

An Integrated Testbed for Wireless Advanced Transport Protocols and Architectures

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Abstract¹— The challenges posed by data communications over both satellite and terrestrial wireless systems make the adoption of adequate countermeasures advisable. In particular, the poor performance experienced by TCP transport protocol in such environments has fed the scientific community to propose novel solutions, from both the protocols and architecture points of view. In order to perform a thorough assessment of such proposals, University of Bologna (UoB) and National Inter-University Consortium for Telecommunications (CNIT) have conceived and set-up an integrated testbed. Its characteristics and capabilities are presented and discussed in this work, focusing in particular on the advantages offered by the ubiquitous remote control of the testbed, provided by a powerful web interface specifically designed for this purpose

I. INTRODUCTION

The performance of data communications over paths that include wireless links can be strongly penalised by some peculiar challenges. Firstly, the presence of losses not originated by congestion events cannot be considered negligible. Secondly, the Round Trip Time (RTT) may be greatly increased either by the long propagation time (as in satellite GEO systems), or by the complexity of link and physical layer procedures (as in the UMTS cellular networks). To cope with these issues, several end-to-end TCP enhancements have been proposed in the past years [1], [2], [3], [4]. Alternatively, TCP enhancements that envisage intermediate agents on the path, usually called Performance Enhancing Proxies (PEPs) [5] can be considered as well. In a future perspective, the adoption of the Delay Tolerant Networks (DTN) may be a viable solution to cope with very challenging environments, such as interplanetary connections and multi-hop satellite radio links [6].

In this framework, it is paramount to design and to provide effective tools, able to reproduce and to test wireless networks as much closely as possible to the real environments. For this purpose, CNIT and the University of Bologna (UoB), decided to integrate their testbeds with the primary aim of increasing their capabilities. To allow an ubiquitous access to the integrated testbed, the adoption of a powerful web interface seemed the most effective approach. Moreover, such a simple interface hides software and hardware complexity to the end-users and offers many

important advantages in terms of testbed managing and control.

II. TESTBED DESCRIPTION

The testbed layout is shown in Figure 1, which reports the home page of the testbed web site. The testbed consists of several PCs running the Linux operating system, and a PC running FreeBSD (Sandy). Sources and sinks have been patched with the Multi-TCP package [7], which allows the user to easily select at run time the TCP variant to be used. Wireless connections are composed of both wired legs and a radio link, while TCP background traffic is present only in the entirely wired paths. All the connections share a bottleneck link, whose bandwidth can be limited in order to study the congestion effects. The router at the bottleneck input, where all the congestion events are confined, follows either a DT (Drop Tail) policy or a RED (Random Early Detection) policy. In both cases, the router parameters are fully configurable from the web interface.

The wireless connections are realized by means of three different emulators. At UoB site both a satellite and a UMTS emulator are present. The first is implemented through the NistNet package [8]; the second, called Galatea, is a powerful commercial emulator [9], which accurately reproduces the UMTS propagation environment. At CNIT site, a second satellite emulator [10] is available. It runs over a cluster of Linux PCs and provides a close representation of the real CNIT satellite network. Conceptually, it works at the datalink layer and it allows tuning both transmission medium parameters and setting MAC schemes. The integration of the testbed components located in the two sites has been performed through the creation of an IP tunnel by exploiting the VPN paradigm. In the following subsections, it will be described how it is possible to configure and run tests by means of the web interface.

A. The end points configuration

By clicking on either a sender or receiver icon, it appears the configuration window reported in Figure 2. On the left, the user can observe the actual value of all the configurable parameters related to TCP. Their meaning is recalled by a contextual help. Their values can be easily changed on the fly, as Multi-TCP does not require the machine to be rebooted. Alternatively, it is possible to load some presets, corresponding to some of the most important TCP flavors (NewReno, SACK, Vegas, Westwood+, Hybla, BIC, etc.).

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B. The emulators configuration

The configuration of the CNIT satellite emulator can be performed through the window reported in Figure 3. It provides the setting of the propagation delay, the bandwidth availability and the choice between two different channel models. An analogous graphical interface is available for the UoB satellite emulator. The configuration of the UoB UMTS emulator being extremely complex, can be performed remotely, but at present not through the web interface.

C. TCP connections set-up and collecting results

After the configuration phase, the next step consists in the set-up of the wanted connections. In particular, it is possible (Figure 4) to select the active senders and their corresponding receivers, the number of connections originated by every sender, a possible starting delay and the emulation length. After the emulation start; for every active sender a corresponding dialogue window appears, presenting useful information about the state of the emulation (Figure 5). Eventually, the final goodput per every connection is reported in the dialogue windows, while the corresponding file containing the full detailed log is made available for download.

III. CONCLUSIONS

The testbed presented in this paper represents an effective solution to carry out comparative performance evaluations of innovative transport protocols and architectures. The integration of the emulation testbeds placed in remote sites has been achieved by means of the VPN technology and its

management through the design of a suitable graphical web interface. This tool provides the user with a simple and intuitive graphical console and offers also an ubiquitous remote control of the experiments, a paramount feature for the planned collaborative research among international partners.

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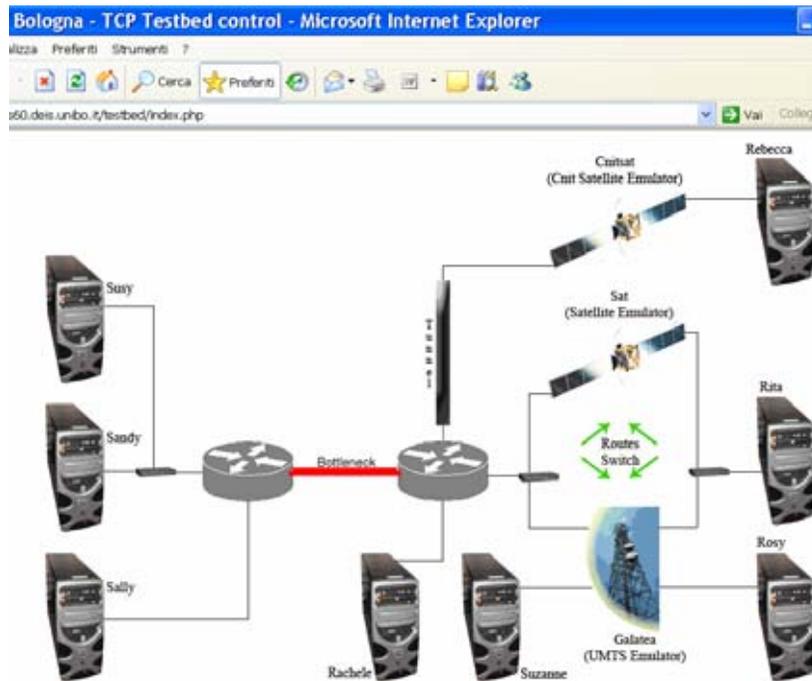


Fig.1 The testbed layout as depicted in the testbed home page.

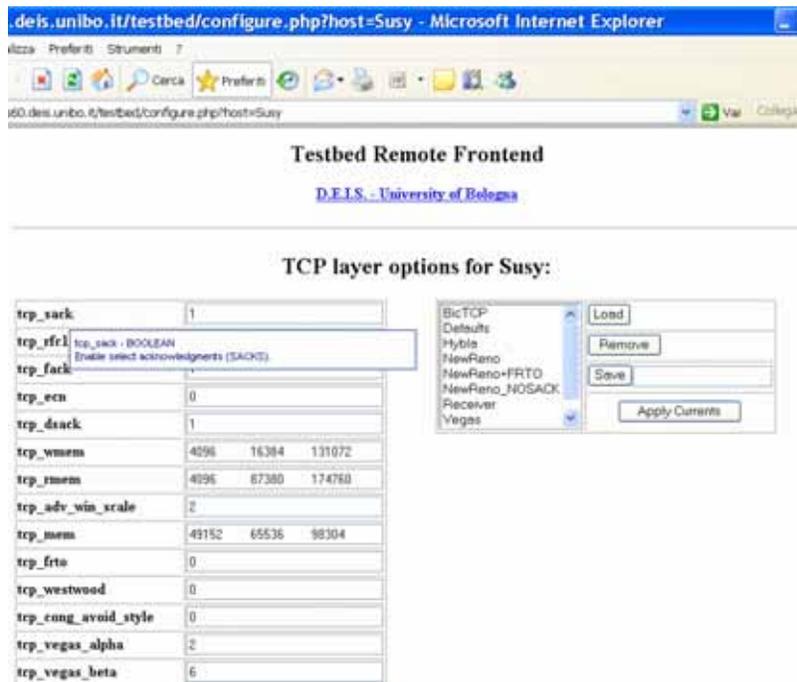


Fig.2 Choice of different TCP variants and setting of the corresponding parameters

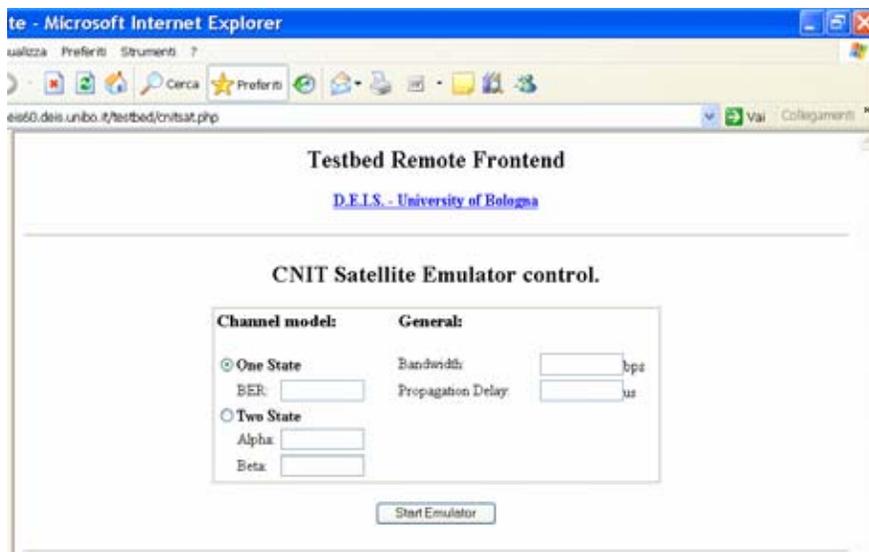


Fig.3 Setting the CNIT satellite channel emulator

