What is Margo?

Margo is a new open standard initiative for interoperable orchestration at the edge for industrial automation ecosystems. Margo is an initiative hosted by the Joint Development Foundation, a part of the Linux Foundation family. Margo's goals are to define the mechanisms for interoperability between edge applications, edge devices, and edge orchestration software. Margo's ambition is to address this important interoperability concern across industrial automation providers.

Mission Statement

Margo's mission emphasizes unlocking innovation barriers in industrial automation through edge interoperability. This is achieved through creation of a reference implementation, open standard, and compliance testing toolkit to facilitate the interoperable orchestration of edge applications and devices. The Margo initiative aims to accelerate digital transformation by simplifying the deployment, scalability, and operation of industrial solutions, thereby enabling organizations to innovate and grow more efficiently.

A double-click into the mission

Margo addresses the interoperability pain points experienced by users in the industrial automation space when deploying edge applications and devices at scale. Industrial environments have specific use cases, requirements, and technologies that can introduce friction when applying modern IT solutions to scale digital operations. IT solutions operate in a centrally managed, cloud-based, and open architecture, while OT must address decentralized, edge-based, and often closed architectures. Margo's interoperability promise looks to establish rapid and agile development cycles for industrial edge solutions without compromising critical controls that ensure secure and robust maintenance cycles.

Addressing industrial edge pain points

Industrial manufacturers anticipate workforce scarcity challenges in the coming years. Solutions are emerging to compensate for the lack of skilled labor. These solutions are typically based on using more software applications in manufacturing plants, close to the manufacturing process, often enhanced with AI and/or cloud connected.

The consequence is a new task for industrial manufacturers: lifecycle management of the massive increase of compute devices and apps from a multitude of suppliers deployed in their plants. Margo intends to reduce the complexity of maintaining and operating such an infrastructure at scale in a multi-vendor environment. This will enable industrial manufacturers to respond to their workforce scarcity challenge by moving with minimal risk from proof-of-concepts to deployments at scale of best in class solutions.

Proposed solution stacks will take into account typical OT requirements, like supporting disconnected state, tight control on lifecycle update cycles & frequency, uptime and high-availability needs.

Industrial manufacturers need to scale their OT processes faster to stay competitive. Margo's envisioned path is to leverage the best of both IT and OT worlds to optimize the performance and efficiency of their factories.

Applying an open approach

While Margo intends to address innovation barriers, this cannot be done without widespread collaboration and interaction with peer communities.

- Margo will actively collaborate with other communities to advocate for industrial edge use cases in cloud-native technologies. Margo will accelerate by adopting existing standards and technologies where possible. This will require ongoing engagement to represent Margo to other technical communities.
- Margo will work jointly with other initiatives in the industrial space to address common objectives and align on interoperability requirements. There are many standardization projects targeting industrial use cases that have ties with Margo's interoperability focus. Regular interaction will enable Margo to complement these initiatives and help maximize adoption.
- Margo will make upstream contributions to other relevant projects (e.g. Kubernetes) to resolve the issues we encounter, so that the issue is not just solved for Margo but also adds value to the other use-cases of these upstream projects.

An edge interoperability user story

Interoperability is a challenge with multiple facets and personas. In order to stay focused on solving the market's pain points, Margo's contributors use a persona based user story as the tangible guideline for the collaboration, where the **plant operator** is at the center. A plant operator is an individual or a team, responsible for keeping a manufacturing process of an industrial manufacturer operational. These organizations can scale from enterprises with a single plant with a few production lines, to entities with multiple plants or locations around the world. With respect to Margo's scope, these plant operators have a common objective: deploy, manage, and maintain a fleet of edge apps & associated hosting devices in an optimized manner.

In Margo's primary user story we follow a **plant operator** who identified two apps promised to improve the throughput of their manufacturing process. These apps are supplied by two different vendors. They first test and validate this promise in a proof of concept in a test line. When the value of the apps is confirmed, they deploy five hundred instances throughout their manufacturing plants across the world. They limit the required tooling for deploying, updating & maintaining their fleet of edge devices and applications throughout their lifecycle, and obtain a single pane of glass to monitor health of the fleet, and to automate necessary actions on their apps and devices hosted at their edge.

During this journey, the plant operator interacts with multiple personas, each with their own objectives and expectations.

App Developers

App developers deliver the value-add apps that plant operators demand. The app developers desire to build, describe & package their application once and make it available to as many plant operators as possible. They support the deployment at scale of these apps, regardless of the fleet management and observability platforms selected by the plant operators and regardless of the edge compute devices, as long as the capabilities of these hosting devices match the requirements of their apps.

Device Manufacturer
A device manufacturer wants to build a device once, equipped to host a wide variety of apps adopted by many plant operators at scale, regardless of their selected fleet management software.

Fleet Management Software Vendor
A fleet management software vendor wants to build a software platform that manages at scale the fleet of apps and devices for a given plant operator, regardless of the chosen app developers and device manufacturers.

System Integrator
A system integrator wants to deliver integration services to plant operators based on reusable deployment patterns with customized apps and devices while allowing plant operators to maintain solutions with the fleet management software of their choice.

Machine Builder
A machine builder wants to augment & differentiate their fleet of machines for plant operators through a combination of apps & devices with a single effort, while allowing plant operators to deploy and maintain these apps with the fleet management software of their choice.

What must be true

Given the personas defined for Margo's user story, the following initial objectives must be accomplished to realize the Margo interoperability promise:

- Enable app developers to build and package their apps once and support deployments to any Margo-compliant edge device
- Enable Margo-compliant applications from any app developer to run side-by-side on any Margo-compliant device that meets the app hardware requirements
- Enable Margo-compliant orchestration software to centrally manage and provide observability for any Margo-compliant application or device at scale

Delivering the interoperability promise

Margo relies on a few principles in tackling the interoperability challenge and simplifying the process of building, deploying, scaling, and operating complex, multi-vendor edge environments for organizations of all sizes.

Industry-focused: Common building blocks are needed for the OT landscape.

Any exploration into modern application architecture patterns quickly highlights a vast selection of standards, common scale patterns, and orchestration tools. This freedom of choice can often result in software solutions that cannot interoperate because they each follow their own “common patterns” for standardization. Margo will not define yet another path for solution building but will recommend a common architecture for app developers and edge device manufacturers to follow and scale. In this way, Margo will help to accelerate the realization of interoperable edge orchestration by unifying existing standards with complementary architectural guidelines.

Openness: Provide an adjustable solution without reinventing the wheel

Cloud native solutions, such as Kubernetes and OpenTelemetry, are incredibly powerful and run the world’s IT systems. At the same time, these solutions are complex and demand expert-level knowledge for configuration, security, monitoring, and management. Industrial environments can benefit from these scale factors but require a simplified operations experience to remain effective at scale. Plant operators require the ability to control when applications and devices receive updates on a granular level (i.e. site-level or system-level) while managing at scale across the fleet.

Margo embraces modern building blocks for digitalization and envisions a need to work with the community to OT-ify these enabling technologies. For example, Margo values Kubernetes as a powerful orchestration platform but also acknowledges that Kubernetes in its current form is not OT-ready. Subsequently, Margo will initiate an effort to improve OT experiences in Kubernetes, including simplified operations and release management. The outcome will be a common experience for IT and OT to leverage those platforms, while also acknowledging their unique requirements.

Scalability: Deeply embedded within the industrial architecture

At the far industrial edge, where raw power and real-time response are paramount, Kubernetes can become unwieldy for smaller edge devices. Here, technologies like Moby and Podman Compose offer a lightweight alternative for deploying containerized applications directly onto industrial PCs (IPCs) with limited resources. This approach enables granular control and faster response times essential for factory floor operations. However, this doesn't mean sacrificing observability. By leveraging OpenTelemetry, a vendor-neutral monitoring standard, these containerized apps can still seamlessly integrate with the larger Kubernetes cluster for centralized monitoring and management, providing plant operators with a unified view of the entire industrial architecture, from the core to the far-flung edge devices.

Margo deliverables

The core deliverables for Margo address the mission to enable interoperability at scale:

- Reference Implementation

  Margo will produce an open-source reference implementation to demonstrate how the standard can be realized as a guide for adopters. The Margo community views a code-first approach as essential to maintaining momentum in specification development. The reference implementation will serve to inform Margo specification documentation, in favor of a documentation-first approach. This also serves as a blueprint for industrial automation device manufacturers, software vendors supplying edge applications, and orchestration software vendors to build commercial solutions. The interoperability goals for Margo can only be achieved once widespread adoption is reached, resulting in an ecosystem of compliant commercial offerings.

- Open Standard

  Margo will develop an open-source specification (specification.margo.org), defining a standard architecture and interfaces to enable orchestration of edge applications and devices at scale. This specification will not address application data exchange in the first revision, but this is intended as a future focus area for specification development. The Margo standard will leverage supporting standards and technologies to avoid ground-up development.

- Open Compliance Test Suite

  An interoperability standard requires compliance validation to ensure consistency and establish trust in products that will adopt a common approach. Margo will provide an open compliance test suite with publicly traceable compliance test results for all products claiming to support the standard.