

Process for Selecting the Default Middleware Implementation for ROS 2

Motivation

ROS 2 serves a diverse and evolving user community for which no single middleware implementation suffices. To support this user community, ROS 2 offers users a choice of high-quality middlewares via the RMW interface. For each ROS 2 distro, we need to choose a default middleware that provides an excellent out-of-the-box experience across many common use cases. Whatever the default, switching between middlewares is as easy as possible for users.

Process

While we can and should collect and evaluate objective data on the available choices, selecting the default middleware is necessarily a subjective process. There are many ways to weigh combinations of quantitative metrics, and there are also relevant criteria that are not quantifiable. Simply put, reasonable people can and will disagree on the best choice.

For these reasons, the determination of the default middleware for each ROS 2 distro is done by a vote of the ROS 2 TSC. To allow the TSC to make an informed vote, the ROS 2 Middleware Working Group (MWWG) provides the TSC with a report that fairly and concisely characterizes the viable choices for a default middleware. The report is not required to include a recommendation on which middleware should be selected.

Schedule

In general, the decision process for each ROS 2 distro has the following milestones (MBR = months before release):

- 9 MBR: MWWG starts work on its report
- 7 MBR: MWWG report delivered to TSC
- 6 MBR: Vote by TSC
- Following the vote, work begins to enact changes as needed

For ROS 2 Galactic Geochelone, with a release date of May 2021, we will follow a slightly compressed schedule:

- 5 November 2020: MWWG report delivered to TSC
- 19 November 2020: TSC discusses MWWG report during its regular meeting
- 3-10 December 2020: TSC votes
- 11 December 2020: Result announced

- <end-of-year break happens for many people>
- January 2021: work begins to enact changes as needed

At the time of writing (early September 2020), the MWWG has ~2 months in which to complete its report before the delivery deadline of November 12th.

The MWWG Report

The Editor

Not unlike the selection of the default middleware, preparation of the MWWG report is itself subjective. To ensure a neutral perspective and timely completion, the process is led by an Editor provided by Open Robotics. The Editor takes input from the MWWG with the goal of reflecting the consensus view of the group. The Editor has ultimate authority over the content of the report.

Frequency of Default Evaluations

ROS 2's default middleware implementation should be reevaluated for each new release of ROS 2. The stages of evaluations should consist of data gathering, presentation of findings, TSC vote, and enactment. Enactment should be reached at least 6 months before the new release is finalized.

Characteristics for Qualification

For a middleware implementation to qualify for consideration as default, it should meet the following criteria:

- The middleware should be open source
- The middleware should support multi-host communication
- The middleware implementation should be tier 1 (as per [REP 2000](#))

Evaluation

Only middleware implementations that qualify for consideration will be evaluated. Collecting data for evaluation should distinguish between testimonies and metrics.

A group of volunteers from the Middleware Working Group will do the work of collecting testimonies and metrics for the recommendation being sent to the TSC.

Testimony

Testimonies are qualitative, anecdotal accounts of experiences working with any of the considered middleware. Testimonies should be collected by the Middleware Working Group, and through solicitation from key users.

A testimony should include the version of ROS 2 used, and preference should be shown to the testimonies involving the latest version.

The authors from the Middleware Working Group will attempt to collect testimonies for each of the following use cases:

- Single machine configuration
- Multi machine configuration
- WiFi / lossy network
- Managed / restricted networks
- Scalable configuration / large number of entities
- Security
- Microcontrollers

Ideally, testimony should be collected for different situations under each use case, for example focusing on out-of-the-box behavior and flexible behavior. Out-of-the-box behavior indicates a situation where no configuration was needed beyond ROS 2 installation and setting the middleware implementation, and flexible behavior indicates extreme cases served with any level of required configuration.

Additional testimony surrounding developer experiences working with a middleware, such as the middleware maintainer's responsiveness and helpfulness when solving problems and interacting with issue tickets, will be considered.

Before submitting the testimonies to the TSC, there will be a chance for responses to testimonies which can be suggested from anyone attending the Middleware Working Group meetings.

Metrics

Metrics are quantitative, measurable data. Metrics should only be considered when collected from a known, controlled, and reproducible environment, such as a buildfarm. Data collected in other scenarios can still be considered, but unless their methodology is well documented, they would more appropriately be submitted as a testimonial. Possible metrics from performance tests are:

- Latency

- Throughput
- CPU utilization
- Memory usage
- [Quality level](#)

Metrics should be tested against variable scenarios, for example:

- Large / small messages
- High frequency
- Controlled lossy networks

There can be more kinds of metrics, for example we should consider the pass/fail statistics for the tests in ROS 2's CI.

Another kind of more biased, but still useful, source of information could be data on the projects taking the steps to switch from the default middleware should be collected and used in the evaluation. This data could be testimonial in nature; it could consist of projects that have made the switch sharing why they decided to do so and their perceived weight of effort vs. gain. It could also be metrics-focused; an evaluation of the ratio of switches amongst known projects could be considered.

Presenting the report

The report given to the TSC will include the gathered testimonies and any responses to those testimonies from the middleware owner, the gathered metrics, and, optionally, a recommendation from the Middleware Working Group or authors of the report.

The TSC will vote on the final decision using their internal voting rules.

Report preparation timeline

- Gathering data (weeks)
 - 17 Sep: Publish RFC to solicit input (likely to be done as a survey).
 - 17 Sep - 8 Oct: Accumulate responses from RFC. In parallel, extract data from existing performance tests.
 - 8-14 Oct: Collate responses and data into a draft report.
- Draft report for the MWWG (weeks)
 - 15 Oct: Deliver draft report to MWWG.
- Comment period with amendments (weeks)
 - 15-28 Oct: Accumulate comments from MWWG on draft report.
 - We slipped this until 21-28 Oct:
<https://discourse.ros.org/t/middleware-working-group-update-to-schedule-for-default-middleware-selection-report/16803>

- 29 Oct - 4 Nov: Incorporate and/or address comments as needed to produce final report.
- Present to the TSC
 - 5 Nov: Deliver final report to TSC.