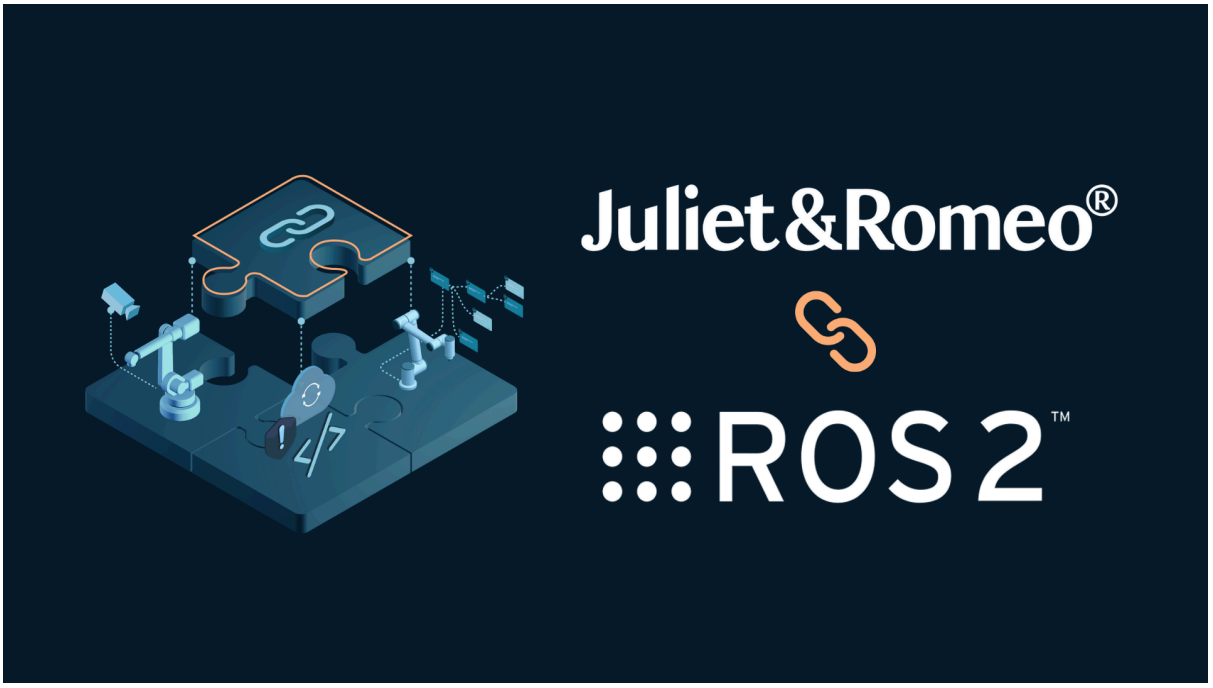
# An explanation of the relation between Juliet & Romeo® and ROS 2

This article explains how the Robot Operating System (ROS) 2 and Juliet & Romeo® relate to each other, outlining their similarities, differences, and how to decide which to use for specific tasks. When comparing Juliet & Romeo® and ROS 2, the question isn't which one replaces the other; it's how they complement each other.




## At a Glance: Juliet & Romeo vs. ROS 2

- **ROS 2** is a very capable, broad, well-established framework with a huge ecosystem. Excellent for research and prototyping for robotics systems needing many sensors, perception, planning, and application-level multi-robot coordination. With correct design and extensive careful configuration, one *can* get real-time guarantees and low latency on the component level; the scalability and determinism for non-expert users is, however, questionable.

- **Juliet & Romeo** is designed specifically for scalable industrial robotics and automation scenarios. It is suitable for motion + sensor fusion + process logic + AI and more. At the same time it offers safe execution, deterministic motion, low latency guarantees, and consistent behavior as needed for efficiency and scalability.



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The Juliet community is much younger and offers fewer available components but. Despite this, it already delivers stronger “industrial readiness” in specific settings.

If you have found suitable ROS 2 components that fit your application, the question should not be whether to use one or the other, but how to optimally combine them to accomplish a scalable industrial industry-ready solution that even non-experts can maintain over time.

Do consider that even applications that at first glance do not involve extreme latency requirements, often are dramatically simpler to implement when determinism, reactiveness, and a unified expressive language are given.

# Brief introduction to Juliet & Romeo and ROS 2

**Juliet & Romeo**

- Juliet is a robotics & automation programming language: real-time, multitasking, with safe execution features and automatic memory management.
- Romeo is a real-time virtual machine/runtime that executes Juliet (and any bytecode conforming to its format), designed for deterministic behavior, low latency, responsive to events, sensor feedback, etc.
- The goal of Juliet & Romeo is to unify motion control, process logic, sensor handling, AI, UI, etc. in one expressive language/runtime stack; to reduce development overhead, improve consistency, help scale automation systems and make them easier to evolve.

**ROS 2**

- ROS 2 is an open-source robotics middleware/framework: modular, component-based, facilitating communication between distributed nodes, sensor integration, planning, control, etc. It’s widely used for robotics research and increasingly in production.
- Key features include: DDS (Data Distribution Service) for inter-node communication, support for QoS (Quality of Service) policies, real-time capabilities on component level, cross-platform support, a large ecosystem of packages, tools, and community.



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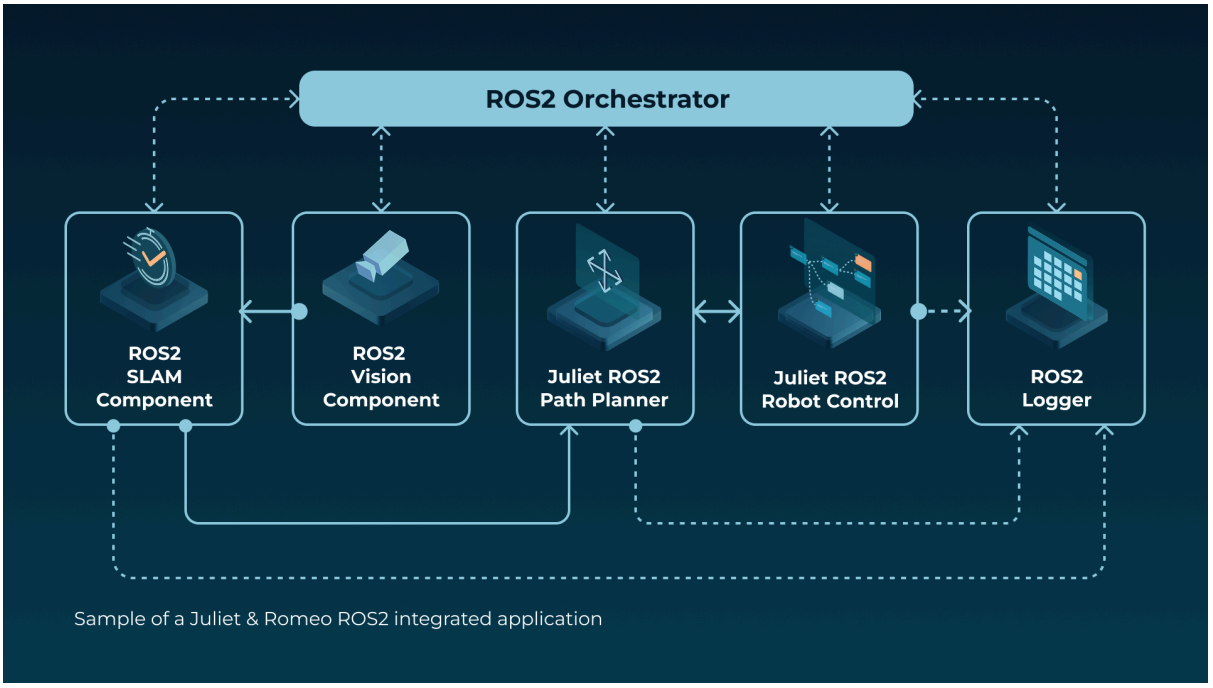
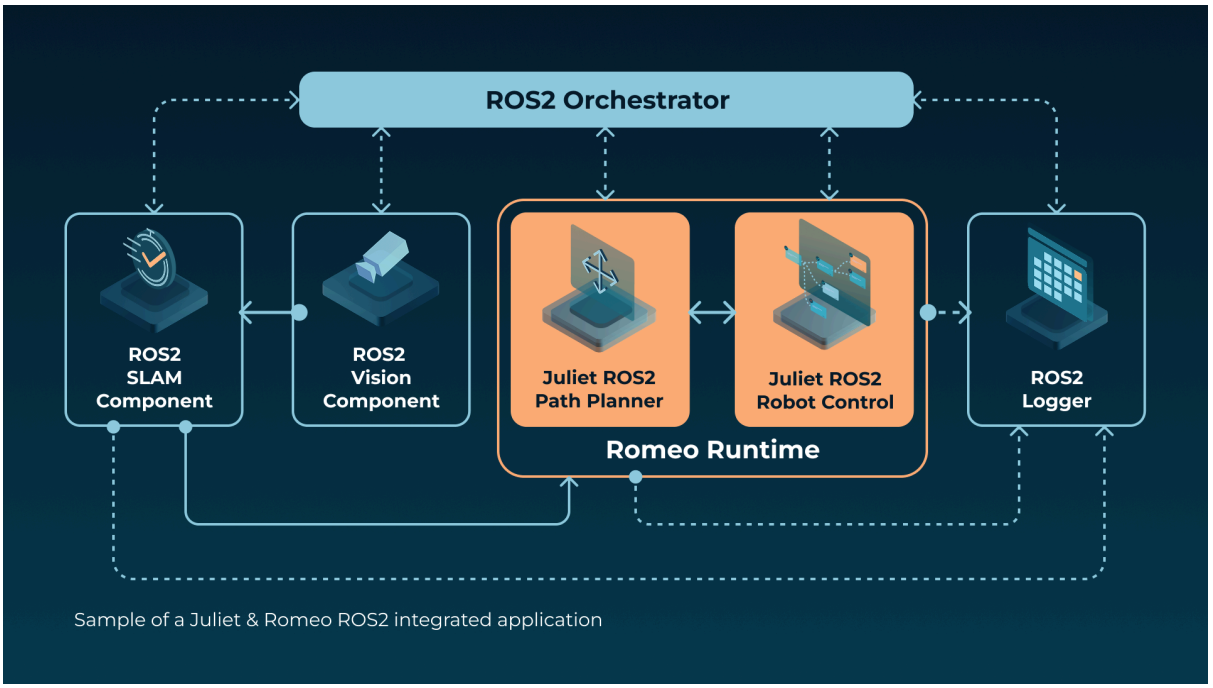
# Compatibility between Juliet & Romeo and ROS 2

As outlined above, the technologies are complementary, not competing. ROS 2 is a middleware, and Juliet & Romeo are a real-time development solution. ROS 2 components can easily be developed in Juliet, and you could also implement the instrumentation part of ROS 2 in Juliet and have it running on Romeo. In a similar manner, Juliet implemented applications can use/include ROS 2 components to benefit from the available ecosystem.



Sample of a Juliet & Romeo ROS2 integrated application



Sample of a Juliet & Romeo ROS2 integrated application



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# Feature-by-Feature Comparison

Here's how they line up on specific dimensions:

| Dimension | ROS 2 | Juliet & Romeo | Comments / Gaps / Overlaps |
|---|---|---|---|
| **Real-time guarantees** | Has improved real-time support via DDS, ability to run on real-time OS / RT patches, scheduling, QoS, etc. But "hard real-time" (worst-case guarantees) can be challenging depending on hardware, OS, and configuration. | Designed from the ground up for real-time, low-latency, deterministic VM, automatic memory management, safety in execution, and multitasking. Juliet/Romeo explicitly targets these constraints. | Juliet & Romeo have stronger guarantees for deterministic timing "out of the box". ROS 2 gives flexibility, but achieving the same level of guarantees requires extensive expertise, tuning and porting of components to the right hardware/OS. |
| **Expressiveness / Integration of logic + motion + sensors + AI** | Very expressive via packages. You can integrate sensors, perception, planning, control, AI, etc. The modular node model supports separation of concerns. Large ecosystem. | Juliet allows writing all of that in one language (motion, logic, sensor, UI, AI) with modern programming constructs. Romeo handles the runtime safety and real-time behavior. | ROS 2 still excels in ecosystem breadth; Juliet & Romeo aim to unify the stack with expressive syntax while preserving real-time safety. |
| **Ecosystem / Tooling / Maturity** | Very mature, a large number of packages, widely used in academia and industry. Tools for simulation (Gazebo, etc.), visualization (RViz), planning, SLAM, etc. Community support. | Still newer. Juliet & Romeo are being launched (market launch planned 2025); partner platforms and demos (e.g., with KEBA, Bosch Rexroth) are emerging. | ROS 2 has maturity and a large library of existing solutions and tools; Juliet & Romeo and Julia eco-system will need time to build equivalent tools and package libraries, but the result has better scaling and |



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| Dimension | ROS 2 | Juliet & Romeo | Comments / Gaps / Overlaps |
|---|---|---|---|
| | | | business possibilities over time. |
| **Determinism, safety, memory / resource management** | ROS 2 has tools and configuration possibilities to improve determinism (QoS, real-time OS, etc.), but parts (like dynamic memory allocation, garbage collection, etc) depend on how you build your nodes, what languages you use, and what runtime. It can be done, but not enforced. | Juliet & Romeo specifically mention automatic memory management and safety, deterministic behavior by design. Less risk of unpredictable behavior due to e.g., dynamic memory issues or scheduling differences between systems. | For safety-critical or hard real-time systems, Juliet & Romeo has a simpler path to satisfying constraints, while ROS 2 might need additional disciplines/restrictions.. |
| **Flexibility & Modularity** | Very flexible: many languages supported (C++, Python, possibly others), many ROS 2 “nodes” can be swapped, many middleware implementations, etc. Users can choose which parts they use. | Also designed to be modular, Juliet provides expressive syntax; Romeo can support any language that compiles to its bytecode format. So, potentially high flexibility. | Both are flexible; ROS 2 has an advantage in sheer breadth of modules; Juliet & Romeo in flexibility with determinism & real-time baked in. |
| **Platform / Hardware Abstraction / Portability** | ROS 2 works on many platforms (Linux, Windows, macOS, embedded), and supports cross-platform development. Many robots/simulators are already supported. | Juliet & Romeo target linux based open industrial automation platforms. It runs on most systems and provides integration with legacy hardware. | ROS 2 is broadly portable; Juliet & Romeo is more specialized toward industrial automation, offering stronger abstractions for industrial robots, motion control etc out of the box. |



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| Dimension | ROS 2 | Juliet & Romeo | Comments / Gaps / Overlaps |
|---|---|---|---|
| **Safety / Certification / Industrial Readiness** | ROS 2 has been moving toward more industrial use, including security features, etc., but depending on domain, you may need compliance/certifications, etc; also ROS ecosystem includes many research/prototyping packages. | Juliet & Romeo are positioned explicitly for industrial, automation life-cycle, safety, scaling, and reducing maintenance; providing more industrial-grade consistency. | For deployments needing certified safety, determinism, and predictable behavior, Juliet & Romeo offer advantages. ROS 2 may also be used, but more care is needed. |
| **Learning Curve & Adoption** | Many people already use ROS 2; lots of documentation, community tutorials, and academic examples. But complexity can be high: many ways to do things; configurations (DDS, QoS, etc) can be confusing; building and debugging distributed systems has overhead. | As a younger system, fewer existing users; learning a new language (Juliet) + VM (Romeo); fewer off-the-shelf packages; but the promise of simplification of motion + logic + sensor integration reduces complexity in some domains.<br>University-level free courses are available to ease the learning curve. | If you already have ROS 2 knowledge/ecosystem, adopting ROS 2 may be easier; if starting fresh in industrial automation, Juliet & Romeo may be more intuitive in domain-specific tasks. |



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| Dimension | ROS 2 | Juliet & Romeo | Comments / Gaps / Overlaps |
|---|---|---|---|
| **Community & Ecosystem / Libraries** | Huge: ROS 2 has many packages (perception, mapping, planning, control, simulation, robotics hardware drivers, etc.), many companies, and many tools. | Smaller, emerging; likely fewer pre-built drivers, fewer community packages, less open-source; but growing and with good support for IP-protected packages with deterministic behaviour across systems. | If your application needs off-the-shelf sensors, mapping, SLAM, etc., ROS 2 has more ready-made components. If you have more constrained tasks (industrial motion, process logic, etc.) Juliet & Romeo covers more out of box. |
| **Security** | ROS 2 has built-in features (DDS security, etc.), supports encrypted communication, authentication etc. | Juliet & Romeo mention safety, deterministic behavior, likely also concerns about secure operation; but public info is less clear about built-in security protocols / encryption etc. | Depending on scope/security needs, ROS 2 might already provide more in some areas; Juliet & Romeo may need configuration or further modules for network security, etc. |



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# Use-Case Strengths with ROS 2 vs Juliet & Romeo

| Use-Case | ROS 2 is a strong fit | Juliet & Romeo is a strong fit |
|---|---|---|
| Research & prototyping, robotics involving many sensors, perception, SLAM, path planning, open-hardware, academic / multi-robot labs | Very good. Lots of existing infrastructure, simulation, wide adoption. | Possibly usable, but less mature in tools for perception / mapping etc; strongest where industrial motion, automation control, deterministic behavior are more important. |
| Industrial automation with strict real-time requirements, safety, precise motion, combining motion + control + AI + sensor fusion in tightly constrained environments | Possible, but may require extra engineering, RT OS, careful configuration. Some parts of ROS 2 will likely not meet worst-case latency or safety constraints without careful design. | Designed for this domain. Real-time VM, deterministic execution, more focus on predictable behavior and industrial needs. |
| Scenarios where many third-party sensors, hardware, libraries are needed | ROS 2 is better here. Library / driver support is vast. | Over time may grow, but initially less breadth. |
| Scalable automation platforms that need evolvability, modular updates, including sensor logic, UI, AI all in unified programming language | ROS 2 is modular, but using many separate nodes, languages can integrate, but may require more orchestration. Deterministic module behaviour is not given across systems. | Juliet & Romeo is well suited. The promise is to unify many roles in one framework. |
| Environments where open source, community contributions, reuse of existing robotics packages are important | ROS 2 is very strong. | It is younger, so fewer community packages; perhaps more proprietary or partner-based in early stages. |



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# Key Trade-Offs in Application Design

- **Maturity vs Innovation**: ROS 2 is mature; many tools, well tested in many environments. Juliet & Romeo are newer, so risk of missing features, slower support in niche areas, etc. As ROS relies heavily on open source, Juliet & Romeo offer stronger support for industrially proven multi vendor software package business as it grows.

- **Flexibility vs Predictability**: ROS 2 gives you flexibility and a wide ecosystem, but you have to pay in configurability to satisfy determinism and safe execution. As of the time being, predictability needs to be confined to one component and can not be between components as DDS do not guarantee the predictability. Juliet & Romeo sacrifice some flexibility (you work within Cognibotics language/runtime) to get stronger guarantees.

- **Ecosystem lock-in/dependency**: ROS 2 offers a broad open ecosystem with many community packages, great flexibility, but versioning, compatibility, and maintenance across packages can add integration overhead. Juliet & Romeo® provides a coherent, vendor-backed stack with deterministic runtime and fewer moving parts; the trade-off is a younger, narrower third-party ecosystem.

- **Learning and recruitment**: ROS 2 benefits from a large user base, abundant open resources, and a wide talent pool (C++/Python + ROS concepts). Juliet & Romeo® is purpose-built for real-time motion with higher expressiveness for timing, events, and blending; it requires specific onboarding but includes a free Coursera course, and the aim is to open advanced motion programming to a broader set of developers across controls, software, and AI.

- **Licensing / open vs closed**: ROS 2 is open source. Juliet & Romeo is proprietary and licensed under Cognibotics' terms; that can matter for cost, freedom, and modifications, but also offer benefits as defined maintenance and responsibility.



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