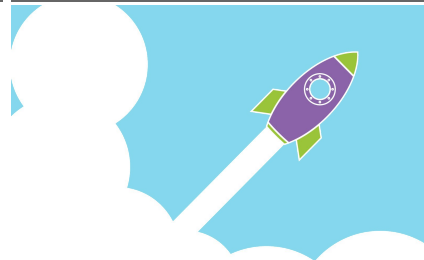
Specialists in security and Trusted Execution Environment (TEE) on Arm, we leverage open source to ensure you **benefit from the latest upstream features and security fixes**.

Maintain quality cost-effectively



We offer continuous integration (CI) and automated validation for your product software, ensuring the **highest possible quality**. We upstream code to **reduce the cost and effort needed to maintain your product**.

Build, Test and deploy faster



We support every aspect of product delivery, from building secure board support packages (BSPs), product validation and long-term maintenance - we help get your **products to market faster**.

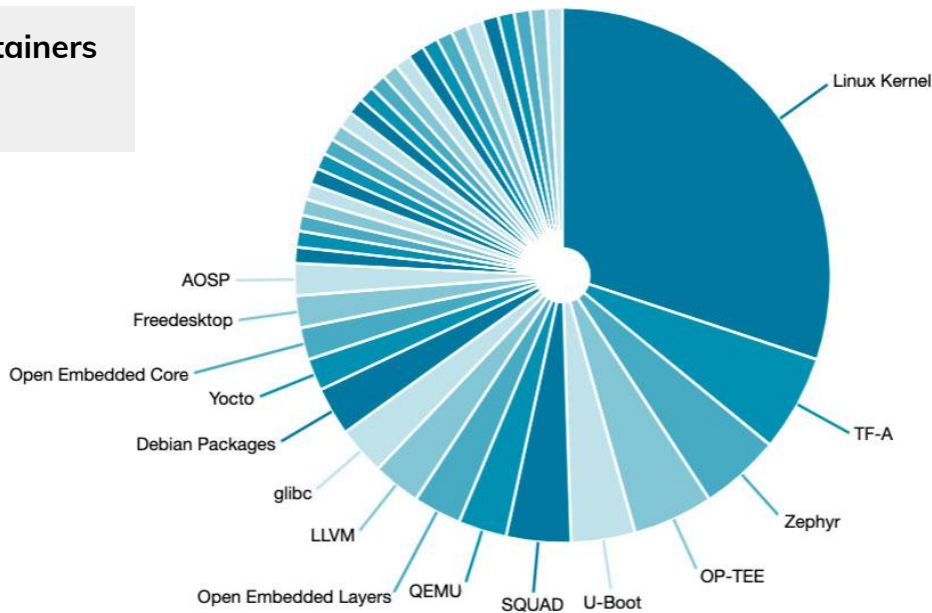
Why Linaro?

Linaro bridges the gap between the open source software community on Arm & industry leaders

68

**Open Source Software Maintainers
work at Linaro**

Many of our engineers are maintainers on open source projects in the Arm software ecosystem. This makes us uniquely positioned to drive the conversations needed between the open source community and industry leaders to identify opportunities, highlight problems and propose solutions.



We accelerate time to market and help deliver higher quality software

2010

Year Linaro formed to
Address fragmented code
bases and consolidate &
improve how OS is used

4m

Tests on Android per week

50%

of Linaro patches are
accepted within 7 days of
submission (75% within
35 days)

Number of patches submitted to
upstream projects in the past 2 years

47K

Consistently
in the top

10

Contributors to
the Linux kernel

The active role we play in the Arm software ecosystem and the technical domain experts we employ also result in solutions being upstreamed quicker. Our automated testing capabilities and security expertise ensure products are more secure and of higher quality when they end up in the hands of end users.

What Linaro members have to say



"The collaboration platform for the Arm partnership. Where everyone comes together to collaborate on open source software, where conversations take place and non-differentiating solutions are discussed and worked upon."

Thomas Molgaard, Arm



"Linaro are like the all-star team of open source technology in many ways. This is a group of highly experienced experts that know what they're doing. We learn a lot by being members of Linaro that we wouldn't be able to learn in any other community"

Rob Oshana, NXP



"In order to become part of the open source community, I felt it was very important to join our peers. I believe we benefited greatly from joining Linaro since we now have a connection with various communities including Linaro and the Linux Community."

Kouichi Hirai, Fujitsu

What Linaro Developer Services customers have to say

"At Square, we face the challenge of maintaining our Terminal and Register hardware products, which are based on short-support-cycle mobile technology, in an industry that requires long lifespans and up-to-date security patching. After the Qualcomm SD615 processor (2014) powering our devices went end-of-life in 2018, Square chose to engage with the Arm Linux specialists at Linaro for upstream-based extended life. Having seen their previous work on the DragonBoard 410c, we were confident that upstreaming was the right path and Linaro was the right partner to deliver a new Linux kernel paired with an up-to-date Android release.

The team dispatched from Linaro Developer Services was highly experienced in how to accomplish this without compromising on productization-level stability, battery life, or performance. As a result of this collaboration, Square is able to continue providing regular OS and kernel upgrades to our Terminal and Register customers for 5-10 more years. In particular, Linaro's expertise and assistance in bringing SoCs and boards into mainline ensures upstream support doesn't decay over time & provides a platform for the community to continue contributing to and benefiting from the work, reducing long term software burden."

Benjamin J. Li, Hardware, Square



"Linaro Developer Services provide deep Arm technical knowledge as well as strong relationships within various upstream communities. Their engagement in the latest Arm technologies allows for quick and solid deliverables, helping to de-risk a program. They have helped enable an Arm-based Windows laptop to support Linux, developed a variety of Docker containers for Arm-based servers, and also enabled firmware secure boot capabilities on an NXP-based system. If you need help with Arm firmware or software development, Linaro brings that professional edge."

**Paul Benson, Program Director,
Central Engineering, Arm**



Engineering solutions for the **Arm Ecosystem**

Members collaborate on projects which aim to..

Solve Ecosystem Quality Problems

Projects which aim to solve ecosystem quality problems focus primarily on testing. Here stakeholders collaboratively fund consistent continuous testing of key configurations to make upstream the quality reference.

Deliver Upstream Support for Architecture and OS Requirements

Projects which concentrate on upstream support focus on improving technology by adding more functionality, increasing security across the ecosystem and regression testing. Through these projects, member companies have access to maintainers who have a say in what does or does not get upstreamed.

Solve problems of Fragmentation which limit Market Deployment

Linaro was initially formed to address fragmentation in the Arm software ecosystem and this is something we still do today whenever a new market emerges. The projects which address fragmentation focus on upstreaming all necessary technologies across multiple open source projects so that all ecosystem players work from a common reference.

Automotive, IoT & Edge Devices

Software defined functionality is no longer restricted to the cloud network but is now expected to extend to the edge. Autonomous AI-driven features are being deployed to positions of trust in gateways and even sensors. The Zonal Architecture revolution driving the evolution to software-defined vehicles is just one indicator that industry has switched to a software-first methodology. The technologies underpinning these use cases are continuously evolving but all suffer from one common denominator - the lack of open software standardization.

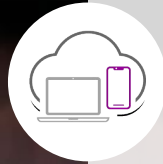


Linaro Projects

- **Open-CMSIS-Pack** - Simplifying IoT Workflows and Lifecycle Management
- **Stratos** - Developing hypervisor agnostic Virtio interfaces and standards
- **Trusted Substrate** - Bringing standards based secure booting and over-the-air (OTA) updates to the most trust demanding embedded computing projects
- **Ledge Reference Platform** - A lightweight highly secure and robust container runtime environment that has dependable boot and update capabilities.
- **Oniro** - A publicly available open source version of the HarmonyOS operating system. Linaro is driving engineering efforts on this project
- **Optimize AI for Microcontrollers** - Enabling inference workloads on Arm microcontrollers while optimizing the AI compiler experience for deeply embedded environments.

Client Devices

There is no doubt that Arm chips can deliver an exceptional user experience through efficient power consumption, fast performance and all day battery life. But for devices running on Arm-based technology to truly leverage these capabilities, operating systems (OS) need to ensure that open source tools and applications using their OS can run natively on Arm. This is no small task and the reason why Google and Microsoft collaborate with Linaro, its members and the open source community. Linaro drives the work needed to create strong ecosystems for Android and Windows on Arm.



Linaro Projects

- **Windows on Arm** - Establishing a healthy self-sustaining Arm open source ecosystem for Windows. This involves looking at a diverse set of tools, languages and frameworks and working to ensure these run natively on Windows on Arm.
- **Linux Kernel Development targeting Android** - Enabling and maintaining upstream kernels to work well with Android/AOSP so that end users have devices which are using the latest and most secure technology.
- **Software Device Enablement for Android** - Producing development boards which can be used for testing AOSP.

Cloud Computing & Servers

It is a well known fact that Arm chips have dominated the mobile market. The flexibility Arm offers device manufacturers who can design Arm chips to meet specific needs make it an attractive choice. But for Arm server chips to continue to meet the demands of businesses needing more storage and more data, there needs to be a software ecosystem in place that helps drive feature enablement, testing and bug fixing. Linaro works together with its member companies on strengthening the software ecosystem for Arm servers.



Linaro Projects

- **Arm Server Architecture** - Focusing on Arm UEFI, GRUB2 and related components to ensure the AArch64 boot process uses familiar tools already in common use and active development.
- **Big Data and Data Science** - Driving engineering activities and ARMv8 builds for projects such as Apache BigTop, Hadoop, Spark, Ambari and Drill.
- **Cloud Infrastructure** - Providing open-source cloud infrastructure projects with the capabilities to easily deploy, manage and deliver performance on Arm64.
- **Optimize for AI for Datacentre and Edge** - Addressing a wide range of use cases for AI training and inference, targeting Armv8.x based servers and supercomputers
- **Enhance Software-Defined-Storage on Arm Servers** - Providing competitive and leading storage solutions with Arm servers
- **Linaro Ecosystem Dashboard** - A one-stop resource for everyone to find necessary software project info and resources about Arm support.

Core Technologies

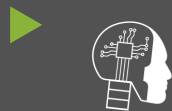
One of the main objectives when forming Linaro was to consolidate the Arm code base. Since the Linux kernel release 3.10, Linaro has been consistently listed as one of the top ten company contributors, worldwide, to Linux kernel. We are also widely recognized for the work we have done on toolchains such as GCC and LLVM. In addition to our work in the Linux kernel and toolchains, we are known for our expertise in security and testing through projects such as OP-TEE, LAVA and LKFT.



Linaro Projects

- **Arm GNU Toolchain Enablement and CI** - Improving optimizations for popular Arm cores & supporting new features.
- **Arm LLVM Toolchain Enablement and CI** - Implementing new and improve existing code-size and code-speed optimizations for AArch64 and Arm targets.
- **Enable Arm Architecture in QEMU** - Ensuring the Arm ecosystem is well represented & actively maintained in QEMU.
- **Linux Kernel Quality** - Ensuring and improving ongoing quality for 6 years Linux LTS releases, linux-next, and Linux mainline on the Arm architecture
- **Power and Performance** - Improving Linux subsystems such as the scheduler, thermal framework and traditional power management subsystems
- **Stratos - Hypervisor Abstraction** - Developing hypervisor agnostic Virtio interfaces and standards
- **System Control and Management Interface** - Some systems cannot afford a dedicated processor tasked with solving the challenge of sharing critical resources. This project addresses those use cases.

Technologies Linaro specialises in



Artificial Intelligence

Linaro works with industry leaders to bring the best in class Machine Learning Inferencing and Artificial Intelligence (AI) to the Arm ecosystem. This involves pushing experiences optimized for Arm on our member companies hardware across a range of strategic AI projects.



Linux Kernel

Linaro actively contributes to the upstream community and help facilitate acceptance of Linaro code into the Linux mainline kernel. Our ultimate goal is to ensure kernel consolidation - a single source tree with integrated support for multiple Arm SoCs and Arm-based platforms.



Security

Security has been an important topic for Linaro since our inception and we continue to play an instrumental role in designing and developing the essential security components found across multiple open source projects on Arm.



Testing & CI

Linaro provides the software tools to rapidly detect build and functional-test regressions in Linux, Android, Zephyr, and other operating systems against a variety of emulated and hardware targets (IoT, embedded, and server).



Toolchain

Linaro works directly with upstream communities such as GCC, Binutils, GDB, Glibc, Newlib, LLVM, Clang, LLD, LLDB, QEMU, Valgrind and OpenOCD. Our mission is to improve and maintain open-source Arm toolchain projects.



Virtualization

From faster turnaround to reduced downtime and costs, the benefits of virtualization are clear to see. Linaro plays a key role in QEMU and is also driving the project Stratos, which is developing hypervisor agnostic Virtio interfaces and standards to address richer ecosystems such as automotive, and IoT.

Linaro Initiatives

Delivering the only SoC independent open platform

96Boards is a range of hardware specifications created by Linaro to make the latest Arm-based processors available to developers at a reasonable cost. The specifications are open and define a standard board layout for SoC-agnostic (processor independent) development platforms.

For more information, go to www.96Boards.org



The Consumer Edition (CE) targets the mobile, embedded and digital home segments.



The Enterprise Edition (EE) targets the networking and server segments.



The IoT Edition (IE) targets the Internet of Things (IoT) and Embedded segments.



The SoM Edition (SoM) encourages the development of reliable and cost-effective embedded platforms for building end-products.

Securely Manage your Software Supply Chain

CodeLinaro is a cloud-based DevOps platform enabling companies and communities to comprehensively and securely manage distribution of software to their customers and users. For more information go to www.codelinaro.org



Seamlessly
integrated



Uncompromising
Security



Open
Collaboration



Business
Friendly



Collaboration
comes in **many forms**

How to work with Linaro

Linaro membership

Interested in collaborating with Linaro on any of our projects?

These are the levels of membership that allow you to participate in projects

CORE membership

Access to all projects
Dedicated Landing Team
One vote on the board

CLUB membership

Access to all projects

GROUP membership

Access to projects within a particular segment

PROJECT membership - Access to one single project

Linaro Developer Services

Interested in leveraging Linaro's Arm and open source expertise on your company's project?

Through Linaro Developer Services you have access to Linaro's engineering teams.



Linaro
Developer Services

Linaro Core Membership



Participate in all projects across all verticals
and have exclusive access to your own dedicated engineering team

- Arm GNU Toolchain Enablement and CI
- Arm LLVM Toolchain Enablement and CI
- Arm Server Architecture
- Big Data and Data Science
- Cloud Infrastructure
- Enable Arm Architecture in QEMU
- Enhance Software defined storage on Arm servers
- Ledge Reference Platform
- Linaro Ecosystem Dashboard
- Linux Kernel Development targeting Android
- Linux Kernel Quality
- Open-CMSIS-Pack
- Optimize AI for Arm Data Center and Edge
- Optimize AI for Arm Microcontrollers
- Oniro
- Power and Performance
- Project Stratos - Hypervisor Abstraction
- Software Device Enablement for Android
- System Control and Management Interface
- Trusted Substrate
- Upstream Maintainership
- Windows on Arm



Linaro Club Membership



Participate in all projects across all verticals





























- Arm GNU Toolchain Enablement and CI
- Arm LLVM Toolchain Enablement and CI
- Arm Server Architecture
- Big Data and Data Science
- Cloud Infrastructure
- Enable Arm Architecture in QEMU
- Enhance Software defined storage on Arm servers
- Ledge Reference Platform
- Linaro Ecosystem Dashboard
- Linux Kernel Development targeting Android
- Linux Kernel Quality
- Open-CMSIS-Pack
- Optimize AI for Arm Data Center and Edge
- Optimize AI for Arm Microcontrollers
- Oniro
- Power and Performance
- Project Stratos - Hypervisor Abstraction
- Software Device Enablement for Android
- System Control and Management Interface
- Trusted Substrate
- Upstream Maintainership
- Windows on Arm

socionext™



Linaro Group Membership

Select the group membership which focuses on the vertical of your interest

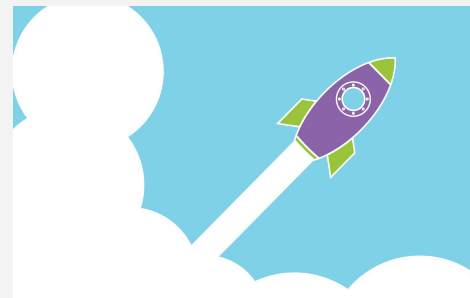
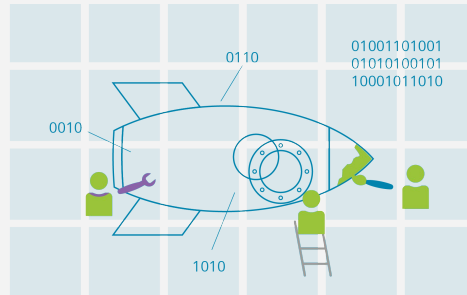
 Linaro Consumer Group	 Linaro Datacenter & Cloud Group	 Linaro Edge & Fog Computing Group	 Linaro IoT & Embedded Group	 Linaro Windows Group
Projects: <ul style="list-style-type: none">• Software Device Enablement for Android• Linux Kernel Development targeting Android	Projects: <ul style="list-style-type: none">• Arm Server Architecture• Arm Server CI with the OpenEuler Community• Big Data and Data Science• Enhance Software-Defined-Storage on Arm Servers• Linaro Ecosystem Dashboard• Optimize AI for Datacenter and Edge	Projects: <ul style="list-style-type: none">• Heterogeneous Platform• Linaro Contributions to OP-TEE• Oniro OS• Trusted Substrate	Projects: <ul style="list-style-type: none">• Heterogeneous Platform• Open-CMSIS-Pack• Optimize AI for Arm Microcontrollers	Projects: <ul style="list-style-type: none">• Windows on Arm
    	    	     	  	   

Work with our experts on your project

If you have a project where you want to leverage Linaro's Arm Software Expertise, **Linaro Developer Services** is the right option for you.



From initial design through to development, implementation, support and training, Linaro Developer Services help you leverage open source on Arm to ensure fast time to market, exceptional quality and security, and cost effective long term maintenance.



Thank you

Go to www.linaro.org

