

## ns-3 Consortium Meeting Outcomes and Next Steps

July 2023

The [ns-3 Consortium](#) held its [annual meeting](#) in Ballston, VA, including hybrid (virtual) participation, during the week of June 26. The first two days (June 26-27) were devoted to several tutorials and panel discussions, including a focus on 5G sidelink models and next steps on Monday June 26, and a variety of topics including O-RAN, machine learning, and GNU Radio integrations with ns-3, a conversation between industry/government and the U.S. National Science Foundation, and a tutorial on the NetSimulyzer. Following two days of paper presentations and short talks on June 28-29, ns-3 maintainers and other interested participants met on Friday June 30 for a brief maintainer meeting.

This document reviews plans and action items for the next year of ns-3 Consortium activities, based on discussions at the meeting and shortly thereafter. To the extent that the ns-3 Consortium can support and fund these activities (e.g., through software development or website development support), we propose to use existing ns-3 Consortium funds to do so. However, most activities are going to have to be crowdsourced among interested participants, so we propose to develop small (open invitation) working groups to develop a schedule and milestones to make improvements in each of the following topics.

### 1) Exploiting new Python/Jupyter capabilities

Gabriel Ferreira recently overhauled the ns-3 Python binding system, and started to package ns-3 libraries in the Python packaging repository PyPI. Gabriel also demonstrated Jupyter Notebook examples that he had developed for a class on networking. This has the potential to be transformative for new users and educational users.

We propose to form a group to develop new Jupyter-based ns-3 examples, particularly with an emphasis on educational topics, with intention to maintain them somehow in the ns-3 project namespace on GitLab.com. Furthermore, we propose to prominently advertise the availability of these examples and explore web-based online experimentation linked from our project front page <https://www.nsnam.org>.

We are reminded of [Mohit Tahiliani's talk](#) from 2022 about overhauling the ns-3 tutorial and examples-- work that Mohit still plans to do. This overhaul could be done in concert with developing Python/Jupyter capabilities.

### 2) Exploiting new visualization capabilities

Evan Black has been developing the [NetSimulyzer visualization tool](#), and a brief discussion ensued on Thursday about desirable new capabilities. The current tool has focused on 3D rendering of position and mobility, and on time-series charting capabilities. Sumit Roy asked about visualizing packet traces/Wireshark or who is transmitting to whom, and also about the ability to configure simulations from a graphical interface. It was noted that other network simulation tools have graphical configuration tools available. Evan expressed interest in learning more about new feature requests from the community and would take that into consideration. In the meantime, the open source project could do a better job of weaving visualization into its examples and tutorials, and some of the planned rework of ns-3 examples could also include this point.

### **3) TCP and Wi-Fi model/configuration improvements**

Michael Welzl provided a [keynote talk](#) critical of ns-3's TCP models, and in particular, the need to fine tune the configuration to produce simulation output that would be expected by a TCP expert. He also noted the possible opportunity for ns-3 to provide a reference implementation (currently lacking in the field) if such code were well validated by experts, and further mentioned the decommissioning of Stanford's Pantheon as a possible opportunity for ns-3. After the talk, Tom Henderson, Mohit Tahiliani, and Michael Welzl started to collaborate on fixing the deficiencies that Michael found, and are open to expanding to a working group on this topic.

Peter Detzner, during his talk on the SOLA middleware, complained that ns-3 doesn't provide enough support for application-level, or system-of-system simulations, and cited specifically the lack of an easily configurable Wi-Fi network that 'just works' and supports seamless roaming. Subsequent discussions led to the creation of a new ns-3 issue on this topic. The planned next steps are to gather industry feedback on what a reasonable simple baseline algorithm and meshing capability for this might be, and to write some requirements and then a model. A group of interested developers to either code this model or provide the outline for a student to follow is recommended.

### **4) Model validation track at WNS3 2024**

During the annual meeting, Sumit Roy again emphasized the importance of documenting the validation of ns-3 models, and discussed whether some level of certification work (by experts who are tasked to validate that ns-3 models provide the expected output for different scenarios) could be organized? Tom Henderson noted that some kind of incentive would need to be created to get people to work on this, and a publication opportunity might be that incentive. He proposed the possibility of setting aside some space in future WNS3 for a validation track (possibly with a separate call for papers and some suggested topics for students). Sumit has also advocated in the past for more prominent display on our website of the publications that validate ns-3 models. A small working group can be formed to find and list such papers, and to develop a suggested call for papers for a validation track at next year's WNS3.

### **5) Reproducibility guidelines and future committees**

Tom Henderson reported on the outcome of this year's effort to review accepted WNS3 papers for [ACM Artifact Review and Badging](#). Nine of the sixteen papers were reviewed and judged to have met the criteria for the 'Artifacts Available' badge, and the other seven were given an opportunity to update their links to artifacts and submit for a re-review. The committee had to establish some criteria applicable to ns-3 for papers that had published only partially complete artifacts. The committee was small (five reviewers), and it was difficult to recruit members. As a result, the committee was not able to review for badging at higher levels, due to the time required to more fully evaluate artifacts. Finally, the committee noted that none of the papers used truly permanent storage such as the ACM Digital Library, and these permanent repositories could be encouraged in the future. It was suggested to consider asking regular TPC members to fold this Artifacts Available badge review into their normal paper review. For WNS3 2024, it is recommended to establish a small committee to post review criteria and process guidelines for performing these reviews in the future.