Meeting summary for strongly typed units and quantities

July 11, 2024

Attendees: Tom Henderson, Jiwoong Lee, Sebastien Deronne, Federico Guerra, Erfan Mozaffariahrar, Peter Barnes, Eduardo Almeida, Gabriel Ferreira

This meeting was to discuss whether to adopt MR !1887, proposed by Jiwoong and advocated by wifi module maintainers, or to consider alternatives. Tom Henderson briefly summarized some comments left on the MR tracker, and the summary of the June developers meeting discussion. At the end of that meeting discussion, we had agreed to examine the mp-units library (recommended by Peter because it may be on a path to eventual standard library inclusion).

Tom then asked Sebastien and Jiwoong to introduce their motivating concerns and why they proposed a new library. Sebastien reminded that he had brought up the need for units support at the WNS3 2023 meeting, and that he has fixed many bugs over the years regarding conversions and arithmetic, and suggested that there may be many more latent bugs. Jiwoong introduced some of the rationale for his library, stating that he identified there are numerous unreported bugs in the code due to the inconsistency in physical quantities, and that he has experience with this issue from other projects for several years, and a few years ago had looked at the existing library choices and didn't like them for a few reasons: (1) poor ergonomics (2) lack of readiness for wireless comm needs (3) far from the prospect of standardization (4) extra dependency on other OSS maintainers (5) the debugging complexity of templated programming (6) unexplored integration with ns-3 such as attribute system, and proposed a new one that is specifically tailored to ns-3. He also volunteered to maintain it with an open idea to keep the momentum and to evolve to adopt a mature OSS library, emphasizing the SI units is a starting initiative for robust simulation and not the end

Sebastien shared that he had been privately working on converting the wifi module to use weak types (aliases) and strong types based on SI unit library for some of these quantities, as an initial step, but had not reached the full conversion. He said that he felt that the two options to move forward were to introduce it now with limited scope to wifi, or jump to putting it in the core module if others agreed.

Tom asked whether he or Sebastien had considered extending the approach that we had adopted for Time and DataRate classes, such as defining Frequency and Power classes, and neither felt that this was a viable approach (note: Peter later also said that he felt that this would be the wrong approach).

Tom asked for some clarification about whether there were bugs that were unreported, and Jiwoong said that he had found many but that he hadn't written them down (instead preferring to write the SI units library as a systematic solution to utilize the compile-time correctness, and to avoid relying on individual reports and fixes), while Sebastien said that he was not aware of any

current bugs but that there may be latent undiscovered bugs. Jiwoong added, without offering concrete examples, the topic is also related to the floating point precision errors when dealing with small energy values in `double` (in Watt - this unit information was not mentioned during the meeting). Peter said that years ago, he tried unsuccessfully to convince the energy module maintainer about a units-related bug related to power draw.

Peter summarized his view that we all probably agree on the need for more robust units and to reduce the chance for bugs, but that we may disagree on the immediacy of making a change, and on the eventual end state goal.

Eduardo asked about the migration path to SI units, to which Jiwoong replied that he envisioned a graceful migration, and Sebastien said that we could move from weak types (aliases) to strong types later. Existing attributes and APIs could stay as is for now, but new attributes would be introduced with the new strong types.

Peter offered his opinion that adapting our own library brings a maintenance burden onto the project.

There was a lot of discussion about mp-units vs. Jiwoong's SI units, but Tom mentioned that there were other libraries and asked whether they had been considered specifically for wifi. Sebastien replied that he hadn't looked at the alternatives. Jiwoong replied he looked into them several years ago, and reviewed them unfavorably.

Tom expressed the opinion that for none of the choices (SI units, mp-units, or others) have we fully worked through the user impacts and suggested that possibly a next step forward would be to take one specific unit (such as Wi-Fi use of power) and try to port fully over to library support and evaluate the impact. Peter said that the most user-facing API would be possibly the user-defined literals or weak type adapters, which could be supported underneath by different libraries over time, so focusing on that API might be worthwhile.

Peter remarked that he would prefer that we not adopt a point solution specific to wifi or even networking needs, because ns-3 is used outside of networking for simulations including system lifetime evaluation and biology problems, so a more general robust solution in the core might better serve those other communities.

Tom suggested a few possible next steps:

1) Sebastien had volunteered to publish an interim draft MR with his conversion of some internal wifi types to aliased types

2) Tom suggested to try to look at a library such as nholthaus/units and prototype support for it, or at least understand why we might technically dismiss it in favor of SI units.

Tom said that he agreed with Peter's view that an externally supported library may be better for us than a custom one, unless the external ones cannot be made to work adequately. He also did not think we were ready for adopting mp-units, because of the need for newer compiler support and the observation that it still seems to be under development.

Jiwoong remarked that Sebastien's weak type adoption should be useful regardless of the ultimate choice of a strongly typed library, and proposed to prep a "dBm" only MR on top of Sebastien's interim draft MR to offer the community the look-and-feel, and recommended commensurate efforts should be done for exploring other alternatives.

A follow-up meeting is considered for early August.