ONELAB Rationale & History

March 04

Grounded on ENEXT
Identification of
critical testbeds for networking research

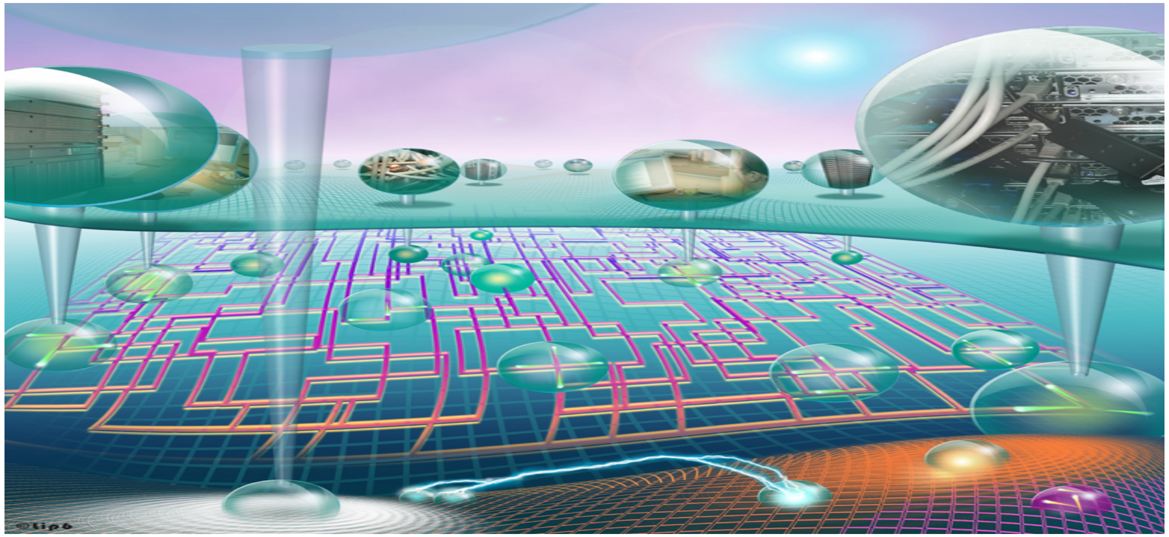
Sept'06

ONELAB [1] project funded as an IST project
under the FP6 funding program
(10 partners, 2 years)

Sept'08

ONELAB [2] proposal funded as an IST
project under the FP7 funding program
(26 partners, 2 years)

OneLab[1] Goals



- Extend
  - Extend PlanetLab into new environments, beyond the traditional wired internet.
- Deepen
  - Deepen PlanetLab's monitoring capabilities.
- Federate
  - Provide a European administration for PlanetLab nodes in Europe.

OneLab[1] main Workpackages

- WP1 Operation (UPMC)
- WP2 Integration (INRIA)
- WP3 Monitoring (Quantavis)
  - WP3A Passive monitoring (Quantavis)
  - WP3B Topology monitoring (UPMC)
- WP4 New Environments (FT lead)
  - WP4A WiMAX component (UCL)
  - WP4B UMTS component (UniNa, with ALA)
  - WP4C Multihomed component (UC3M)
  - WP4D Wireless ad hoc component (FT, with TP)
  - WP4E Emulation component (UniPi)
- WP5 Validation (UPMC, with all partners)

OneLab^2

- The main objectives of OneLab^2 are to:
  - Run and operate PlanetLab Europe, federated with PLC.
  - Integrate and extend the new functionalities of the curent PlanetLab
  - Enhance network monitoring (topology information and packet tracking)
  - Define requirements and support forthcoming experiments for new pilot project as:
    - Wireless
    - Content-driven networking
    - Situated and Autonomic Communication (SAC)

OneLab^2 pillars

- Platform Pillar:
  - **Operational, planet-scale, experimental platform for the community**
    - Run PlanetLab Europe, grow its European sites coverage, continue federation process (EverLab, PL Japan,…)
  - **Improvements of the basic platform capabilities**
    - Conducting ongoing integration and validation of the core OneLab Build codebase and devekop advanced incentive mechanism.
    - Implement a reservation mechanism for PlanetLab and Integrate emulation into the standard software distribution.
  - **Dissemination of the platform and of its usage**
    - Provide documentation (users, admin, developers), and organize various public events and workshops.

OneLab^2 pillars

- Tools Pillar:
  - **Topology information available to experimentations**
    - Provide a community-wide topology information component, timestamp events at high-precision-capable nodes and create a virtual observatory.
    - Federated two measurement infrastructures (TopHat and DIMES) and bring improved precision with ETOMIC.
  - **Tools for end-to-end packet tracking**
    - Track packets from applications, collect information about other application's data flows at key points within the network.
    - Deploy and improve passive measurement infrastrucutre based on the CoMo architecture. Add resource management capabilities, and synchronized multipoint measurements.

OneLab^2 pillars

- Customers Pillar (1):
  - **Deeper integration of wireless testbeds**
    - Work on Wireless "virtualisation" in order to develop the ability to run concurrent experiments involving wireless subnets, configuration tools for experiment wireless capacities, and access wireless-specific monitoring information
  - **Better tools for experimenting with Content Delivery Networks**
    - Provide infrastructural support for large-scale data-centric networking research. Develop techniques for virtualisation of central pieces in large-scale publish-subscribe (pub/sub) systems and CDNs;

OneLab^2 pillars

- Customers Pillar (2):
  - **Steps towards SAC integration**
    - Develop a SAC gateway, together with the interfaces and tools necessary for the inter-operation between PlanetLab Europe and existing SAC testbeds.
    - Problems, such as opportunistic networking and delay-tolerant networking (DTN), will be taken into account.
  - **Experimentation methodology and benchmarking**
    - Provide a methodology, and a set of tools, that permits benchmarking, minimise the impact of environmental factors on their behaviour.
    - Address two major types of experiments:
      - namely peer-to-peer systems.
      - fixed and mobile wireless systems.
      - NS3 (Integration)

OneLab^1 main achievements

- Federation
- New Environments
- Monitoring

Federation

- PlanetLab Europe is federated with PlanetLab Central
- OneLab Operation team maintain, administrate PlanetLab in Europe

OneLab[1] main achievements

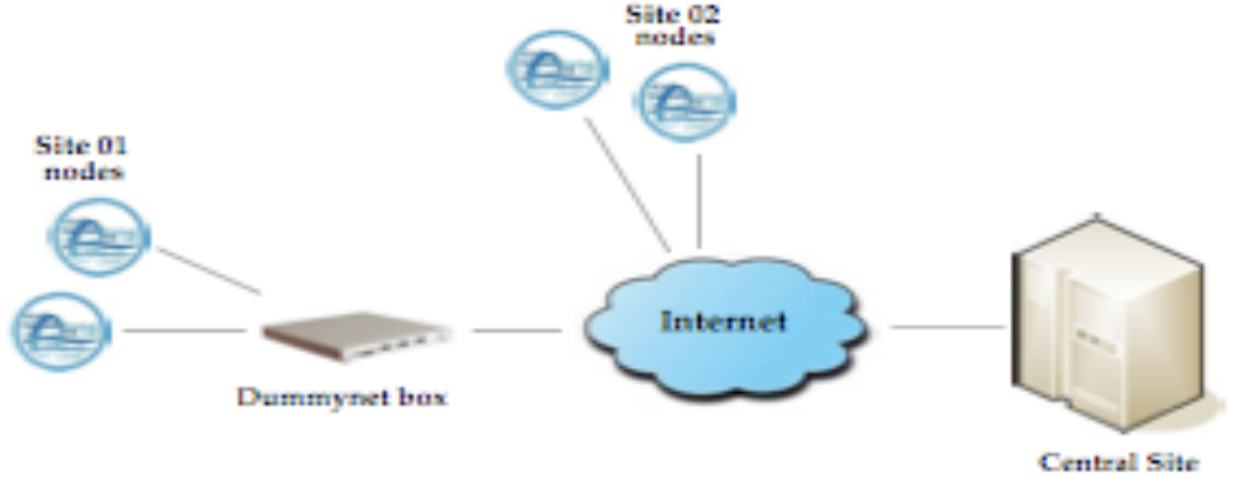
- Federation
- New Environments
- Monitoring

OneLab[1] Emulation component

- DummynetBox (DBox):
  - Based on Dummynet
    - (Emulation component used in EmuLab)
  - Individual users (slivers) can independently and concurrently set up the characteristics of the emulated link for their experiment.

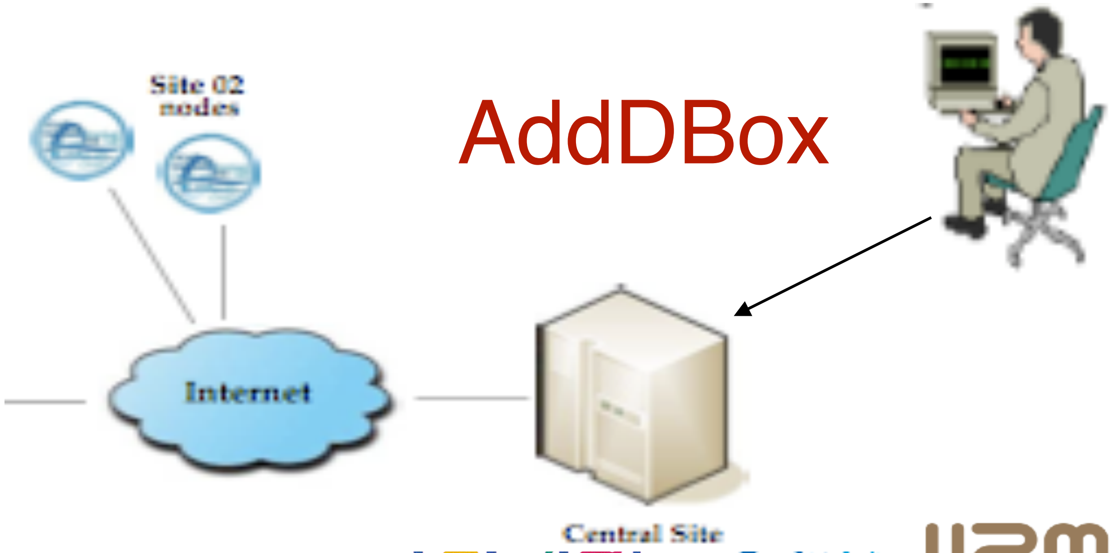
OneLab[1] Emulation component

- Dummynet API:
  - Configure and install the DBox on a site.
  - Assign node, slivers to the DBox.
  - Load emulation configuration file to emulate the wireless link according to the features requested by the users.



OneLab[1] Emulation component

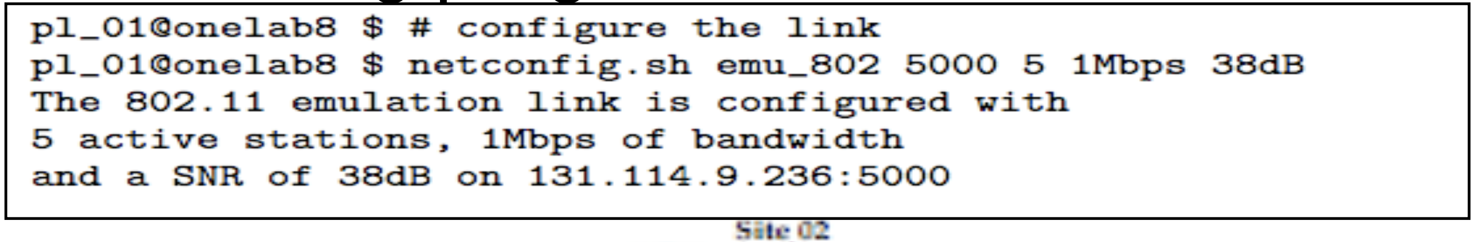
- Configuration of the DBox:
  - Add sliver/nodes on a Dbox with the DummyNet API methods located on PLE.



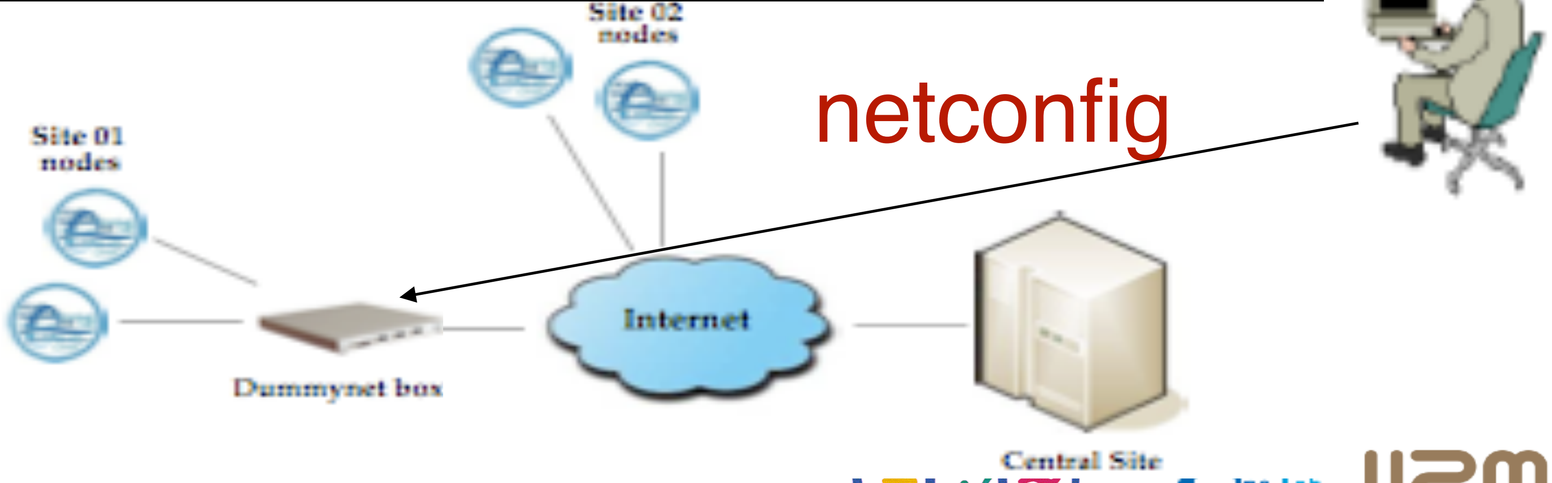
AddDBox

OneLab^1 Emulation component

- Configuration of the DBox:
  - Configuration of the emulated wireless link (802.11g, 1Mbps, 38dB) on the Dbox with netconfig program.

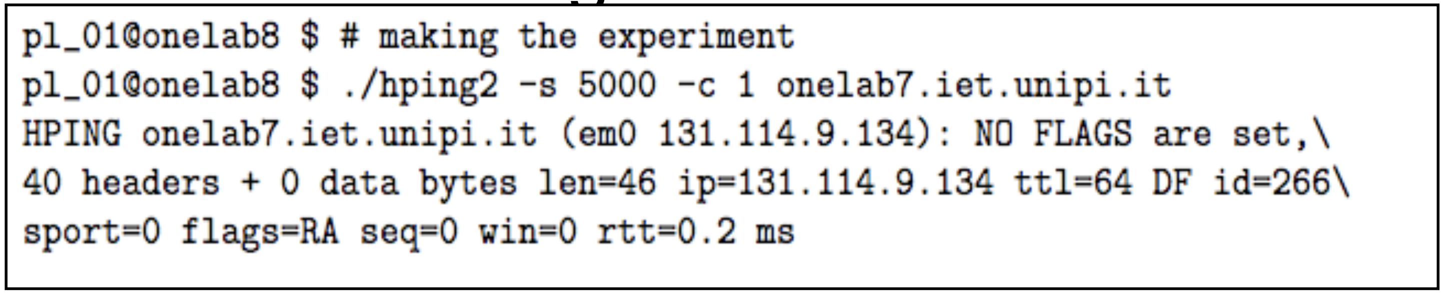


```
pl_01@onelab8 $ # configure the link
pl_01@onelab8 $ netconfig.sh emu_802 5000 5 1Mbps 38dB
The 802.11 emulation link is configured with
5 active stations, 1Mbps of bandwidth
and a SNR of 38dB on 131.114.9.236:5000
```

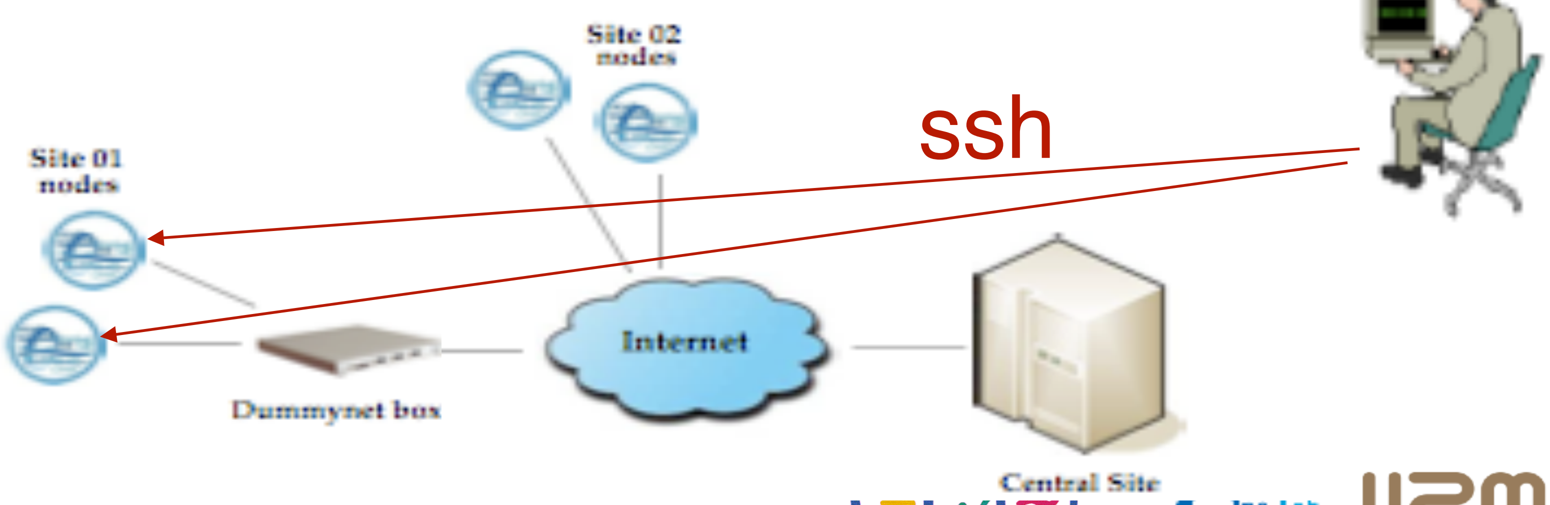


OneLab[1] Emulation component

- DBox experiment using hping:
  - The user can use the hping application on his sliver through an ssh connection.

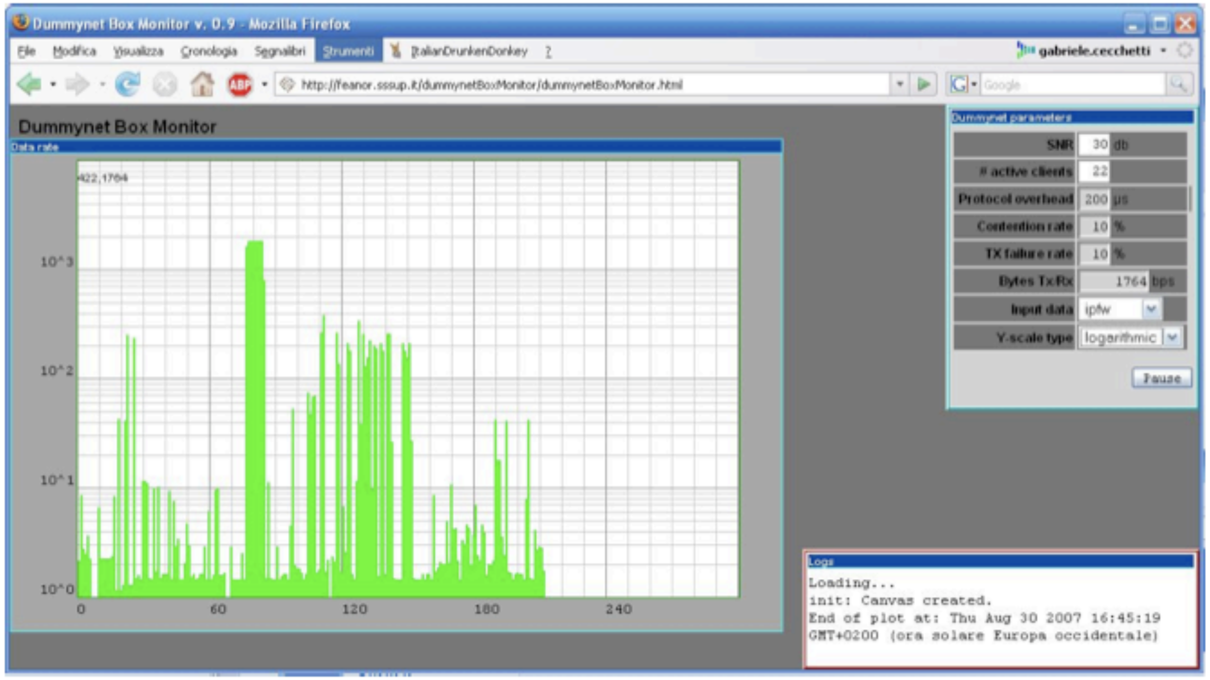


```
pl_01@onelab8 $ # making the experiment
pl_01@onelab8 $ ./hping2 -s 5000 -c 1 onelab7.iet.unipi.it
HPING onelab7.iet.unipi.it (em0 131.114.9.134): NO FLAGS are set,\
40 headers + 0 data bytes len=46 ip=131.114.9.134 ttl=64 DF id=266\
sport=0 flags=RA seq=0 win=0 rtt=0.2 ms
```



OneLab^1 Emulation component

- DBox monitoring :
  - The DBox continuously monitor the traffic flowing through the interface and report on web page dynamically.


Dummynet Box Monitor v. 0.9 - Mozilla Firefox
File Modifica Visualizza Cronologia Segnalibri Strumenti ItalianDrunkenDonkey ?
gabriele.cecchetti
http://feanor.sssup.it/dummynetBoxMonitor/dummynetBoxMonitor.html
Google
Dummynet Box Monitor
Data rate
422,1764
10^3
10^2
10^1
10^0
0
60
120
180
240
Dummynet parameters
Pause
Logs

SNR 30 db

active clients 22

Protocol overhead 200 µs

Contention rate 10 %

TX failure rate 10 %

Bytes TxRx 1764 bps

Input data ipfw

Y-scale type logarithmic

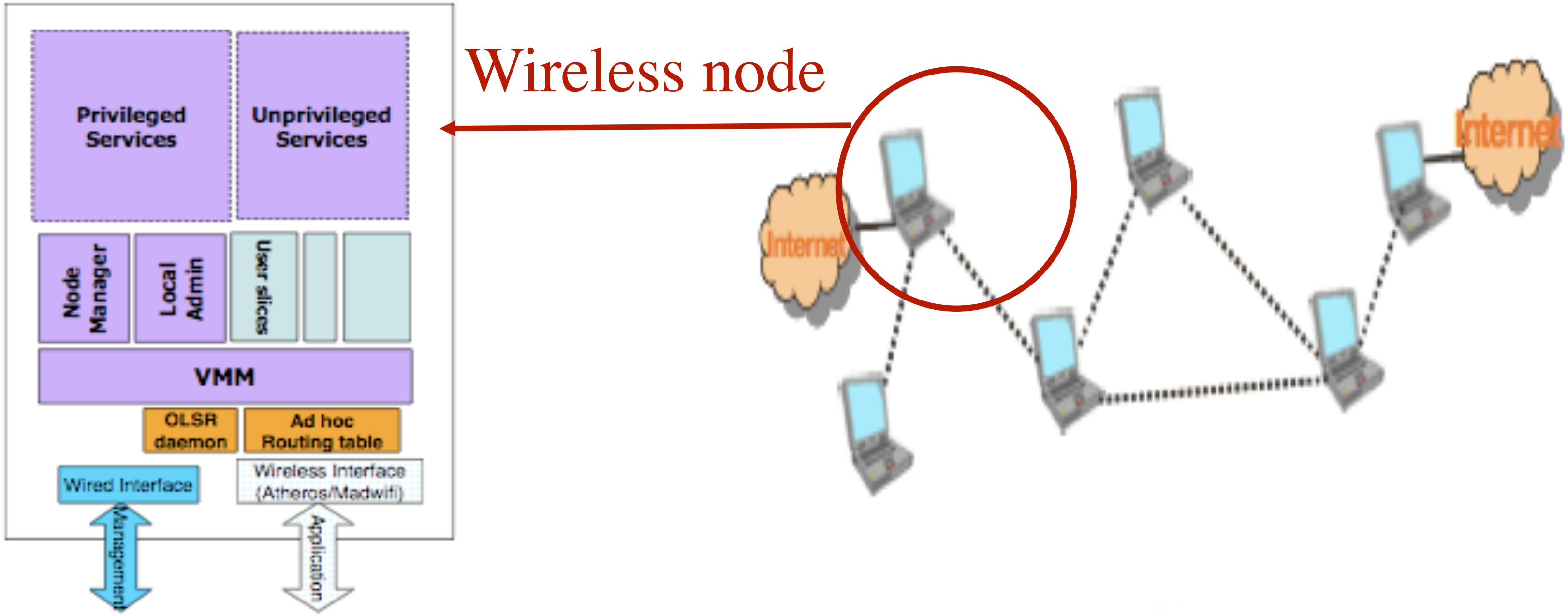
```
Loading...
init: Canvas created.
End of plot at: Thu Aug 30 2007 16:45:19
GMT+0200 (ora solare Europa occidentale)
```

OneLab[1] Wireless component

- Integration of Madwifi drivers on each nodes:
  - ease of use.
  - Compatibility.
  - Wireless virtualisation allowed.

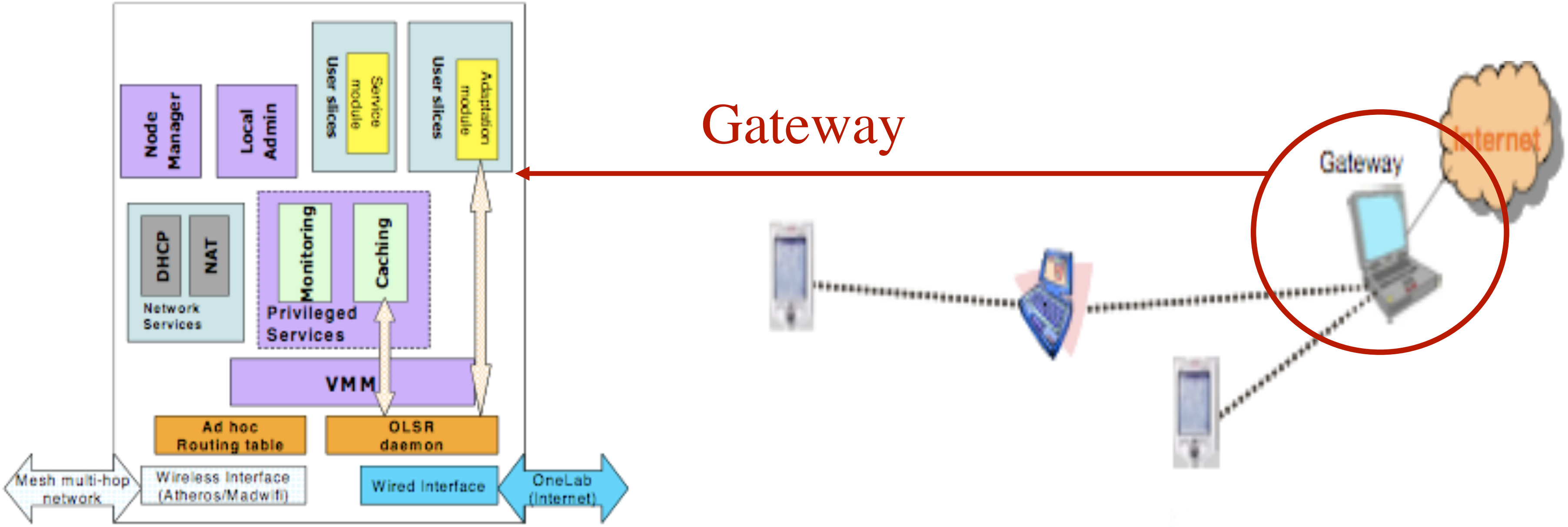
OneLab[1] Wireless component

- The node software allow the deployment and test application in wireless mesh multi-hop network.
- A node has to be configured with a fixed IP, OLSR, and ad hoc routing table.



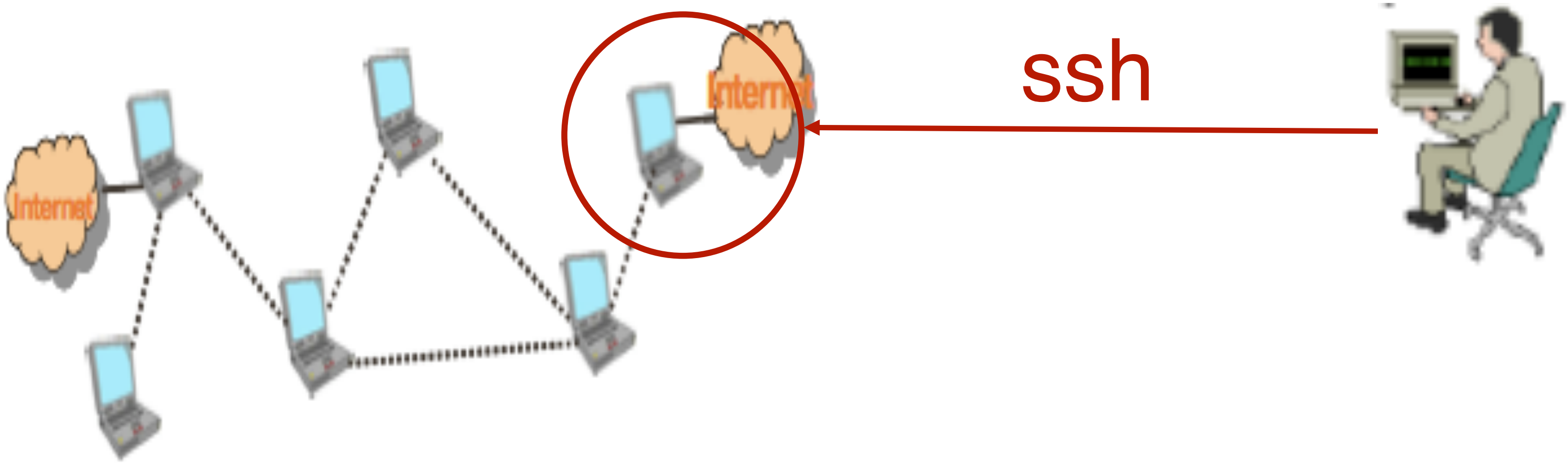
OneLab[1] Wireless component

- In order to broaden the scope of devices (PDAs, mobile phone,…), the nodes can be PlanetLab Europe software independent if they are connected to a gateway configured with the node software



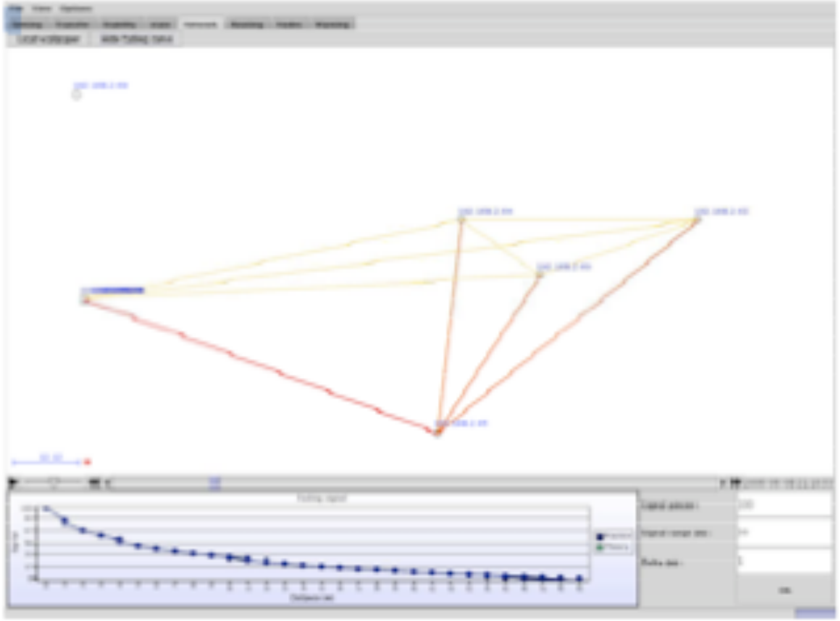
OneLab[1] Wireless component

- If no Gateway is configured the user can:
  - Access to each nodes of the wireless multi-hop mesh network with his ssh key.
  - Use the configured wireless command.
  - Launch application (Streaming video, iperf, hping, …).

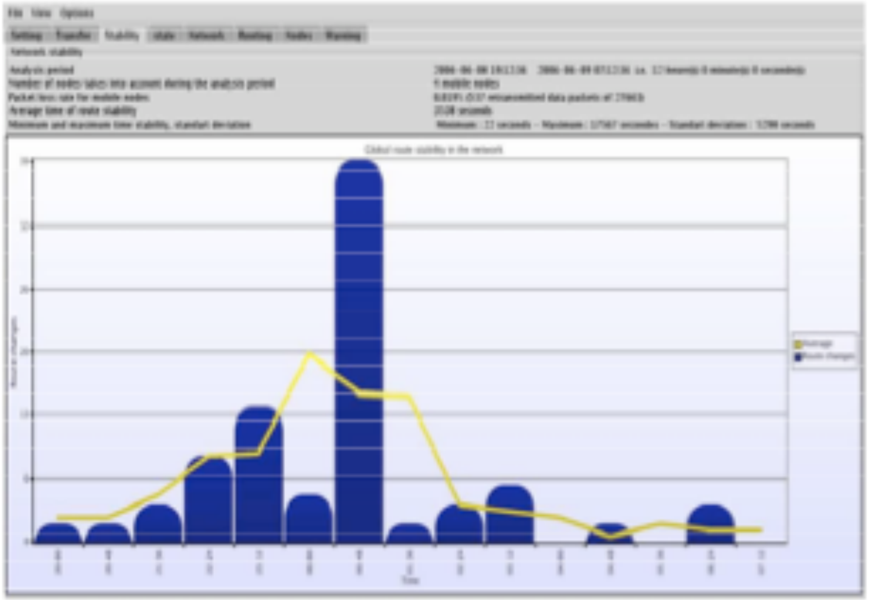


OneLab[1] Wireless component

- If the Gateway is used:
  - A PlanetLab Europe user can have access to the monitoring interface on the gateway node.



Network topology



File View Options

Setting | Transfer | Stability | state | Network | Routing | Nodes | Warning

Network stability

Analysis period — [illegible]

Number of nodes taken into account during the analysis period — [illegible] mobile nodes

Packet loss rate for mobile nodes — [illegible]

Average time of route stability — [illegible] seconds

Minimum and maximum time stability, standard deviation — Minimum : [illegible] seconds - Maximum : [illegible] seconds - Standard deviation : [illegible] seconds

Link Stability

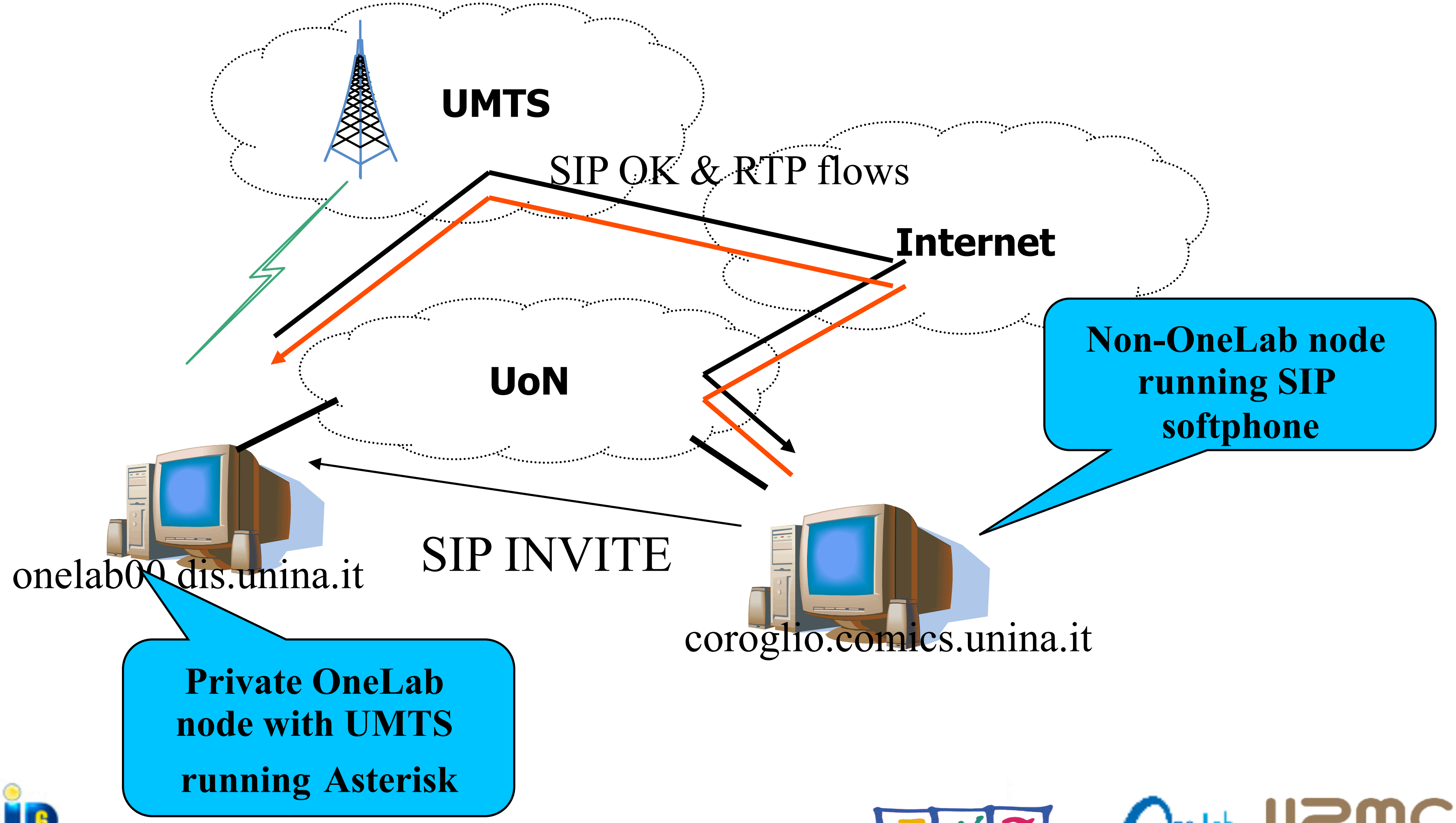
OneLab[1] UMTS

- UMTS connectivity (GlobeTrotter PCMCIA cards)
  - Kernel-level drivers tested and integrated in the Linux kernel. Drivers get installed by adding the node to the UMTS nodegroup.
  - User level PPP daemon and auxiliary tools (gcom, wvdial, umts-tools) included in the Private OneLab package repository. An UMTS connection can be established and teardown in a normal slice context
- A slice user can use the UMTS connection
  - specifying the destinations for which the UMTS connection is required
    - `umts add www.google.com`
  - by explicitly setting UMTS ppp interface as the source IP address
    - `ping -I ppp0 onelab01.dis.unina.it`

OneLab[1] UMTS

- Special frontend-backend pairs have been developed to control the UMTS interface in a slice context:
    - **umts start**, to start the connection
    - **umts status**, to check the status of the connection
- **Creates a new routing table to be used by the slice with only a default rule (using iproute):**
    - **ip route add default dev ppp0 table 10**
- **Adds a rule in order to use the routing table just created for each destination specified by the user in the frontend**
    - **ip rule add to <dest_ip/dest_netmask> fwmark <slice_mark> table 10**

UMTS gateway experiments



UMTS

SIP OK & RTP flows

Internet

UoN

Non-OneLab node running SIP softphone

SIP INVITE

onelab00.dis.unina.it

coroglio.comics.unina.it

Private OneLab node with UMTS running Asterisk

OneLab[1] Multihoming Component

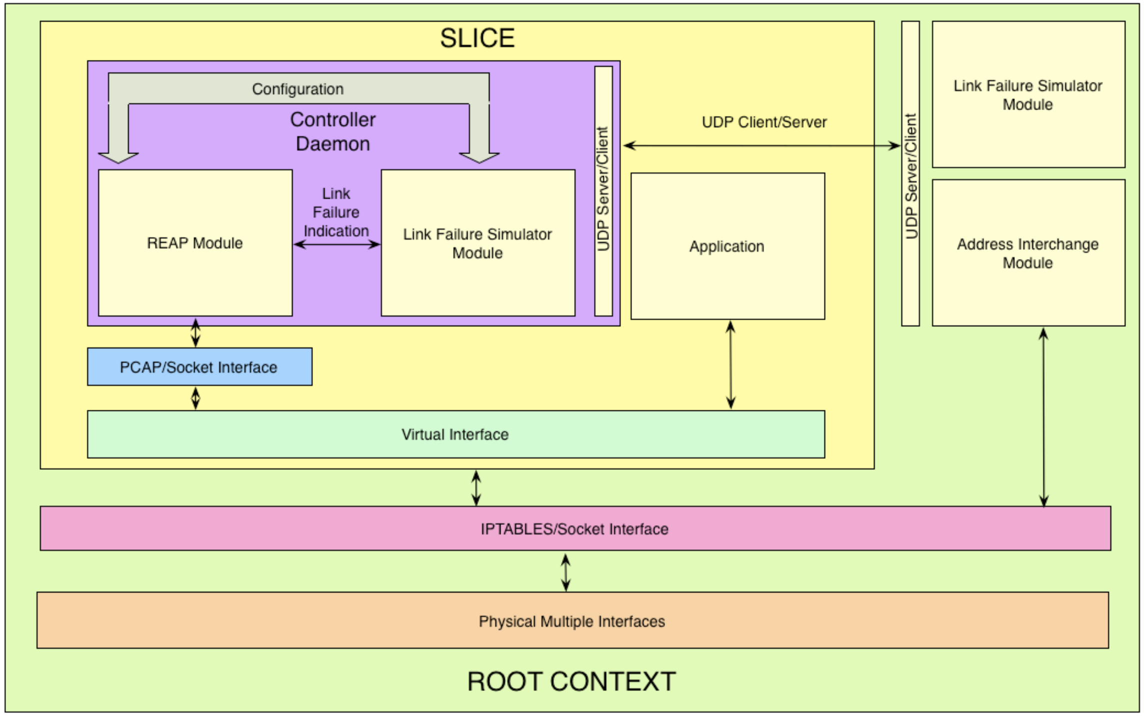
- Functionality of the Multihoming Component:
  - Multiple interfaces
  - Virtual Failure Simulator
  - Path Failure Detection and Path Exploration.
  - Transparent modification of the path

- Testing of multihoming functionality in the Onelab Platform

Multihoming Component Code

- Two versions are provided:
  - For Linux Fedora Core boxes: full functionality
  - For OneLab boxes: provide a subset of the multihoming component functionality
    - Only UDP applications support
- The functionality provided has been fully tested on a Fedora Core 4 box

Multihoming Component Implementation



In order to provide multihoming capabilities on the Onelab platform, interaction with the root context was needed:

- Modification of routes
- Filtering of packets
- Modification of packets

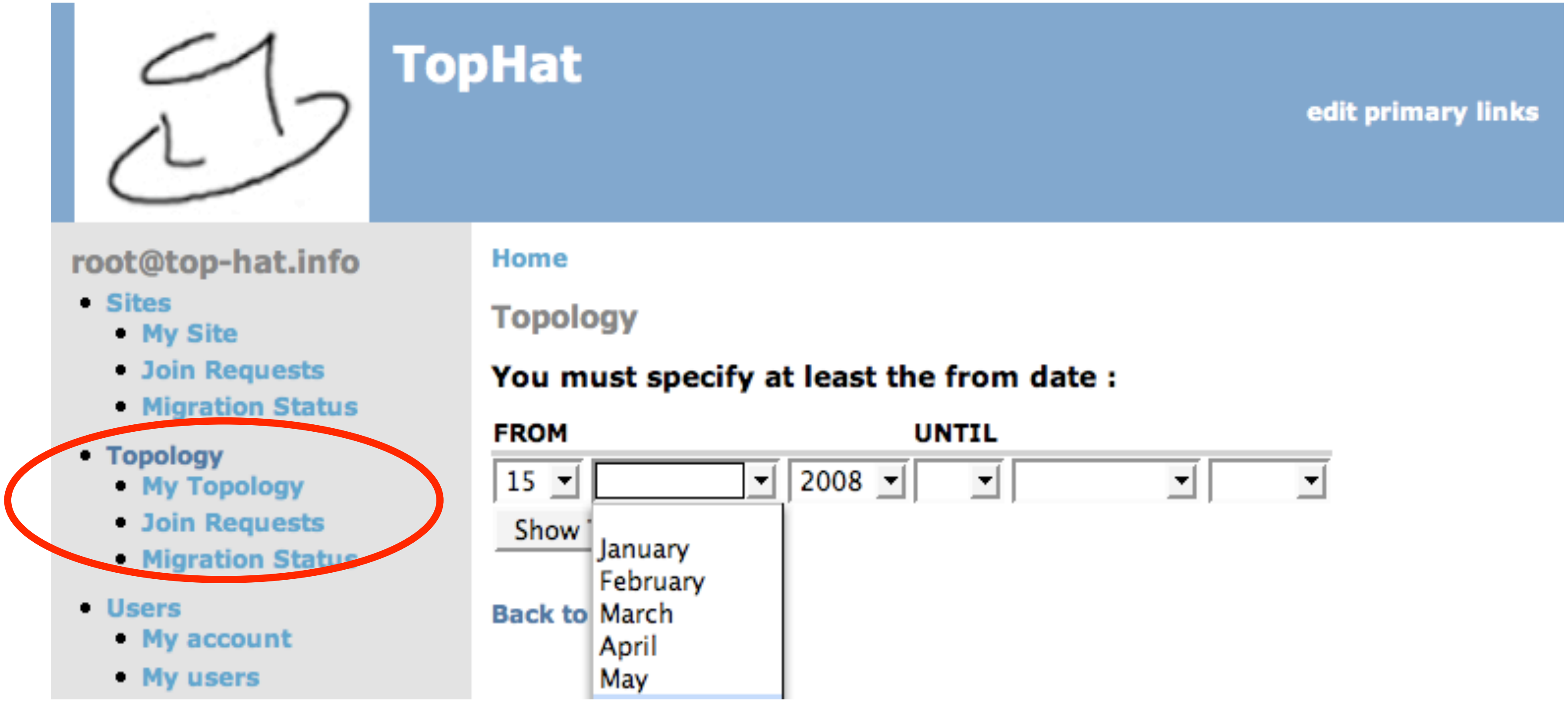
OneLab 1 main achievements

- Federation
- New Environments
- Monitoring

Objective of the Topology information component

- Provide information concerning
  - The underlying network topology (IP/AS-Level)
- Add additional measurement subcomponents.
  - Active measurement subcomponent
    - Traceroute@home: IP-level route traces
  - AS-level subcomponent
    - BGP guided probing: BGP communities
    - Obtains BGP feeds: Allows IP to AS mapping.
- Improve the monitoring capability
  - Allows applications to query the topology information component.
    - TopHat API

TopHat: OneLab[1] Topology Information Component



TopHat

root@top-hat.info

- Sites
  - My Site
  - Join Requests
  - Migration Status
- Topology
  - My Topology
  - Join Requests
  - Migration Status
- Users
  - My account
  - My users

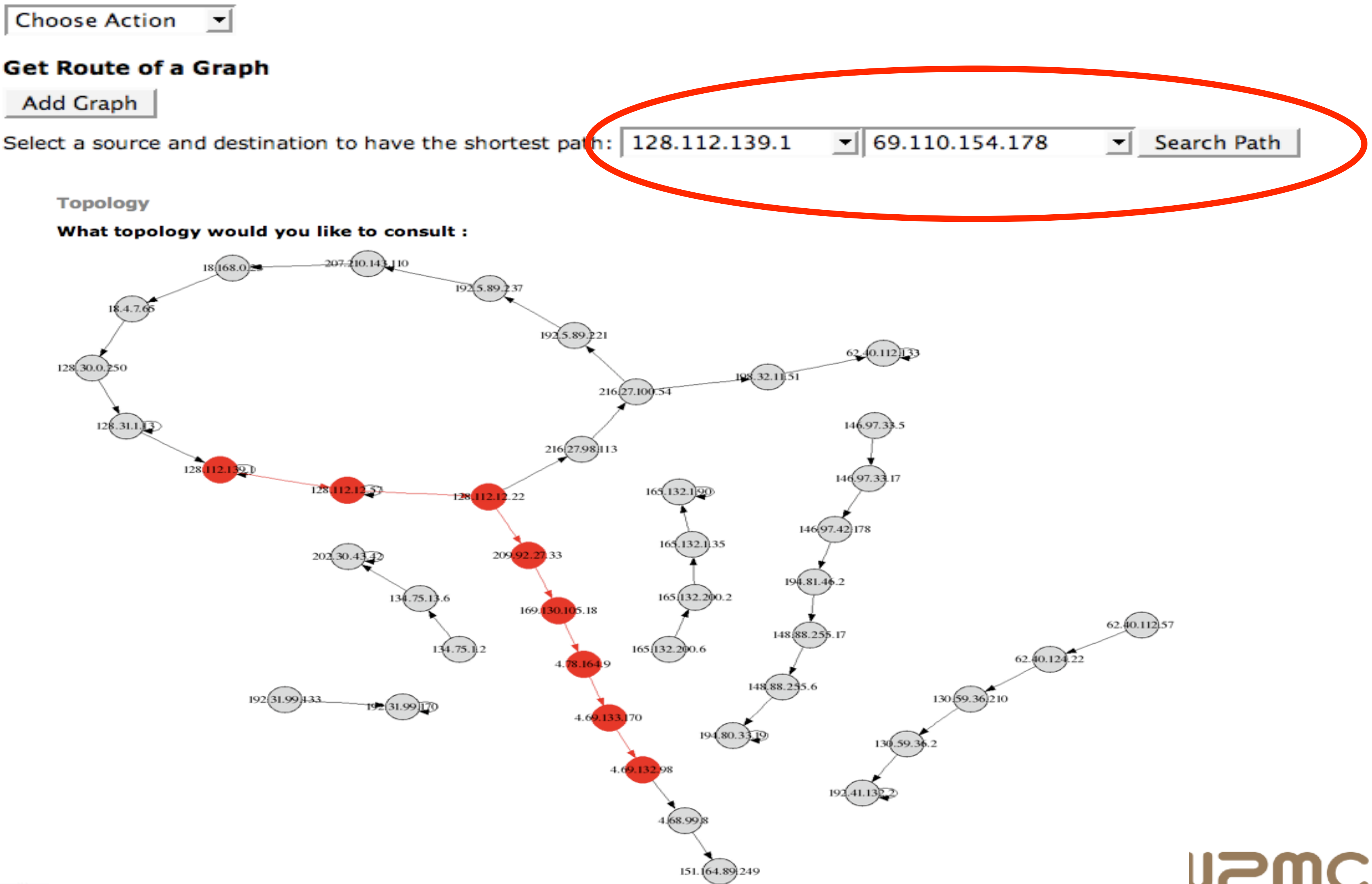
Home

Topology

You must specify at least the from date :

FROM: 15, 2008

TopHat: Search path



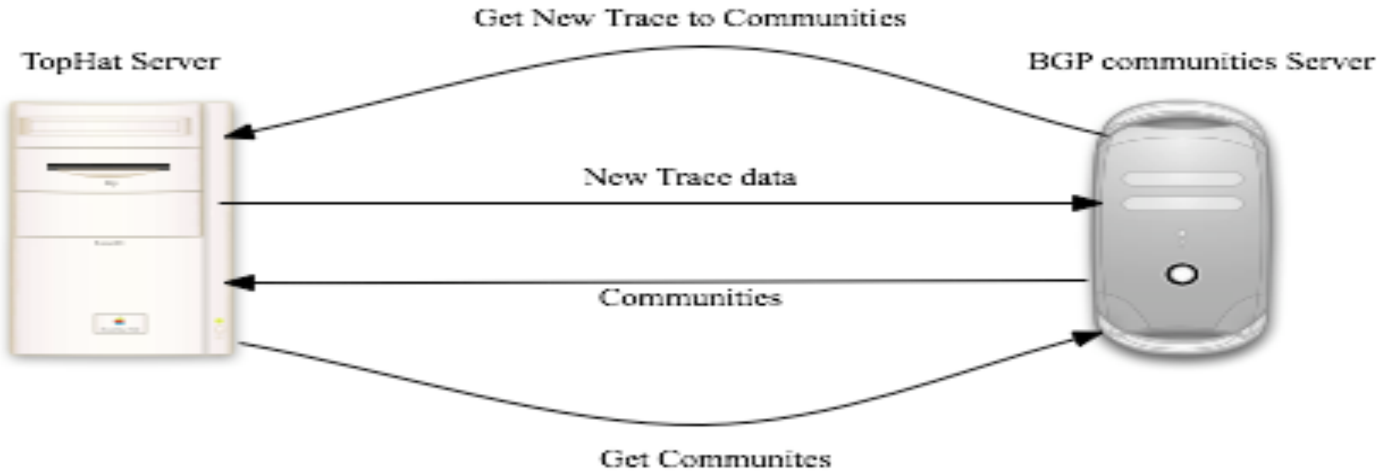
Get Route of a Graph

Select a source and destination to have the shortest path: 128.112.139.1 69.110.154.178

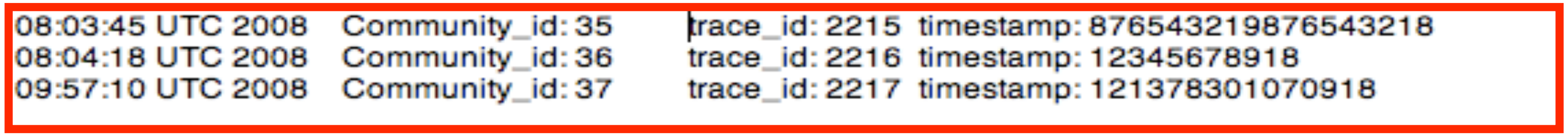
Topology

What topology would you like to consult :

BGP Guided Probing

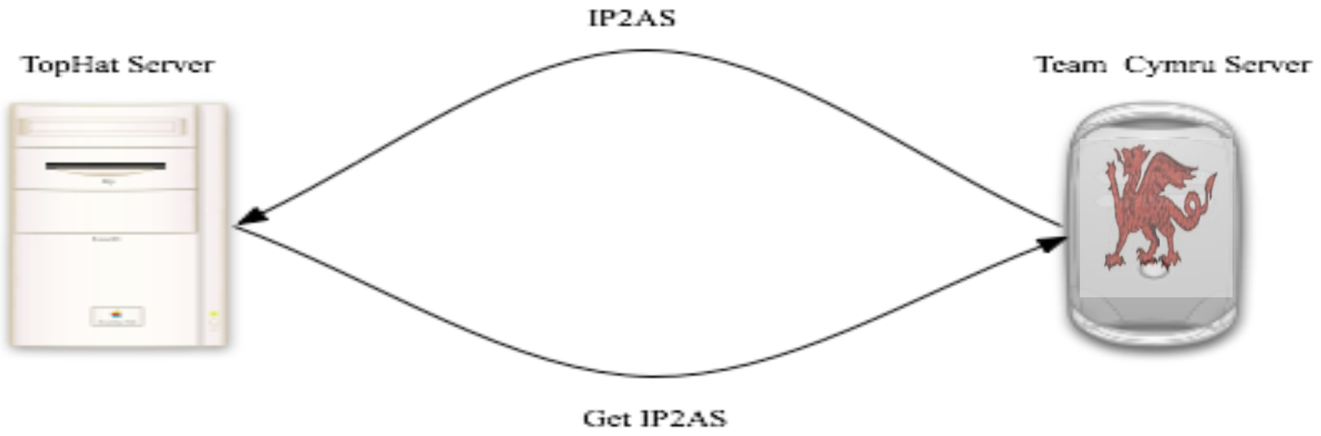


- Launch a traceroute exploration:
  - When a BGP communities change the server contact TopHat to probe where the route has changed.



```
08:03:45 UTC 2008   Community_id: 35     trace_id: 2215  timestamp: 876543219876543218
08:04:18 UTC 2008   Community_id: 36     trace_id: 2216  timestamp: 12345678918
09:57:10 UTC 2008   Community_id: 37     trace_id: 2217  timestamp: 121378301070918
```

Mapping IP to AS



- TopHat Server can:
  - Translate any traceroute@home hop results with its correspondent ASs
  - Store ASs information related to IP: (AS, BGP Prefix, Registry, AS Name)
  - Query Team Cymru Whois server (GetIP2AS)

Thank you

The END

Open questions…