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Demo: OneLab: Major Computer Networking Testbeds for IoT and Wireless Experimentation

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ABSTRACT[1]

Gathering the required measurements to produce accurate results for mobile communications and wireless networking protocols, technologies and applications, relies on the use of expensive experimental computer networking facilities. Until very recently, large-scale testbed facilities have existed in separate silos, each with its own authentication mechanisms and experiment support tools. There lacked a viable federation model that reconciled the challenges posed by how to provide a single entry point to access heterogeneous and distributed resources, and how to federate these resources that are under the control of multiple authorities. The OneLab experimental facility, which came online in 2014, realizes this model, making a set of world-class testbeds freely available to researchers through a unique credential for each user and a common set of tools. We allow users to deploy innovative experiments across our federated platforms that include the embedded object testbeds of FIT IoT-Lab, the cognitive radio testbed of FIT CorteXlab, the wireless testbeds of NITOS-Lab, and the internet overlay testbed PlanetLab Europe (PLE), which together provide thousands of nodes for experimentation. Also federated under OneLab are the FUSECO Playground, which includes cloud, M2M, SDN, and mobile broadband; w-iLab.t wireless facilities; and the Virtual Wall testbed of wired networks and applications. Our demo describes the resources offered by the OneLab platforms, and illustrates how any member of the MobiCom community can create an account and start using these platforms today to deploy experiments for mobile and wireless testing.

General Terms

Measurement, Performance, Reliability, Experimentation, Verification

Keywords

Experimental facility, heterogeneous testbed federation, unique credential, Slice-based Federation Architecture, MySlice

1. RESEARCH TO BE PRESENTED

The OneLab[2] federation of testbeds fills a unique niche: we allow users to deploy innovative experiments across heterogeneous testbeds; and we provide users with the access to these resources with the minimum possible requirements. MySlice,[3] the portal technology that we have developed, provides a tool for easy access to these testbeds. New users sign up and, in a matter of minutes start browsing and reserving resources. Our portal provides a path for users to transition to becoming power users, able to access the same testbeds via a simple and powerful API.

Our demonstration at MobiCom 2015 will present the software behind the OneLab portal and will show users how they may deploy experiments across our heterogeneous IoT and wireless platforms from a single access point. It will also illustrate the characteristics and testing environments that our platforms offer to experimenters.

1.1 The OneLab portal and MySlice

In creating OneLab, we faced with the technical challenges of how to (i) federate distributed resources that are under the control of multiple authorities; (ii) federate heterogeneous resources; and (iii) provide a single access portal to distributed and heterogeneous resources.

Challenge (i) is handled through OneLab's adoption of the Slice-based Federation Architecture (SFA), an API for authentication and authorization that we helped pioneer through the first working SFA-based federation, between PlanetLab Europe and PlanetLab Central in the United States. SFA allows for a distributed web of trust to be constructed around a hierarchy of independent authorities.

MySlice addresses challenge (ii), how to federate heterogeneous resources. Different testbed resources are

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[2] https://onelab.eu

[3] http://www.myslice.info

described in XML files called resource specifications (RSpecs). MySlice exposes diverse RSpecs to users through a common table view, as well as through a set of plug-ins that enable testbed-specific characteristics, such as the geographic location of nodes, to be shown.

The OneLab portal's single access point reconciles challenge (iii), allowing for use of testbeds with the minimum possible requirements: internet access and a web browser; making the portal resources accessible to all users. From our demo, users will easily understand how to use the portal to browse the federated resources and reserve nodes from any of our platforms.

1.2 OneLab platforms

The OneLab federation is made up of the following platforms, encompassing wireless, sensor and mobility testbeds; Internet overlaid testbeds; and broadband access and core testbeds. Our MobiCom demo will educate participants on the characteristics of all of our testbeds, while the experiment will focus on our IoT platforms.

- **FIT IoT-Lab**[4] is made up of six platforms spread across France, boasting a total of 2728 wireless sensor nodes for testing small wireless sensor devices and heterogeneous communicating objects. IoT-Lab platforms have two generations of nodes: SensLAB nodes operating WSN340 open nodes; and IoT-LAB nodes operating M3 and A8 open nodes
- **CorteXlab**[5] is a cognitive radio testbed with WSN, IoT-Lab and SDR radio nodes, and allows for the operating frequency, bandwidth, emitted power and waveform to be adjusted so as to customize the testing environment
- **NITLab**[6] and **FIT NITOS-Lab**[7] platforms provide wireless nodes based on commercial Wi-Fi cards and Linux open source drivers. These NITOS platforms allow for reproducibility of experimentation and evaluation of protocols and applications in real world settings
- **PlanetLab Europe**[8] provides users access to over one thousand nodes on 530 sites worldwide, allowing for large-scale, extensive, and remote testing
- **FUSECO Playground**[9] provides core network technologies such as multi-access network environments, M2M and IoT, sensor networks and mobile broadband, and SDN and openflow cloud environments.
- **w-iLab.t**[10] testbeds allows for wireless networks and solutions testing activities by providing multiple wireless interfaces such as sensor nodes, Bluetooth and Wi-Fi nodes, and offers both fixed and mobile nodes.
- **Virtual Wall**[11] testbeds provide an environment for wired networks and solutions experimentation

2. EXPERIMENT DEMONSTRATION

For the experimentation aspect of our demonstration, we will deploy a basic experiment on the IoT-Lab platform via the OneLab portal. We step users through the process of obtaining an account on OneLab, creating a slice, reserving the IoT-Lab WSN430 nodes, and deploying the experiment. The nodes will send UDP messages to the root over a tree build by the routing protocol RPL; for example: each of the reserved nodes will send to the root a UDP message every second. This rate of traffic is higher than classical surveillance radio traffic but has been considered for practical reasons. Nodes closer to the root have to forward traffic coming from downstream nodes in addition to their own traffic. The root node acknowledges each received data packet. Experiments will run for 200 seconds. Through deployment on IoT-Lab's WSN430 nodes, we will be able to measure the energy consumption of nodes and real time delay and the packet reception rate.

Engineers from the OneLab team and PhD student Fadwa Boubekeur, who works extensively on FIT IoT-Lab for her research, will carry out the demo to show students, researchers and industrial representatives how they can use the OneLab portal and its testbeds to easily deploy their experiments. This demonstration will show to users the ability to have very fine control over what can be done on a node.

3. REQUIREMENTS

3.1 Equipment to be used

For this demonstration, we will need a wired Ethernet connection and a power outlet. Ideally, we would also need a monitor (with HDMI/VGA cables) to connect to the laptop and show the demo on a large screen. Accompanying the experiment will be poster on OneLab's federated testbeds and the MySlice software, which will also require use of an easel to mount the poster.

3.2 Set up and space

As the demonstration is done remotely and through the web, there is minimal setup and space required. We will need one table upon which to set our laptop (plus the monitor, if available) and a poster easel. Most of the demo can be set up ahead of time, so on-site set-up will only be to connect to the various cables and set up the poster.

[4] https://www.iot-lab.info/
[5] http://www.cortexlab.fr/
[6] http://nitlab.inf.uth.gr/
[7] http://fit-nitos.fr/
[8] http://planet-lab.eu/
[9] http://fuseco-playground.org
[10] http://ilabt.iminds.be/wilabt
[11] http://ilabt.iminds.be/virtualwall