A Demonstration of a Slicing Scheme for Efficient Use of Testbed's Resources *

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ABSTRACT

The gradually growing need for testbed use so as networking algorithms to be validated in real environments, has given rise to optimal utilization of testbed resources. Despite the fact that, many laboratories around the globe have deployed testbeds, so as experimenters have the opportunity to test their algorithms, the majority of those testbeds suffer from bad management that prevents users from efficiently exploiting testbed's resources. Moreover, as the number of testbed users increases, experimenters needs for more sophisticated allocation of testbed resources are growing. Toward, this direction, we propose a managerial framework that exploits testbed utilization by introducing *slicing* over frequency spectrum. This new framework will allow a more sophisticated way to optimally control and manage network resources of a testbed.
Lab's website: http://nitlab.inf.uth.gr

Keywords

Slicing, Network Virtualization, Wireless Testbed Framework

1. SLICING AND NETWORK VIRTUALIZATION

The significant drawback of testbeds deployed for experimental reasons is that they are used locally and in a single-user mode. The typical problem that is occurred after a testbed deployment, is the testbed reservation process. The testbed assignment is usually done by an oral agreement between users. As a result, it is very likely inconsistencies and errors to happen, since users may use the same network resources due to the informal way of the oral agreement. Subsequently, this method of assignment rules out the probability of retrieving reliable results and measures are less likely to represent real information.

Due to the above limitations, wireless testbed ORBIT [6] in WINLAB [3] has developed a management mechanism that offers users the ability to book and reserve remotely the testbed at available time slots. As a result, every user knows exactly when another experimenter uses the testbed and potential conflicts and inconsistencies are prevented. However, the particular system design does not take into consideration that a sufficient large number of testbed nodes is left idle, since in the majority of the experiments applied, just a small number of nodes is being used. This is a significant design drawback as it leaves a part of testbed resources unexploited. Taking into consideration the above structural defect, it is important for a management mechanism to incorporate *slicing* features, in terms of applying concurrent use of a testbed at the same time by many users. It is straightforward to comprehend that this mechanism must prevent users from interfering with each other by attacking the problem of choosing the same frequency spectrum. Specifically, the new managerial mechanism must allocate a particular group of channels to a group of nodes that is assigned to a specific user and must monitor users activity to deter malicious intruders.

Slicing can be considered as a part of a larger entity which is known as network virtualization. Particularly, network virtualization combines hardware, software resources and network functionality into a software based administrative entity, called virtual network. Slicing belongs to internal network virtualization, since it enables partitioning of testbed resources, while external network virtualization is used to combine different testbed networks or parts of them into a virtual unit.

2. PROPOSED FRAMEWORK

Having defined on the previous section the conceptual structure of the managerial mechanism that will exploit slicing features, on this section we will describe the software entity that implements it.

2.1 Slicing Scheme

A description of Slicing Scheme through the whole procedure of booking nodes on NITOS scheduler will be clarified next. NITOS scheduler is comprised of three entities: a web interface, a database and a set of scripts. The web interface is the interactive tool that experimenters use to book a part

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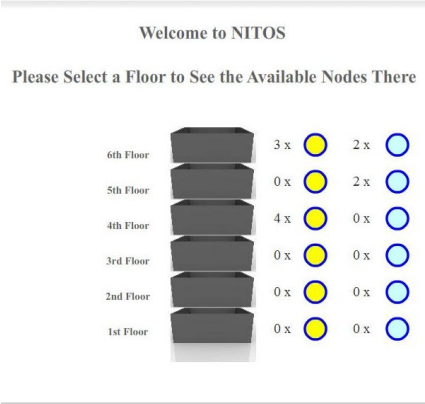
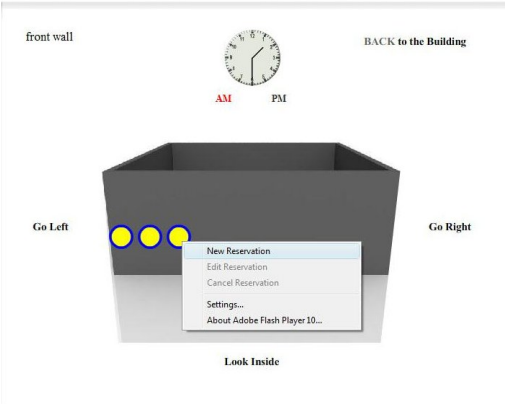


(a) Testbed deployment overview.



(b) Selection of particular testbed node.

Figure 1: NITOS Scheduler Booking Nodes.

or whole testbed for some time. In addition the scheduler informs the database at every booking step, so as to guide users correctly. The database maintains data concerning information about reservation from users to the testbed nodes and spectrum frequency. Besides, a set of scripts is activated to set up the testbed according to users preferences after his reservation request submission.

Specifically, at first the user selects through web interface the date that he wants to use the testbed [Fig. 2]. Then the user gets an overview of testbed deployment [Fig. 1(a)] and clicks on the floor where he chooses the node he would prefer and clicks *New Reservation* [Fig. 1(b)] . Then he goes to the next step where he selects the reservation time and clicks on *Spectrum* to select the channels he would like to use [Fig. 3(a)]. In sequence, he chooses the start and the end time for his experiments. To continue, he selects frequency channels among the available ones [Fig. 3(b)]. Finally, he submits his request.

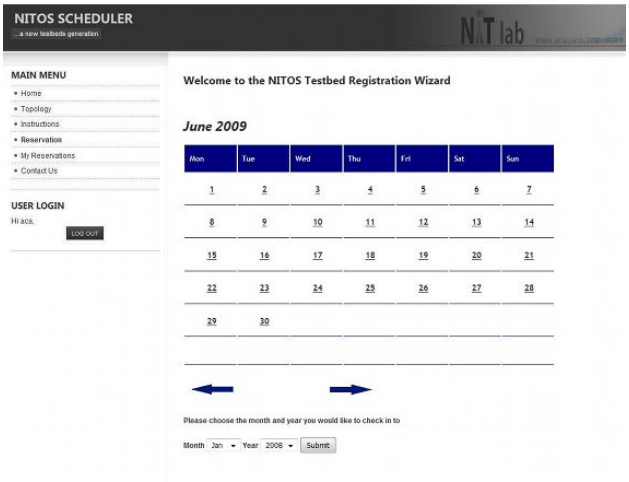


Figure 2: NITOS Scheduler Calendar.

Furthermore, the scheduler is in charge to update the database according to the user's request. In addition the scheduler keeps track of the channels that every user has reserved. This way, the scheduler knows at anytime the available channels and prevents testbed from any overlapping. In[Fig. 4] are represented the channels that a specific user has already reserved. In this way, the system keeps track of the booking process for every user. The database is being updated every time the user chooses a channel so that a channel is not chosen by more than one users. After user's submission request, the system schedules at start time to enable the user account, to allow the user to communicate only with the nodes he has booked, to disable any communication with nodes that are not assigned to the same user (*Note.* Nodes are able to communicate through wired network.)

2.2 Monitoring and Control

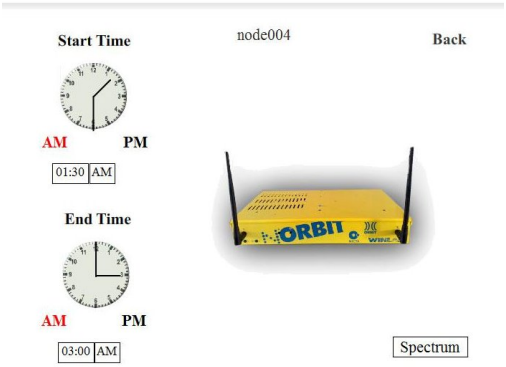
Even in the most sophisticated systems, a trustworthy user might make mistakes that probably cause system's failure and incompliance to specifications. For those reasons, it becomes essential a monitoring scheme for slicing control as a need to ensure the users compliance to what they have booked.Indeed, there is a mechanism, that interacts with the scheduler and ensures user's ability to get access of testbed resources, so that any conflict or malicious actions be prevented.

3. DEMO SETUP

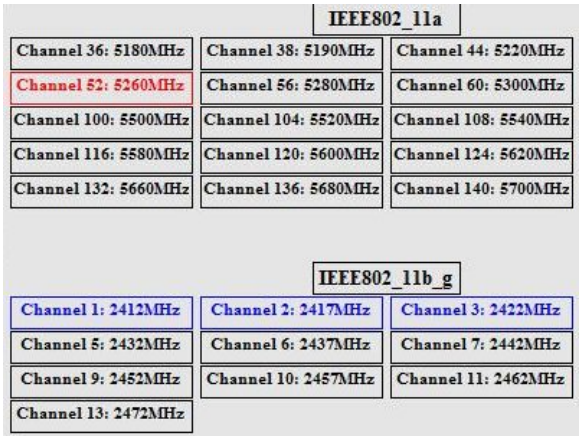
On this section we will describe the setup concerning the demonstration of our work. The demonstration that will take place, it will show how a user can exploit NITOS scheduler features, just by using the beneficial advantages that are provided, in terms of enabling slicing over the testbed resources. It will be demonstrated the way that an experimenter should follow to reserve testbed resources remotely, sitting in front of his computer, miles away from the testbed infrastructure.

3.1 Equipment And Facilities

For our demonstration the equipment needed is a table with one laptop which uses a wired/wireless DSL internet connection. The internet communication between the local



(a) Time reservation of particular node.



(b) Frequency Spectrum Selection.

Figure 3: NITOS Scheduler Reservation Process.

computer and NITOS scheduler web interface is essential for the demonstration, since NITOS testbed deployment is located in Greece, at University of Thessaly campus building. Through a web browser, which is enabled with Flash, users can get a visualization of the NITLAB's testbed topology deployment, with the aid of NITOS scheduler.

NITOS scheduler is dedicated to the tasks of informing the experimenter about the available resources and handling reservations. Each experimenter can reserve the resources needed avoiding any potential conflicts occuring due to simultaneous use of the testbed.

3.2 NITOS Scheduler Demonstration

Firstly, a user enters the NITOS scheduler through NITLAB's wiki *"http://nitlab.inf.uth.gr"* where he registers for a new account. This registration creates in both web-server and testbed's main server *console* an account for the respective user. Now, the user has the ability to see testbed's topology, to check nodes availability, to select and reserve particular nodes in the same way as it was described previously on Section 2.1 in detail. Moreover, this procedure described above enables multiple use of testbed by many experimenters simultaneously.

Resrvation Starting at *2009-06-04 13:30:00* and Ending at *2009-06-04 14:30:00*

NODE: *NODE001*

- **Modulation:** IEEE802_11b_g **Channel:** 9 **Frequency:** 2452

NODE: *NODE007*

- **Modulation:** IEEE802_11b_g **Channel:** 9 **Frequency:** 2452

Resrvation Starting at *2009-06-05 01:00:00* and Ending at *2009-06-05 02:00:00*

NODE: *NODE001*

- **Modulation:** IEEE802_11b_g **Channel:** 9 **Frequency:** 2452

NODE: *NODE007*

- **Modulation:** IEEE802_11b_g **Channel:** 9 **Frequency:** 2452

Figure 4: User Booking Log Information.

Testbed utilization is now achieved when multiple users share testbed resources at the same time. Indeed, the maximum number of users that NITOS scheduler can support is the whole number of registered users, however the maximum number of the *"current operating"* [1] users that a testbed can support is limited by the number of testbed's nodes, since the slicing is being done subject to spectrum frequency in a way that a particular group of channels are assigned to nodes that are reserved to a specific user.

4. CONCLUSION

In this demo paper we present a slicing scheme that enables better utilization of testbed under effective resource exploitation. In particular, different users can dynamically define the slices (testbed resources) they want to use by denoting their intending preferences to a scheduler. Thus, dynamical allocation of slices is supported in an on-fly booking way. The slicing scheme offers better and more effective use of testbed resources, since it allows multiple users to execute experiments and share the testbed.

5. REFERENCES

[1] http://nitlab.inf.uth.gr/.
[2] http://www.planet-lab.org/.
[3] http://www.winlab.rutgers.edu/.
[4] A. Anadiotis, A. Apostolaras, T. Korakis, and L. Tassiulas. A new scheme for slicing over experimental wireless testbeds. Technical report, University of Thessaly, 2009.
[5] D. Raychaudhuri, I. Seskar, M. Ott, S. Ganu, K. Ramachandran, H. Kremo, R. Siracusa, H. Liu, and M. Singh. Overview of the orbit radio grid testbed for evaluation of next-generation wireless network protocols. In *IEEE Wireless Communications and Networking Conference (WCNC 2005).*
[6] R. Mahindra, G.D. Bhanage, G. Hadjichristofi, I. Seskar, D. Raychaudhuri, Y.Y. Zhang. Versus Time Separation for Wireless Virtualization on an Indoor Grid. In *NGI Krakow, Poland, April 2008.*

[1] We denote current operating users those users who are enabled to use testbed resources at present time.