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Managing heterogeneous ns-3 experiments with NEPI

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I – NEPI

What is NEPI?

- The Network Experimentation Programming Interface (NEPI), is an experiment life-cycle management tool that enables conducting heterogeneous experiments where PlanetLab nodes and Emulated nodes can be seamlessly integrated with ns-3 simulations.

Objectives of NEPI

- Support all stages in the experiment life-cycle.
- Automate repetitive and complex tasks.
- Provide a platform-independent API.
- Make it easy to conduct experiments that mix heterogeneous platforms (simulators, emulators, physical testbeds).

II – Life-cycle support

Stages in the life-cycle

- Design
- Execution
- Control
- Results

Experiment design

- An experiment description (ED) is created by connecting boxes, representing experiment components, to other boxes on named ports called connectors. Each connector defines specific rules on how to create, configure and connect components during experiment deployment.

Experiment execution

- The ED generated during design is used as the input for the Experiment Controller (EC). The EC is responsible for supervising the whole experiment, and instantiating the Testbed Controllers (TC) in charge of supervising the different experimentation platform instances involved in the experiment.
- Upon creation, the EC translates the ED into platform-independent messages (e.g. "create Node N"), and sends them to the corresponding TCs. When a TC receives a message, it performs a platform-specific action in response (e.g. a ns-3 TC would create a ns3::Node C++ object in the ns-3 simulation upon receiving a create node message).

III – Heterogeneous experiments

NEPI allows to build scenarios where ns-3 simulated networks can be integrated with the PlanetLab network. This is achieved by connecting an edge node inside the simulation to a virtual interface in the PlanetLab node where the simulation is running. The traffic generated inside the simulation can then be tunneled across the Internet to reach other PlanetLab nodes.

ns-3 simulations can also be integrated with emulated Ethernet networks, making it easy to inject in the simulation traffic generated by arbitrary unmodified applications.

IV – Graphical User Interface

- The Network Experimentation Frontend (NEF), is a Graphical User Interface for NEPI that allows to design experiments by drag & dropping and interconnecting boxes in a canvas.
- Deployment is done simply by selecting an option on the main Menu.
- NEF provides several runtime views to monitor the evolution of the experiment, such as:
  - Topology View, to change experiment configuration during runtime.
  - Mobility View, to view the 2D changes in mobile nodes
  - Results View, to list and retrieve experiment results

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