The Wireless Multihop-Based OneLab Testbed

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I. INTRODUCTION

With the emergence and the success of wireless communications, new opportunities are possible for both users and service providers. Nowadays, services can be consumed, everywhere, using all kinds of devices on any access network. However, even if very promising, the heterogeneity of the wireless networks (UMTS, Wimax, Wi-Fi....) results in diversity of behaviours and constraints. Therefore, developing and deploying existing and novel services over such complex context becomes a difficult task for the service providers. Having an environment which meets the necessary requirements to allow developers to deploy and test their applications in realistic scenarios at scale would speed up the test phase and thus lower the barriers to entry for potential innovators. The OneLab project [1] aims at providing such an available public testbed to enable the deployment and tests of applications in environments that are behind WiMAX links, UMTS links, within multi-hop mesh networks, or in a multihomed context. This paper presents the OneLab project and focuses on the description of the wireless multi-hop mesh environment studied within the project.

II. ONELAB PROJECT

The OneLab project[1] is a two-year European IST project (N° 034819), begun in September 2006, whose objectives are: (1) to allow novel distributed systems and services being tested in various wireless networks by the mean of the development of new components; (2) to provide the means to analyse the applications behaviour in different network conditions thanks to innovative monitoring solutions. It is worth mentioning that OneLab is based on the PlanetLab architecture.

PlanetLab[2] [PL] [1][3] is a geographically distributed overlay network, used as a testbed for broad-coverage network services [2]. Currently, the PL network is composed of 776 machines in 378 sites. Applications or services may be deployed at wide-scale on PL nodes and fully evaluated. In the PlanetLab architecture, applications are deployed in Virtual Machines, called *slivers*. Several slivers can coexist in one PL node, thus isolation is ensured in order that the resources consumed by one sliver will not have undesirable effects on the performance of the other. The set of PL nodes hosting the same sliver (for the same service) form an overlay network for this service, known as a *slice (*Figure 1).

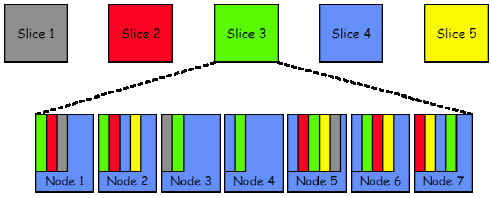

Figure 1: Slices at nodes

The PlanetLab testbed is currently one of the most known and used testbed, in particular within the research community. However, it does not mirror the real network in realistic way since it relies on highly provisioned and wired infrastructure and does not enable the tests of emerging wireless networks. The OneLab project then aims at overcoming this shortcoming and bringing improvements in the PL architecture, mainly by integrating new components that handle wireless communication and by providing better monitoring features. This latter gives the ability to applications running in the testbed to perceive the underlying network environment and thus to know what the network conditions are (were) in order to better understand the applications behaviour. The second innovative feature to be brought by the OneLab project is to extend the current wired PL facilities to the wireless world. This enhancement will enable the consideration of testbed nodes, which are behind wireless links such as Wimax, UMTS or multi-hop mesh networks.

III. WIRELESS MULTI-HOP MESH NETWORK

A wireless multi-hop mesh network is a composite set of wireless nodes which forms a distributed network autonomously. The multi-hop concept means that end-to-end

[1] http://www.one-lab.org
[2] http://www.planet-lab.org

packets are transmitted through intermediate nodes acting as relays, This feature is achieved via the use of an appropriate routing protocol. Among the available ad hoc routing protocols [4], we have selected the OLSR [5] protocol, a well known pro-active routing protocol. Based on the OneLab environment requirements and constraints, our several years experience on the set up and experiments on wireless multihop networks [6], the full compliance with the OLSR RFC standard, its performance over various environments, the implementation from the UniK university[3] has been selected.

Since the multi-hop mesh network is supposed to be used transparently by any application deployed in the OneLab network, the routing protocol should not depend on one slice but should be generic, accessible and usable by all slices.

Because of the distributed character of wireless Multi-hop networks, and the wireless link dynamic, those networks are prone to frequent and rapid changes in topology and links quality. The OneLab platform being a testbed for experimentation and tests, it is essential to provide to users and applications the necessary information on the network state in order to let them understand the applications behaviour, according to the network conditions. To achieve this, we have developed a monitoring tool offering the users access to the information about all the mesh network nodes such as the global route stability in the network, the global volume of packets sent and received, the packet loss per application, the SNR (Signal Noise Ratio) values, the total number of packets and bytes (both data and signalling packets), the CPU load, battery level, memory consumption….A modified version of the madwifi driver has been implemented to retrieve those values.

As illustrated below in Figure 2, the monitoring tool offers a user GUI which depicts useful information about the network state including the network topology with the connections between nodes and the node location in relation to each other, based on the SNR values.

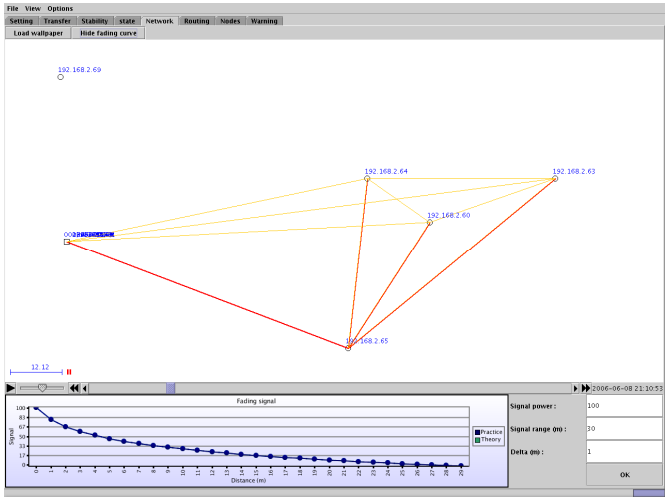

Figure 2: Monitoring tool: network topology

To cope with some limitations experienced with the current implementation of OLSR, in particular route instability, we extend the current implementation of OLSR to consider link quality (based on SNR values) in the path calculation process. Indeed, the native OLSR protocol does not take into account this metrics [7], this can led first to frequent routing table updates, and second on computed paths with bad quality that do not satisfy the requirement of time-sensitive application.

With the measured information and the monitoring tool, we expect to be able to characterize the Onelab multi-hop mesh network and then to enable others entities or service providers to also test their applications in such environment.

IV. CONCLUSION

The OneLab testbed, evolution of the PlanetLab facilities, which enables the deployment and test of applications over various and heterogeneous environments in the real network conditions, has been presented in this paper with a particular attention to the wireless multi-hop mesh networks extension, relying on the OLSR routing protocol. A monitoring tool, providing useful information on the network conditions has been introduced. The provided information allows developers to better understand the behaviour of their applications, with respect to the network conditions. At the end of the project, it is expected that this facilities will be enlarged to others entities outside the OneLab project or be presented, via well documented papers, that enables others institutions to also deploy theirs own testbed in order to increase the Onelab community and available facilities.

V. ACKNOWLEDGMENT

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