

ns-3 Introduction

ns-3 is a free, open source software project building and maintaining a discrete-event network simulator for research and education

Technical goals:

- Build and maintain a simulation core aligned with the needs of the research community
- Help to improve the technical rigor of network simulation practice

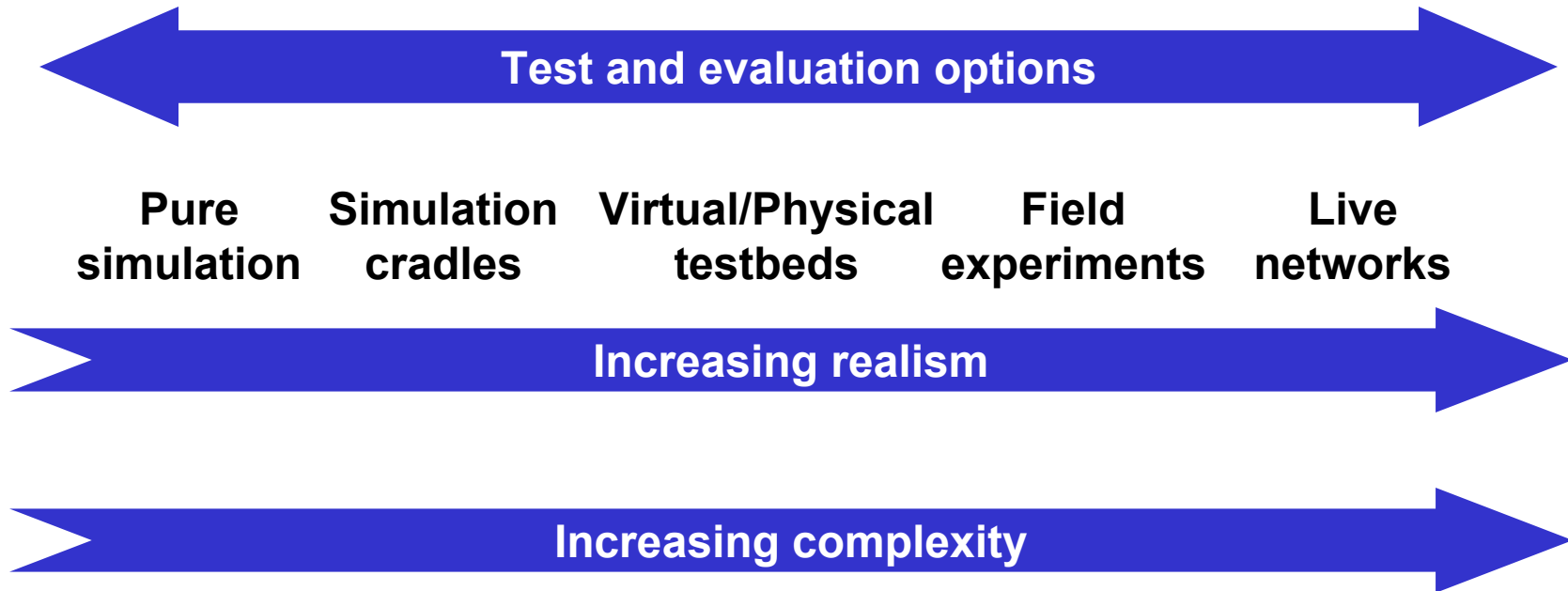
GENI meeting goals

- ns-3 may be of interest to GENI researchers
- ns-3 and GENI are working on similar issues of experimentation workflow
- Several ns-3 events at GENI
 - Control Frameworks WG talk
 - Experimentation Services WG talk
 - ns-3 Tutorial, Thursday 3-6pm
 - ns-3 developers meeting, Friday
 - <http://www.nsnam.org/wiki/>

ns-3 themes

- Research and education focus
 - Build and maintain simulation core, integrate models developed by other researchers
 - Support research-driven workflows
- Open source development model
 - Research community maintains the models
- Leverage available tools and models
 - Write programs to work together
- Enforce core coding/testing standards

Test and Evaluation Options



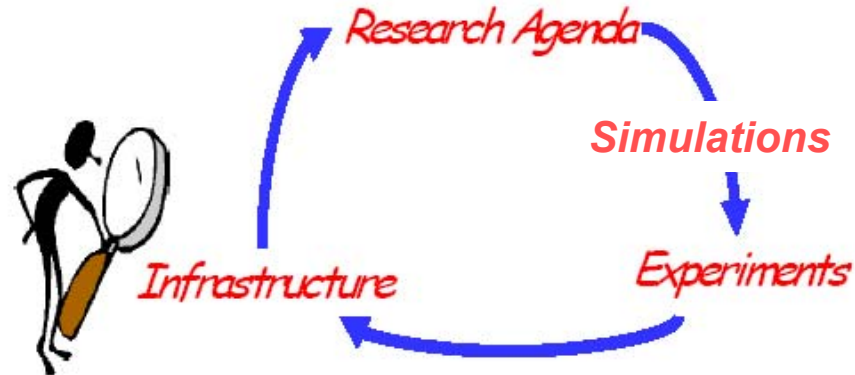
Can we develop tools to span this space?

Simulators can complement testbeds



Research Agenda to Experiments to Infrastructure

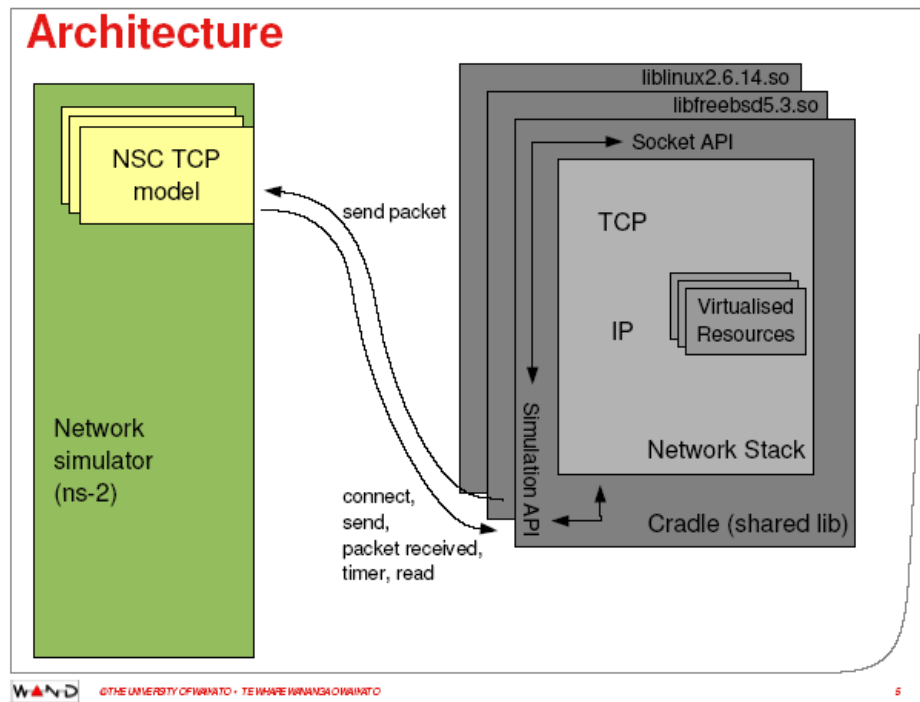
- Research agenda
 - Identifies fundamental questions
 - Drives a set of experiments to validate theories and models
- Experiments & requirements
 - Drives what infrastructure and facilities are needed
- Infrastructure could range from
 - Existing Internet, existing testbeds, federation of testbeds, something brand new (from small to large), federation of all of the above, to federation with international efforts
 - No pre-ordained outcome



- Source: NSF GENI project:
<http://www.geni.net/docs/GENIOvrvw092908.pdf>

Simulation Cradles

- **Existing:** Network Simulation Cradle (Jansen and Westphal)



Accuracy

- Have shown NSC to be very accurate – able to produce packet traces that are almost identical to traces measured from a test network

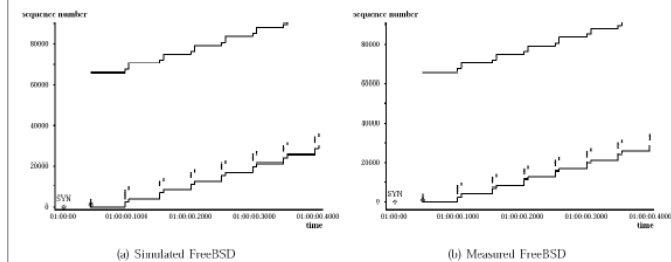
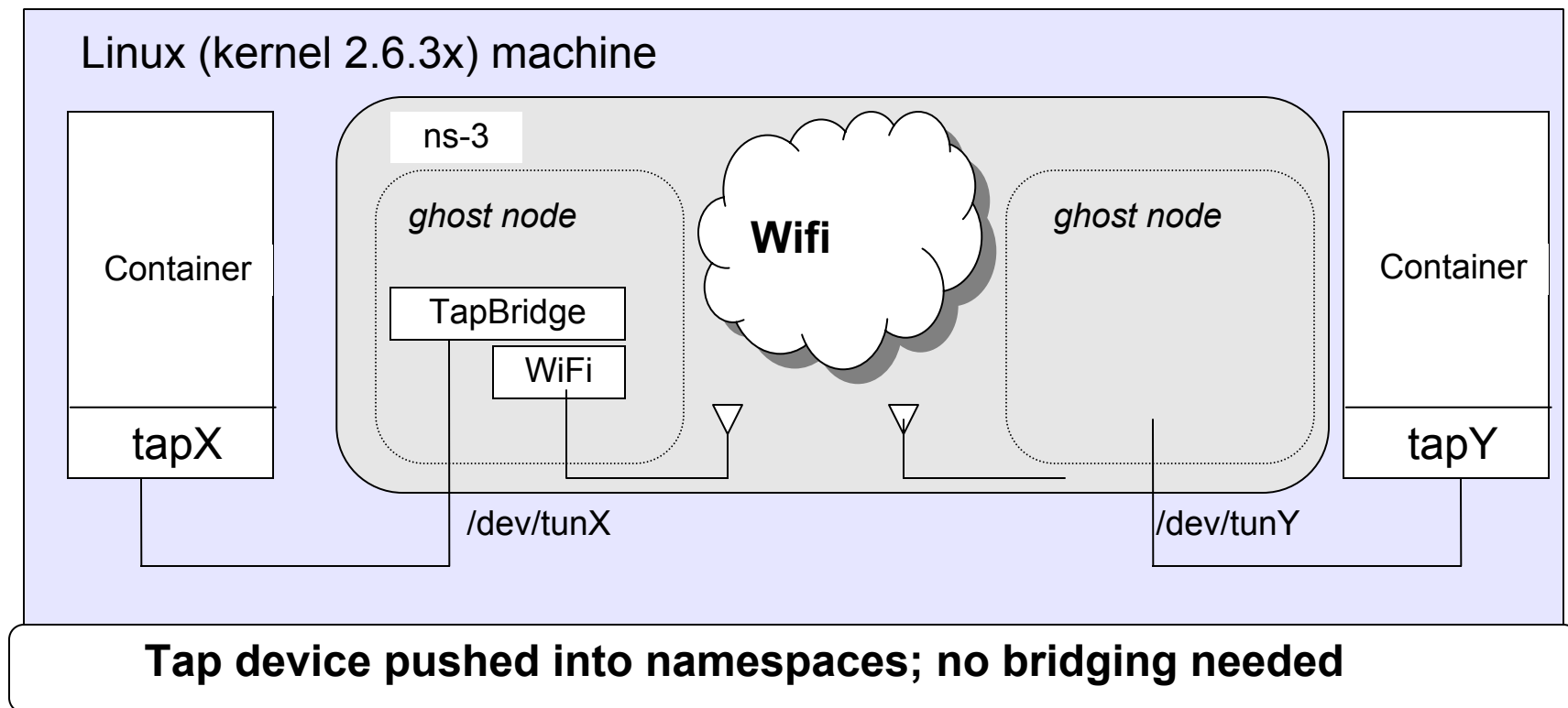


Figure reference: S. Jansen, Performance, validation and testing with the Network Simulation Cradle. MASCOTS 2006.

- **In development:** Full Linux kernel integration, direct code execution environment

Virtual Machine integration

- Several efforts aimed at blending lightweight virtual machines with ns-3



Example: ORBIT and ns-3

- Support for use of Rutgers WINLAB ORBIT radio grid

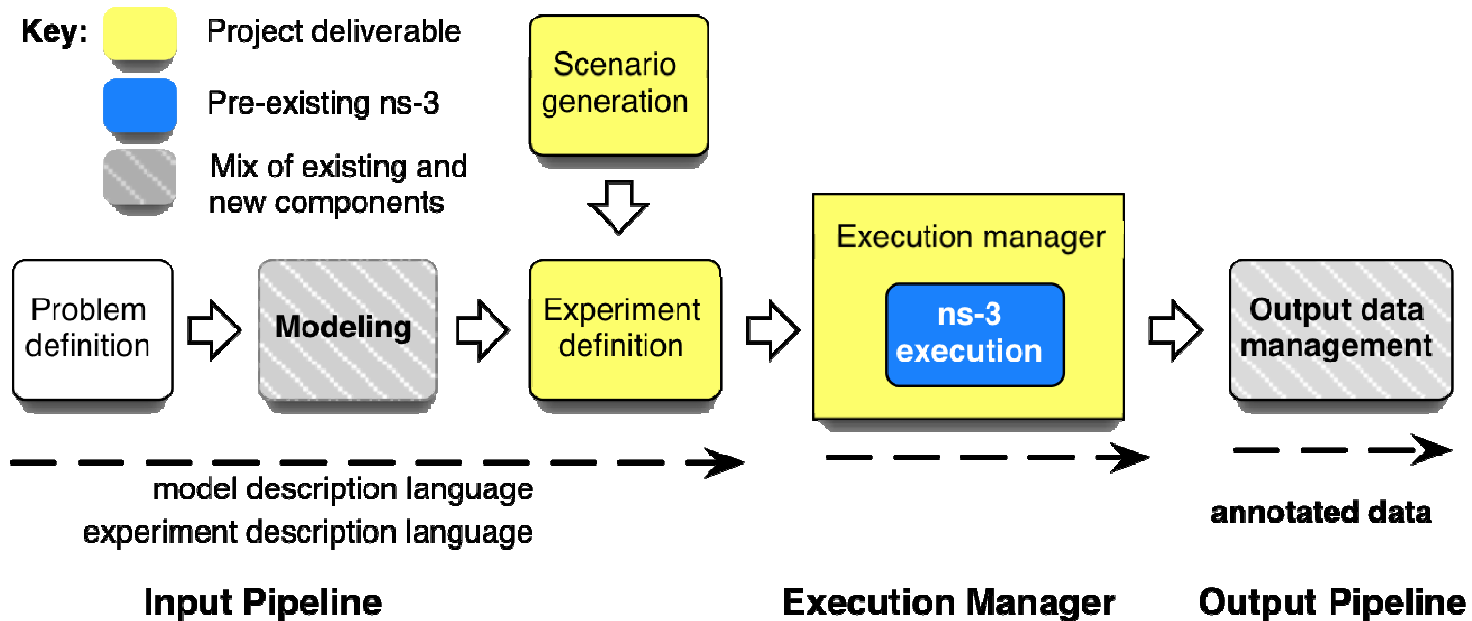
A screenshot of the ns-3 website. The page title is "ns-3" and the main heading is "HOWTO use ns-3 directly on the ORBIT testbed hardware". The page includes a navigation menu with links for "Main Page", "Community portal", "Current events", "Recent changes", "Random page", and "Help". There is a search box with "Go" and "Search" buttons. A "toolbox" section contains links for "What links here", "Related changes", "Upload file", "Special pages", "Printable version", and "Permanent link". The main content area contains two paragraphs of text explaining the real-time emulation package and the testbed hardware. The first paragraph states: "We provide a realtime emulation package that allows us to connect ns-3 to real networks on real machines. Typically the real network will be a testbed of some kind. ORBIT is a two-tier laboratory emulator/field trial network project of WINLAB (Wireless Information Network Laboratory), at Rutgers. This wireless network emulator provides a large two-dimensional grid of 400 802.11 radio nodes as well as a number of smaller 'sandbox' testbeds to allow one to test without reserving the main grid. This HOWTO shows how ns-3 scripts can be used to drive these radio nodes." The second paragraph states: "We assume that you have some experience with the ORBIT system. If you are new to ORBIT, please take a look at <http://www.orbit-lab.org/> and go through the 'Basic Tutorial' and the 'Tutorials on controlling the testbed nodes' at a minimum. We will assume throughout this HOWTO that you have registered for an ORBIT account and have made a reservation on the ORBIT Scheduler for a testbed. This HOWTO assumes that you are on the sandbox one (sb1) testbed." The page also includes a "HOWTO use ns-3 directly on the ORBIT testbed hardware" section with a paragraph: "We provide a node image on the ORBIT system that includes everything you need to get an ns-3 environment up and running on your testbed nodes. This includes the GNU toolchain, a copy of a precompiled ns-3.3 repository, emacs editor, etc. The first step is to get this environment up on the nodes in your testbed. In ORBIT terminology, we need to 'image the nodes.'"

Relationship to ns-2

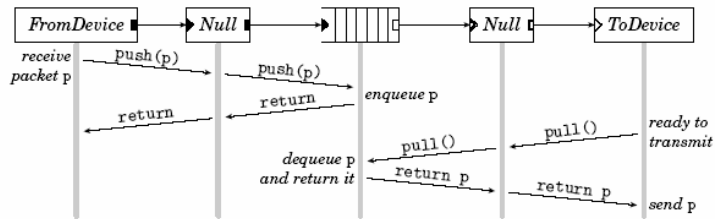
- Decided that we did not have resources to maintain backward compatibility with ns-2
 - OTcl and split-implementation models
 - Different level of abstraction
- Continuing to maintain ns-2 and nam
 - Possible to construct hybrid simulations
- Several models already ported to ns-3
 - Random number generators, OLSR, error models, recent WiFi Phy models

Frameworks for ns-3

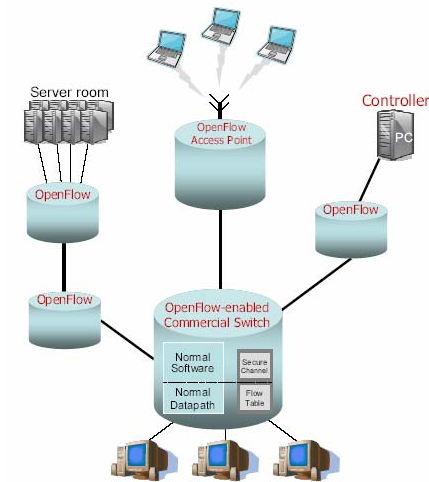
- NSF CISE Community Research Infrastructure
 - University of Washington (Tom Henderson), Georgia Tech (George Riley), Bucknell Univ. (Felipe Perrone)
 - Project timeline: 2010-14



ns-3 and Google Summer of Code



Click Modular Router
Lalith Suresh



ns-3 OpenFlow
Blake Hurd

Underwater Acoustic Networking
Andrea Sacco

ns-3

GENI Eng. Conf., Nov. 2010



ns-3 LTE
Giuseppe Piro

Acknowledgment of support



ns-3

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