

VIRMANEL: using virtualization to study mobile multihop networks

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1. INTRODUCTION

For several years, researchers studying wireless multihop networks (ad hoc, sensor, vehicular, ...) had a hard time getting accurate results on a large enough number of scenarios because of the lack of fully appropriate tool. Simulation usually suffers from strong approximations when modeling wireless communication layers and simulators also fail to reproduce system aspects. Such approaches thus require maintaining a specific code, different from the real-world implementation. Experiments are generally limited to modest size networks, so that scenarios are controlled and reproducible to a certain extent. Large-scale experimental platforms (SensLab, WiseBed, ...) allowed pushing the limit farther, but the support of generic mobility in these experimental facilities is still a difficult issue, as it requires being able to monitor and control a large number of mobile nodes.

In this demonstration, we present VIRMANEL (Virtual MANET Lab), a new tool for studying mobile distributed networks. VIRMANEL is based on containers virtualization (OpenVZ). It dynamically updates firewall rules on virtual nodes to reflect connectivity changes due to mobility. VIRMANEL allows using real code and operating systems on a multihop network that abstracts signal effects such as interferences. Virtual nodes can be distributed over multiple computers, emulating a large number of nodes. It does not substitute to experimentation but allows studying the behavior of a real-world code in a large mobile network.

VIRMANEL is partly realized within the FIT project (<http://fit-equipex.fr/>). It is available for download at <http://virmanel.enst.fr>, distributed under the LGPL license and it is free for academic use.

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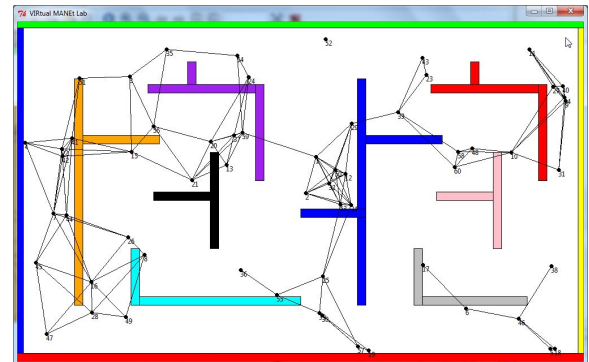


Figure 1: VIRMANEL Graphical User Interface

2. VIRMANEL KEY ASPECTS

Virtualization platform: Mobile nodes are virtualized using OpenVZ (<http://wiki.openvz.org>), an efficient virtualization solution. Each node uses a user-defined template of a Linux-based system. Nodes are connected through a single virtual switch, which make it theoretically possible for every node to reach any other one. Inbound packets are dropped by firewall rules in every node unless they were emitted by nodes within the receiver's transmission range. VIRMANEL dynamically creates and deletes firewall rules in all nodes according to mobility.

Domain-specific language: VIRMANEL relies on a specific language to describe nodes mobility. This language, based on Scala, runs over the Java Virtual Machine. A user specifies the movement policy of a mobile (speed, direction, ...) and its interactions with its environment. For instance, the expression "if (MOBILE ->| WALL) {}" allows to define the mobile behavior when encountering a wall. With this DSL, a user is able to re-create common mobility models and to define new trajectory-based or behavioral models.

Graphical User Interface (GUI): VIRMANEL provides a graphical user interface shown on Figure 1 that allows to monitor nodes movements and communication links appearing and disappearing between mobiles.

3. DEMONSTRATION SCENARIO

The demonstration first presents a mobility model definition using the internal language of VIRMANEL. This model is then used to manage the behavior of a defined number of nodes. GUI displays their movements and allows to monitor the appearances and disappearance of one-hop links.