An Open Federated Laboratory Supporting
Network Research for the Future Internet

OneLab
FUTURE INTERNET TEST BEDS

Instrumenting PlanetLab: presentation of the TopHat measurement infrastructure

Jordan Augé, Thomas Bourgeau, Timur Friedman (UPMC)

Master 2 – UPMC Working Group – March 15th, 2010

Outline

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Motivations

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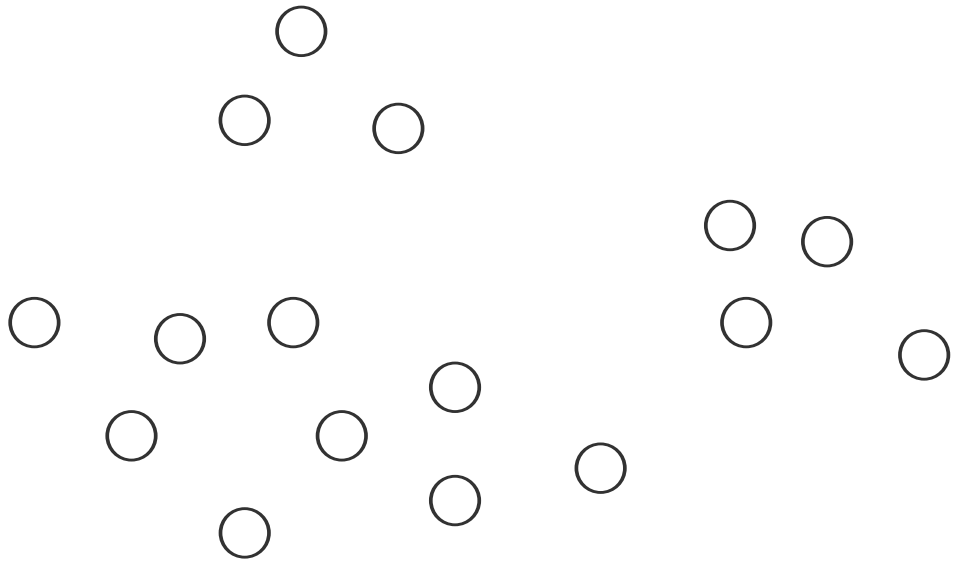

Motivations

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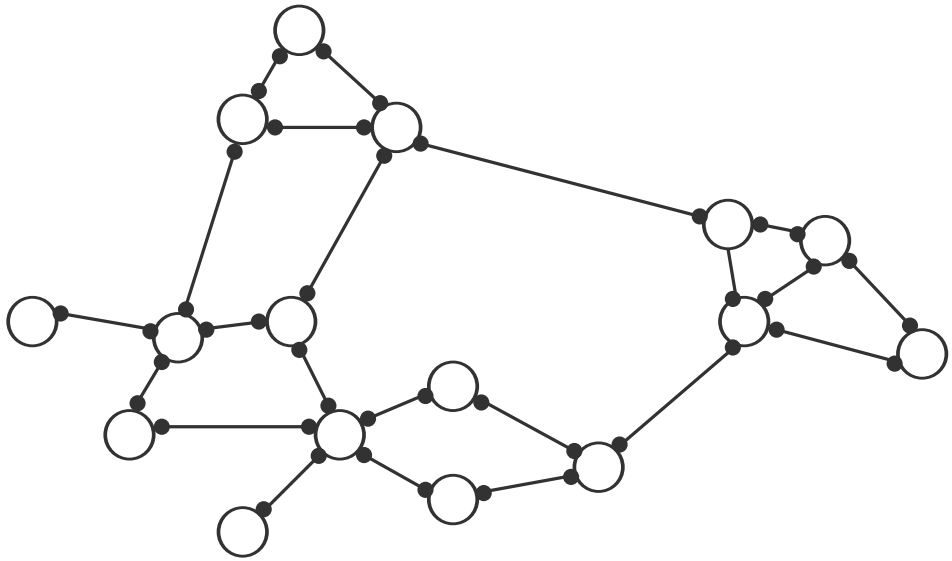

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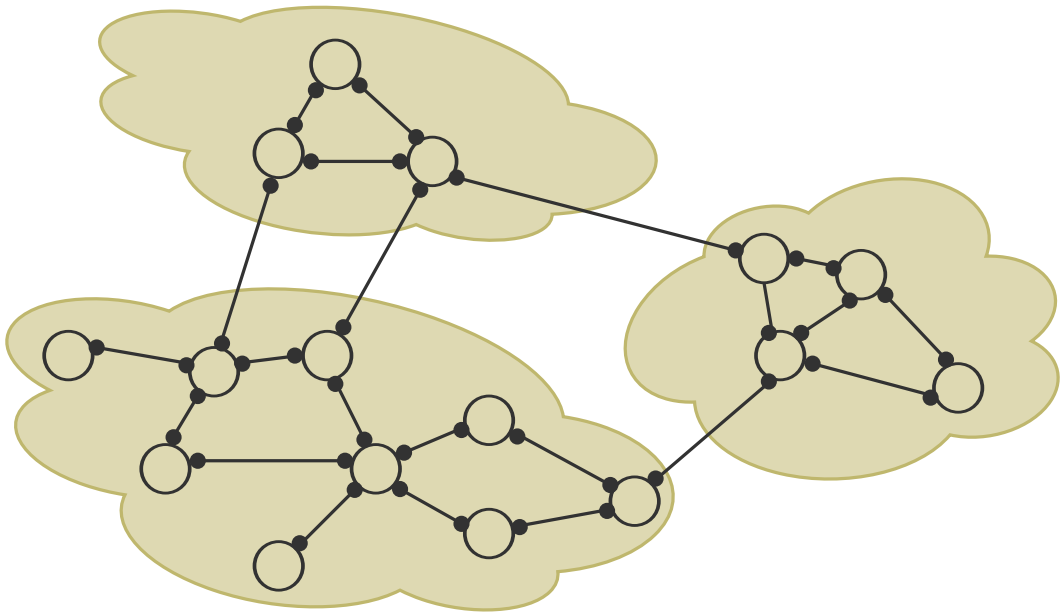

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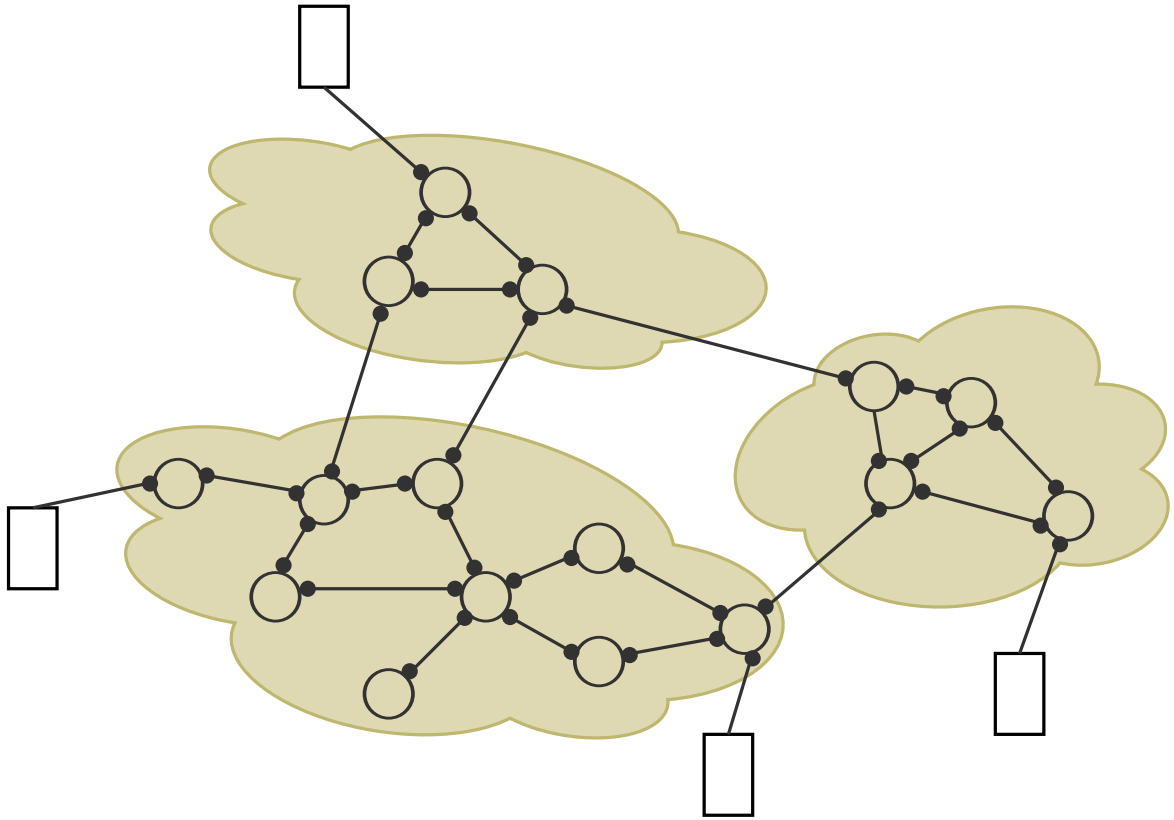

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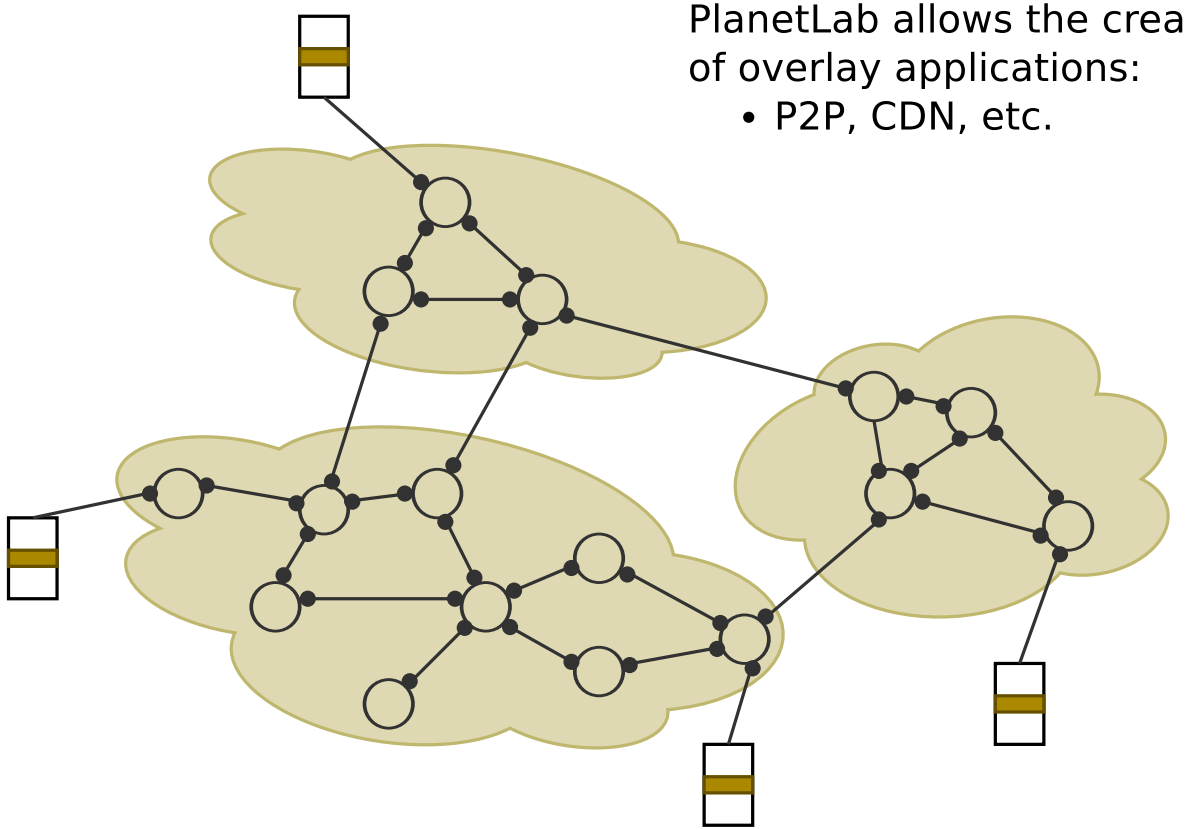
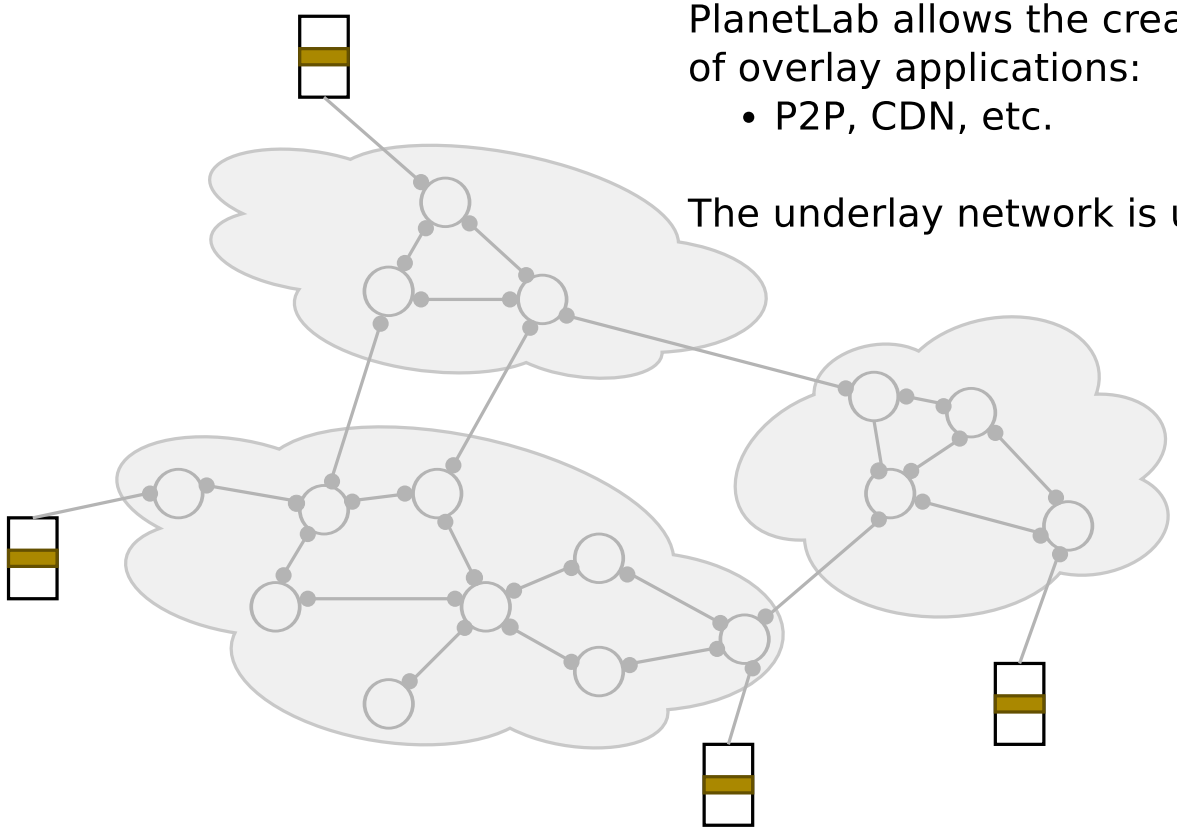


PlanetLab allows the creation of overlay applications:

- P2P, CDN, etc.

Motivations



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The underlay network is unknown!

Motivations

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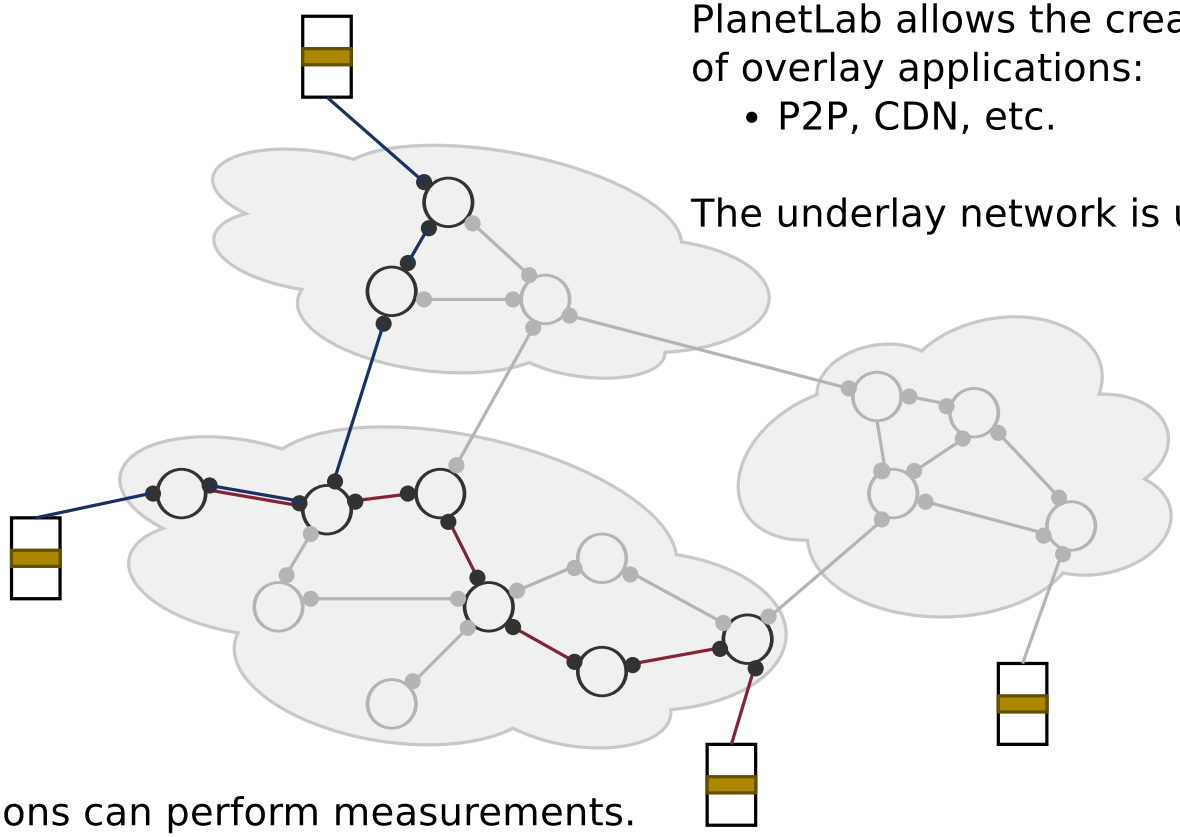

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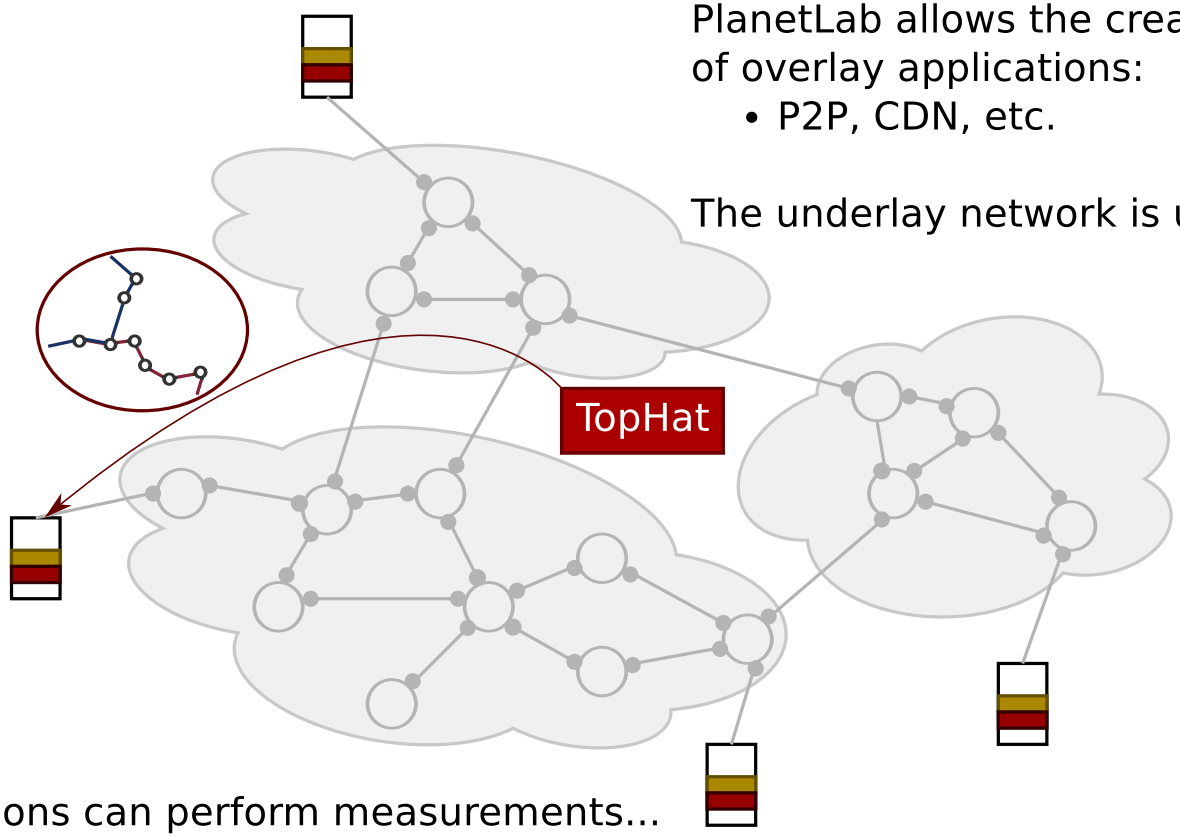
The underlay network is unknown!

Applications can perform measurements.

Motivations



PlanetLab allows the creation of overlay applications:

- P2P, CDN, etc.

The underlay network is unknown!

Applications can perform measurements...
... but we argue a measurement service is better

- users can focus on developing the application, instead of monitoring,
- we can reduce the strain on the network thanks to efficient probing,
- it generally provides more efficient, correct and accurate results.

Measuring the underlay topology

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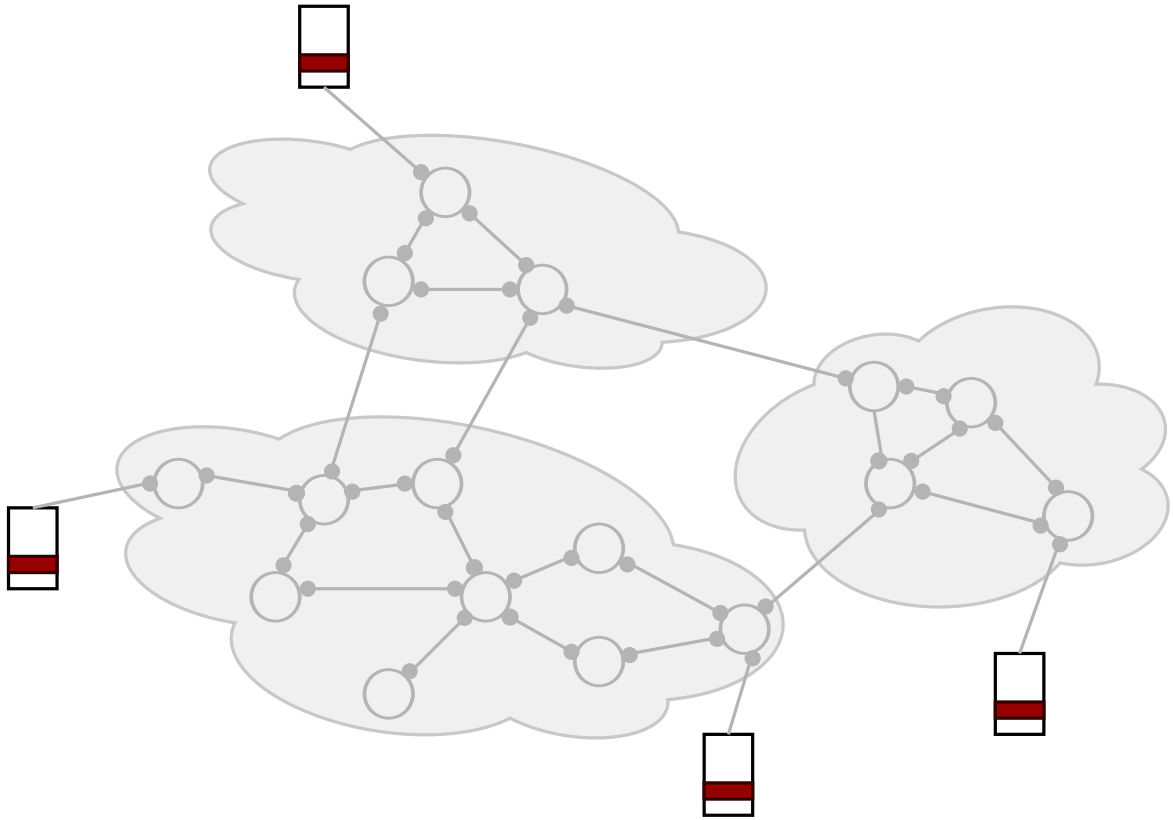

Measuring the underlay topology

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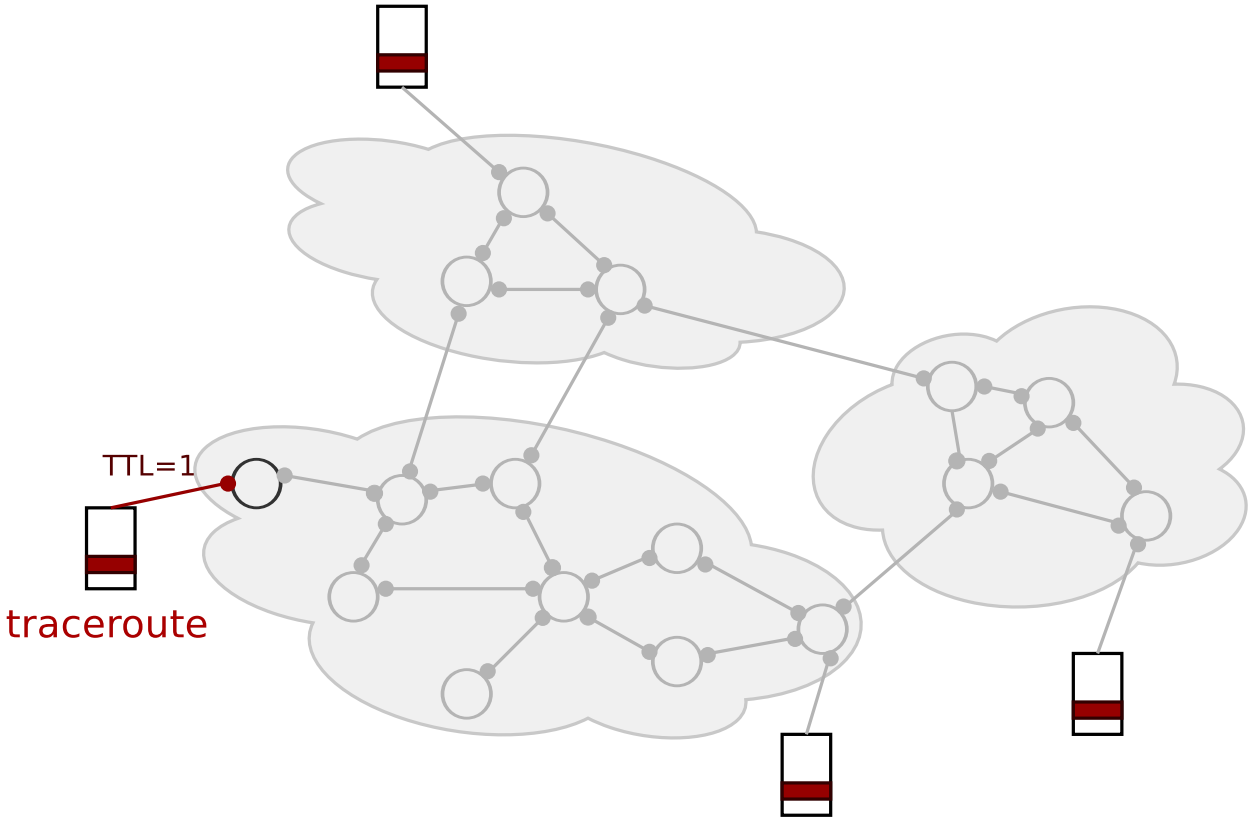

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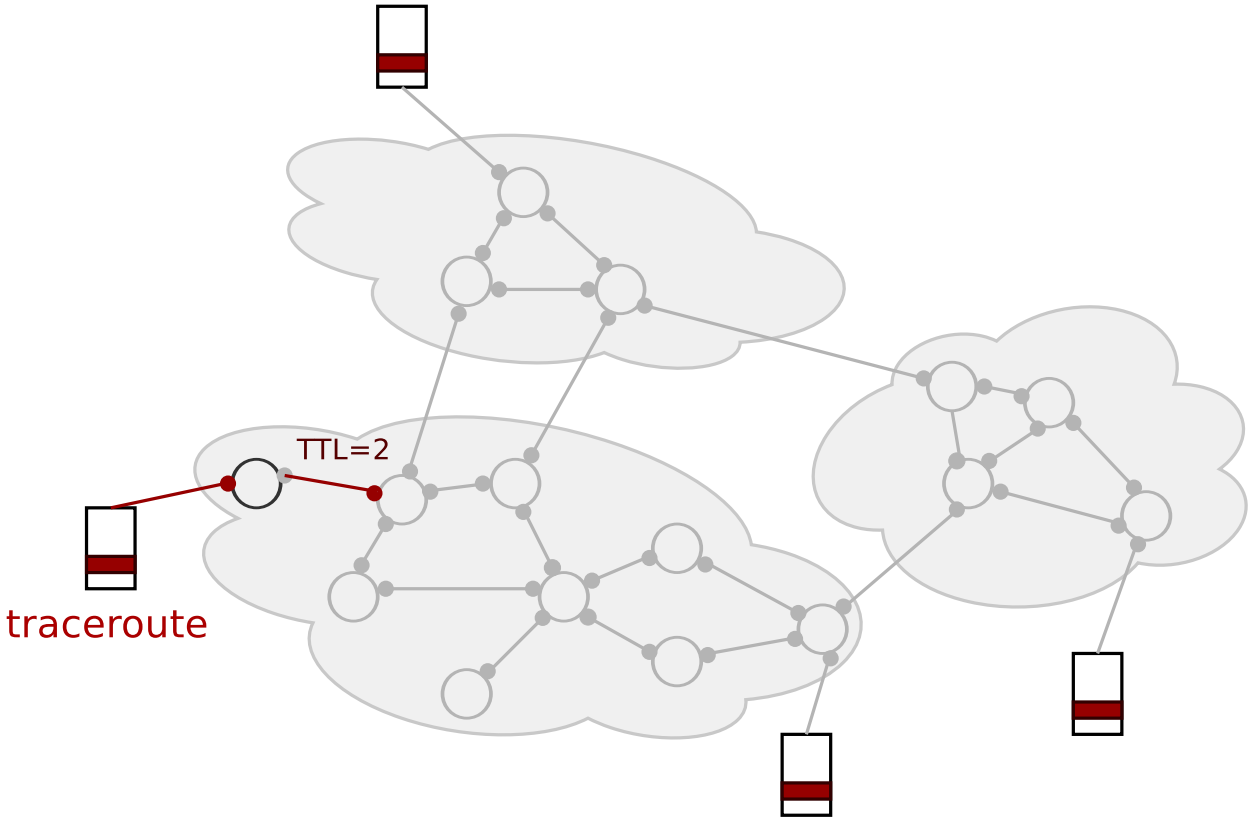

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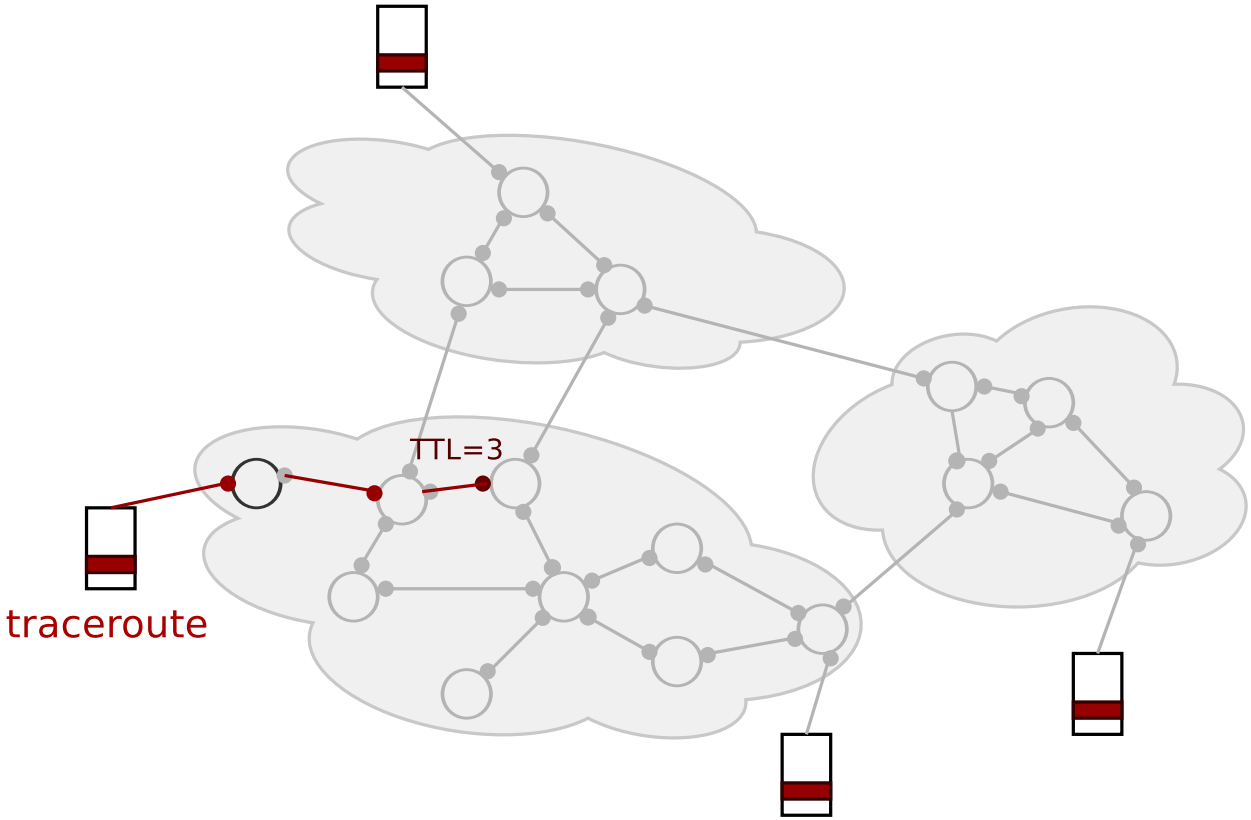

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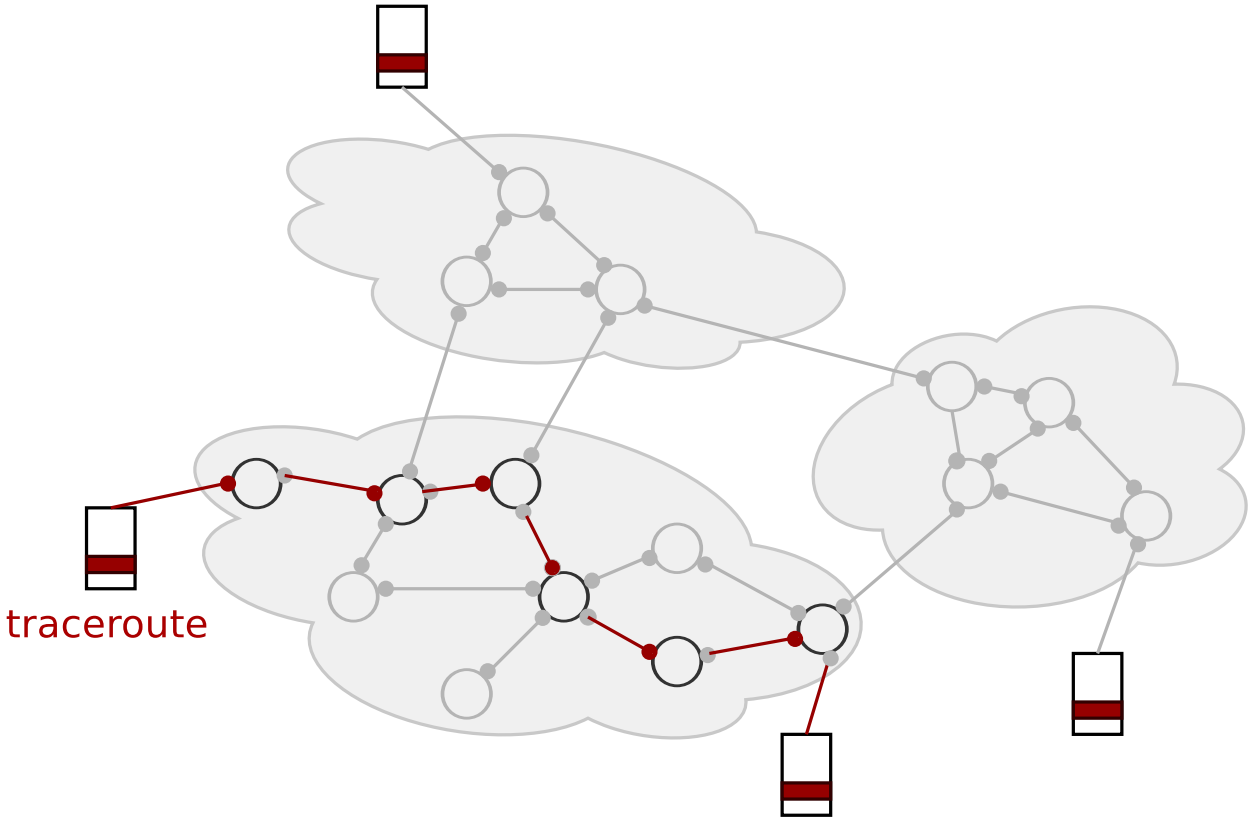

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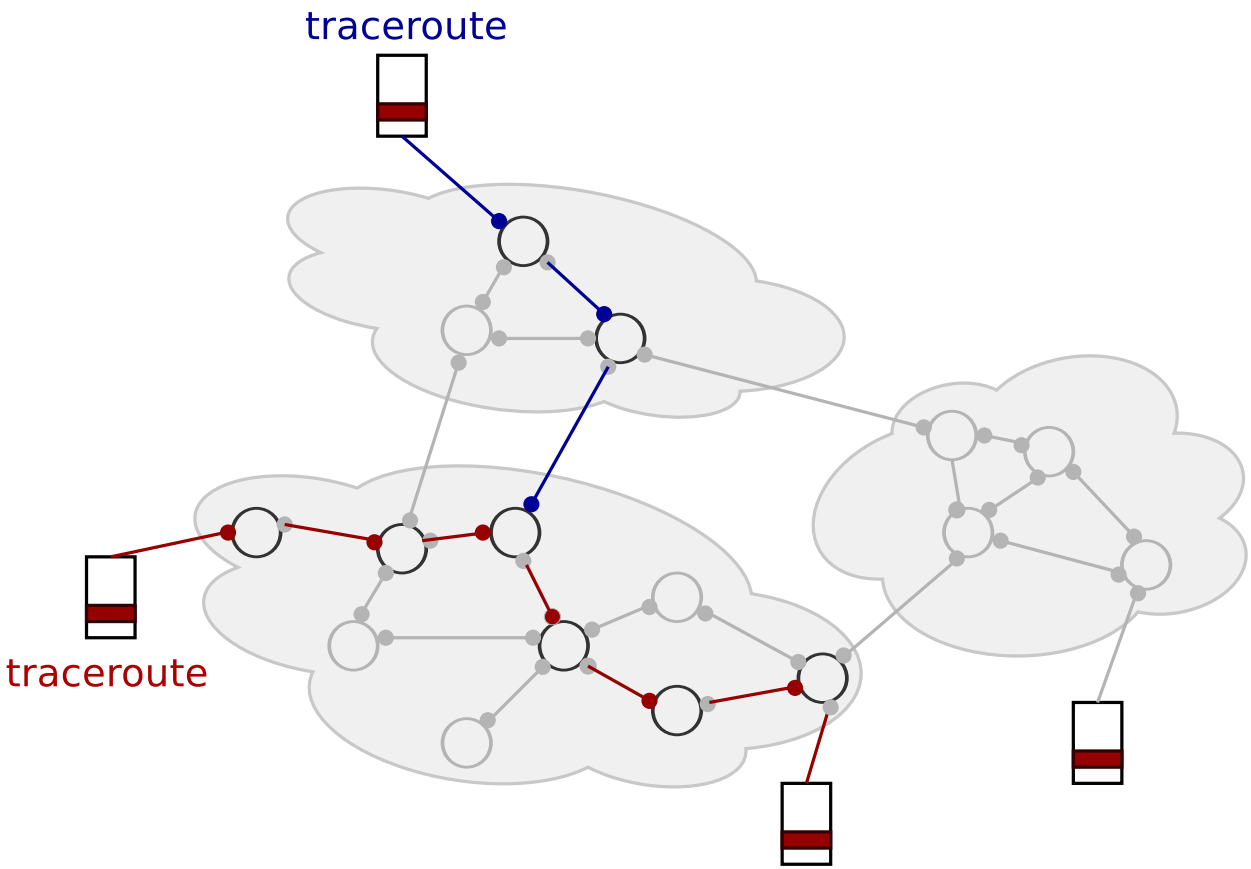

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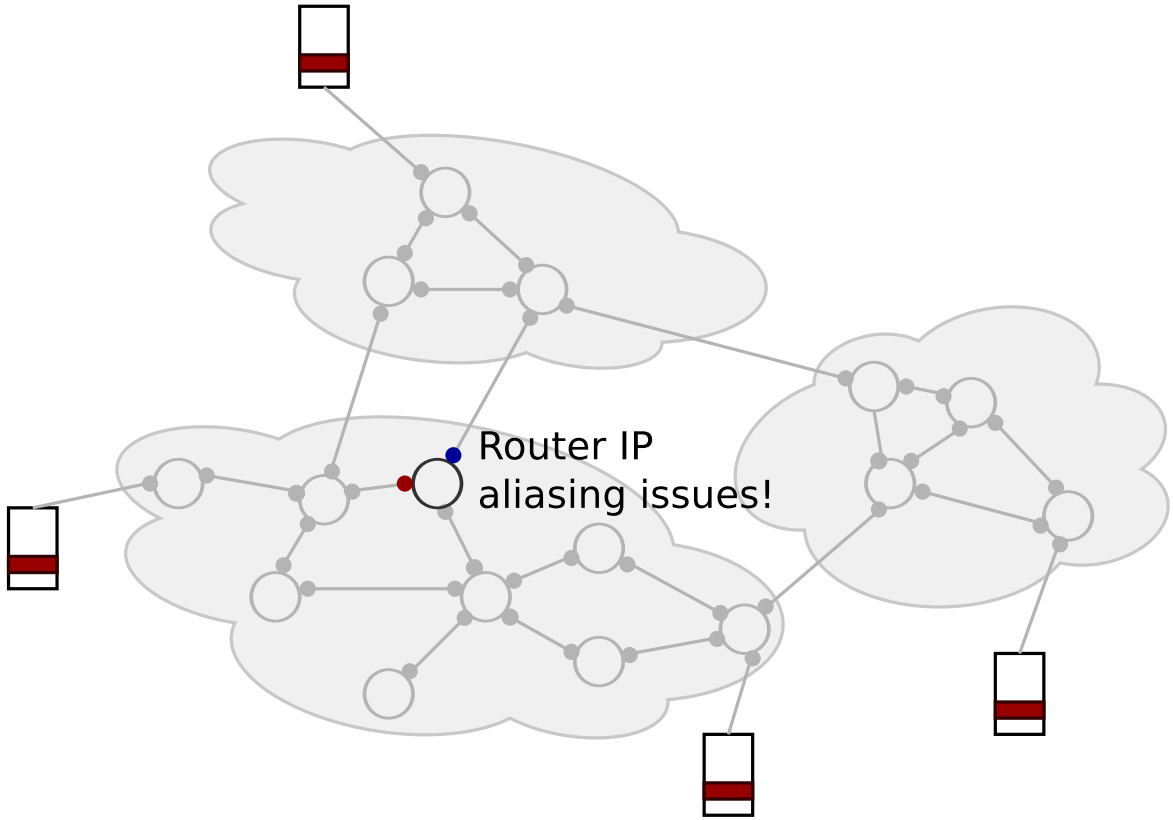

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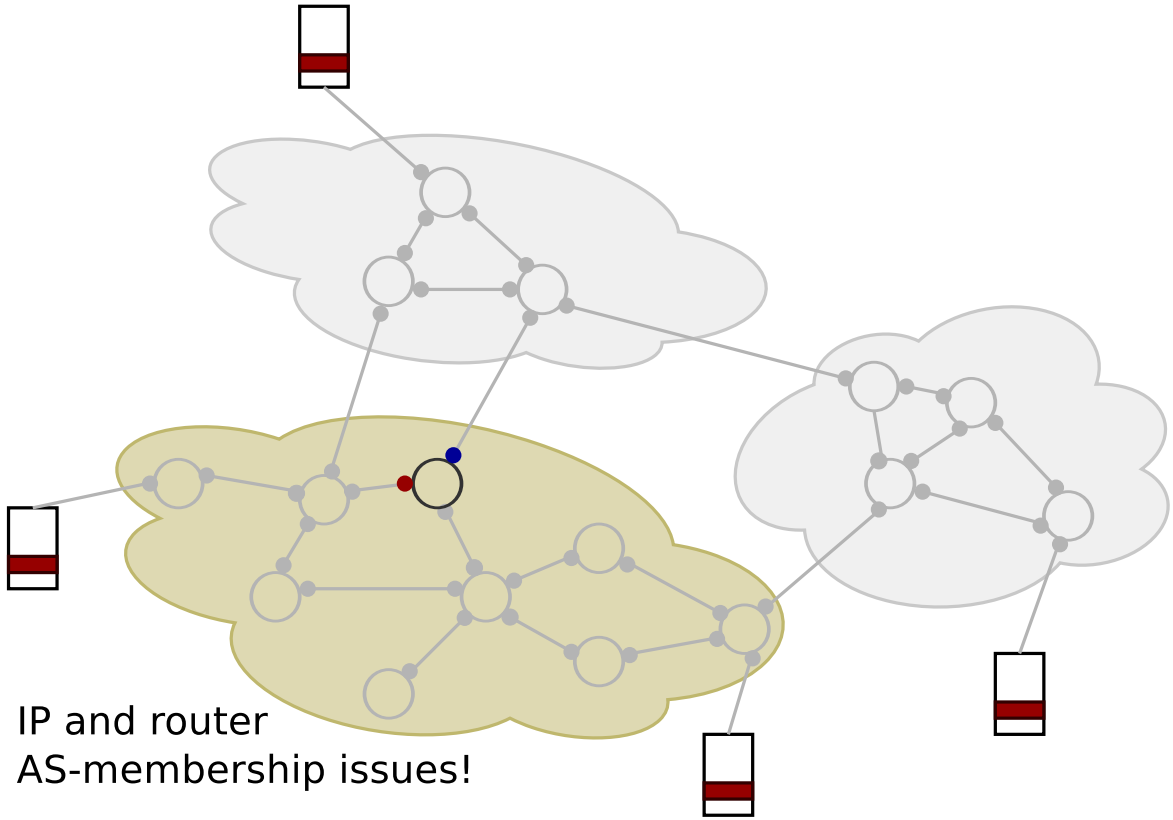

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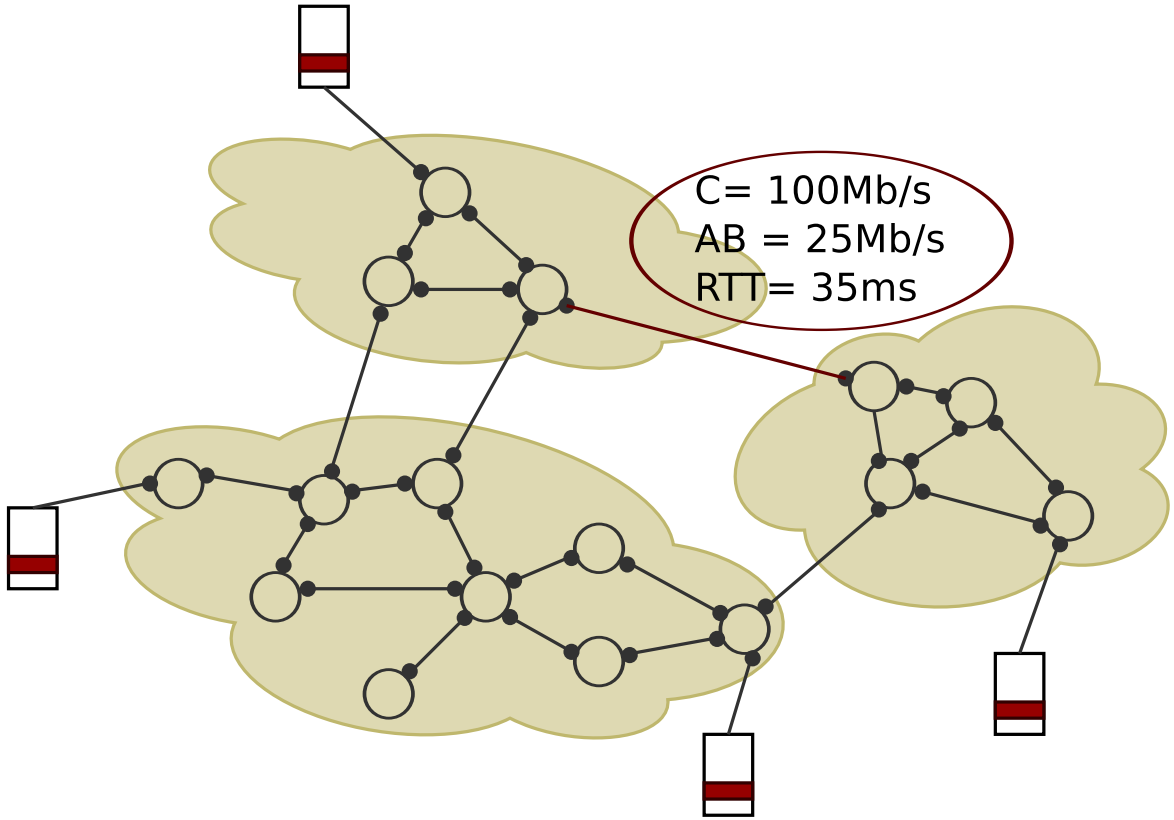
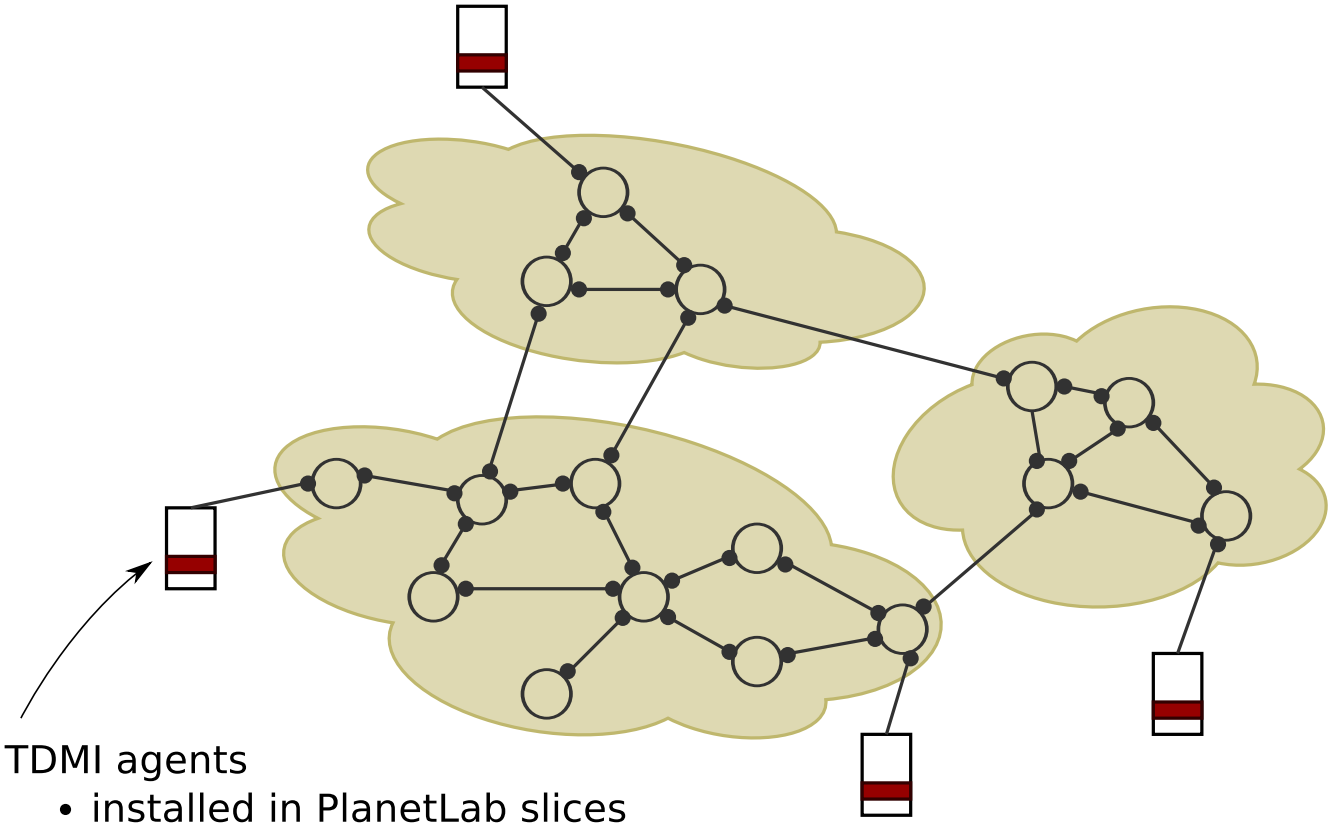


TDMI



TDMI agents

- installed in PlanetLab slices
- full-mesh probing + some IPs outside of PL
- various tools: (paris-)traceroute, ping, pathchar, etc.

The ETOMIC measurement infrastructure

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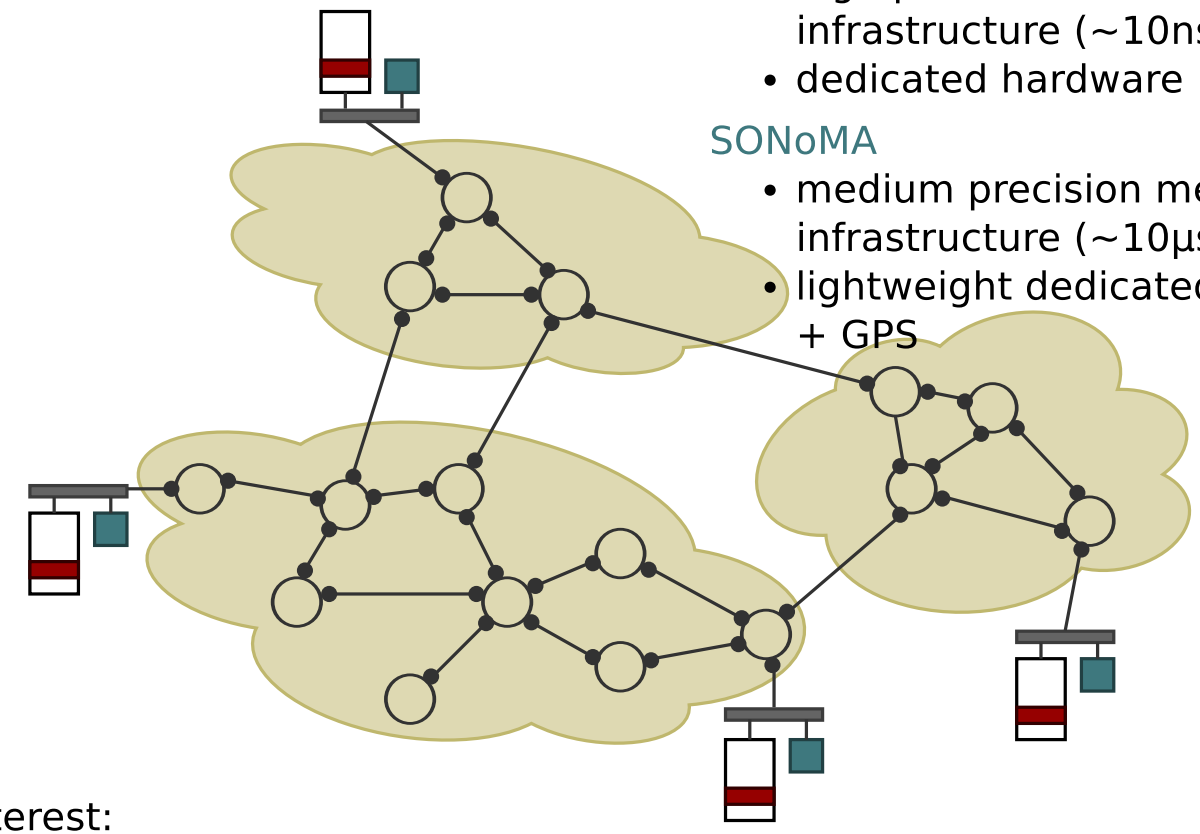

ETOMIC
- high precision measurement infrastructure (~10ns)
- dedicated hardware + GPS

SONoMA
- medium precision measurement infrastructure (~10µs)
- lightweight dedicated hardware + GPS

Our interest:
- equipment colocated with PL nodes
- allows accurate delay, AB, geolocalization, etc.

The DIMES measurement infrastructure

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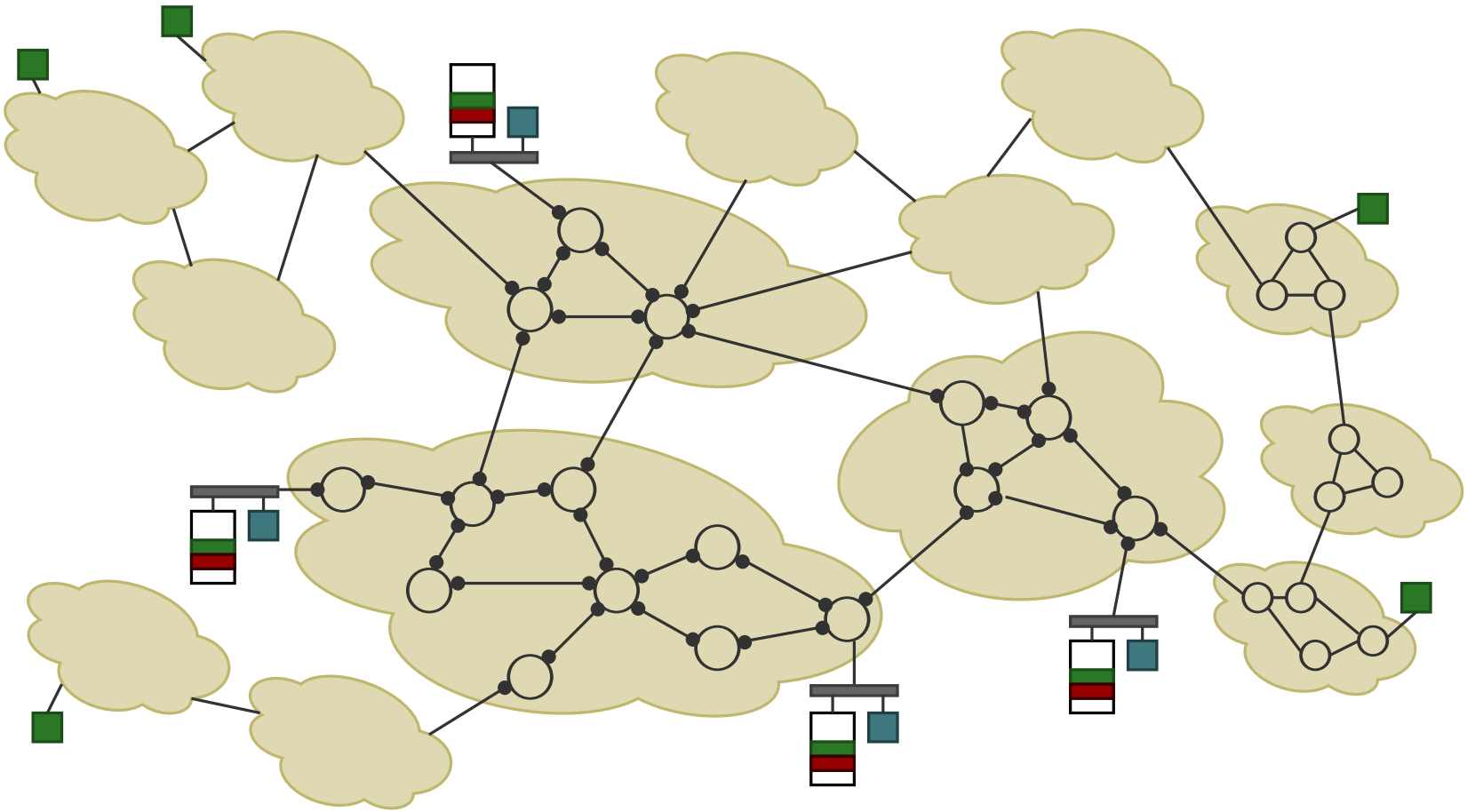

The DIMES measurement infrastructure

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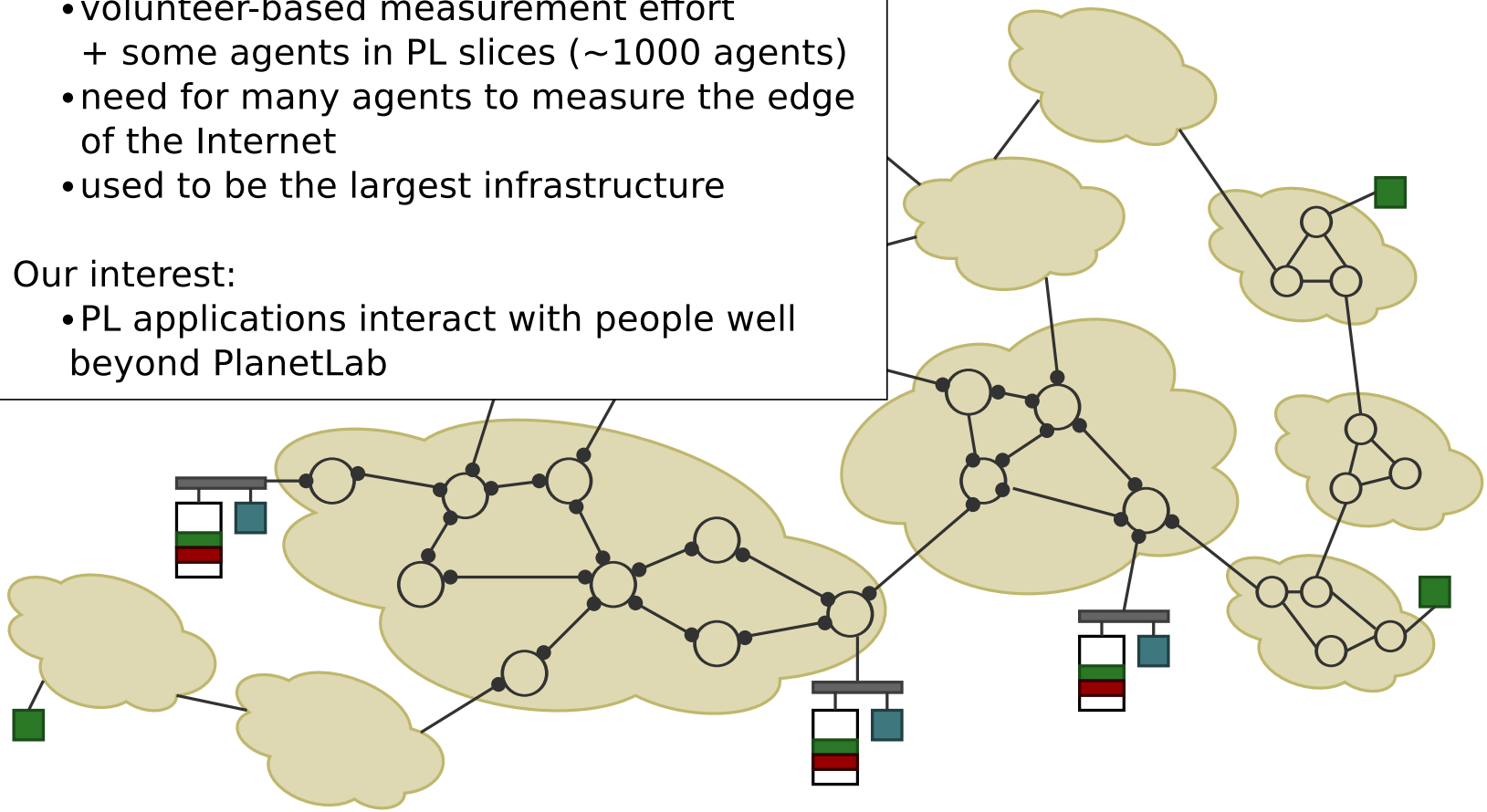
DIMES

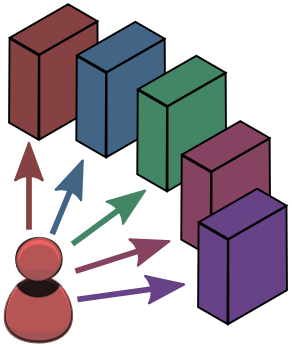
- volunteer-based measurement effort + some agents in PL slices (~1000 agents)
- need for many agents to measure the edge of the Internet
- used to be the largest infrastructure

Our interest:

- PL applications interact with people well beyond PlanetLab



TopHat's niche



- There are many measurement systems
  - DIMES, ETOMIC, Ark/Archipelago, iPlane, ...
- Some are specifically designed for testbeds

- TopHat supports the PlanetLab testbed experiment lifecycle
  - from setup through completion
  - provides live measurements to the application
  - callbacks are used to communicate information to the application
- TopHat interconnects with partner measurement systems (OneLab2 project)
  - to tunnel the information they provide transparently

A convenient infrastructure to support our research

Services in support of applications

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four broad services, following the experiment lifecycle from setup through completion

Setup : help the user choose nodes before launching his/her experiment

Live : provide real-time information about the underlying network (callbacks are used to communicate information to the application)

Rewind : give access to historical data

Viz : allow visualization of experimental data

Extending scope and scale through interconnection

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Ongoing interconnection with OneLab partners and others

DIMES

- large-scale, measurements from outside of PlanetLab

ETOMIC, SONoMA

- high precision synchronized measurements

TDMI

- our own measurement agent, running in a slice

Team Cymru

- AS-level information

TopHat architecture

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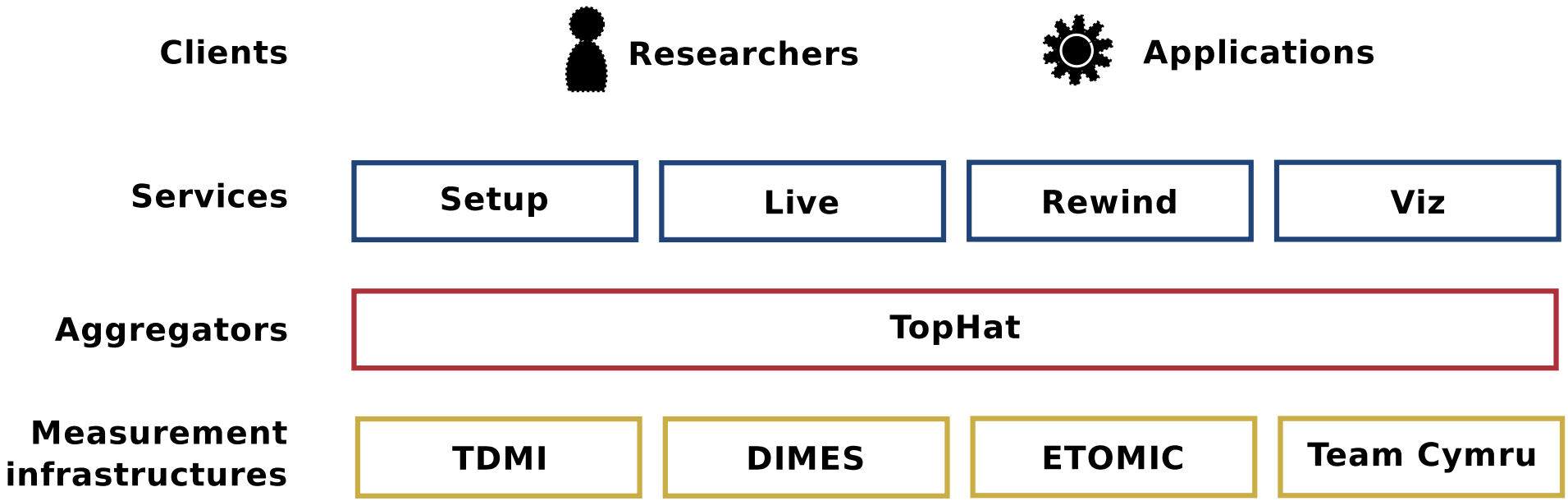

Outline

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Setup: choosing the nodes

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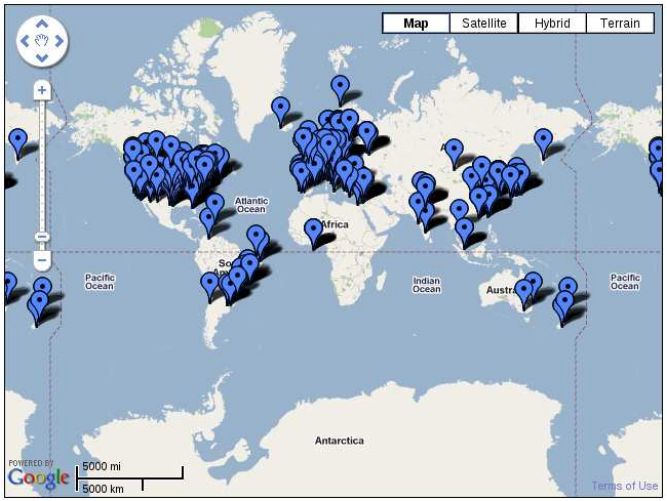

- TopHat provides topological information for the choice of nodes
- Leveraging PlanetLab topological and geographical diversity

Sample query:

Give me twenty relatively unloaded, reliable nodes that are each **at least five traceroute hops away** from each other with **stable routes** and **no load balancer** on the paths

MySlice: node selection interface

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- help researchers deploy and manage their experiments
  - on PlanetLab and future federated facilities
- uniform access to testbed data
  - **system information** from CoMon (reliability, load, etc.)
  - **topological information** for TopHat and interconnected systems
- gain insights in how people use the testbed

We demonstrate the two interfaces to MySlice (Web and XML/RPC) with the AS-level information

MySlice: node selection interface

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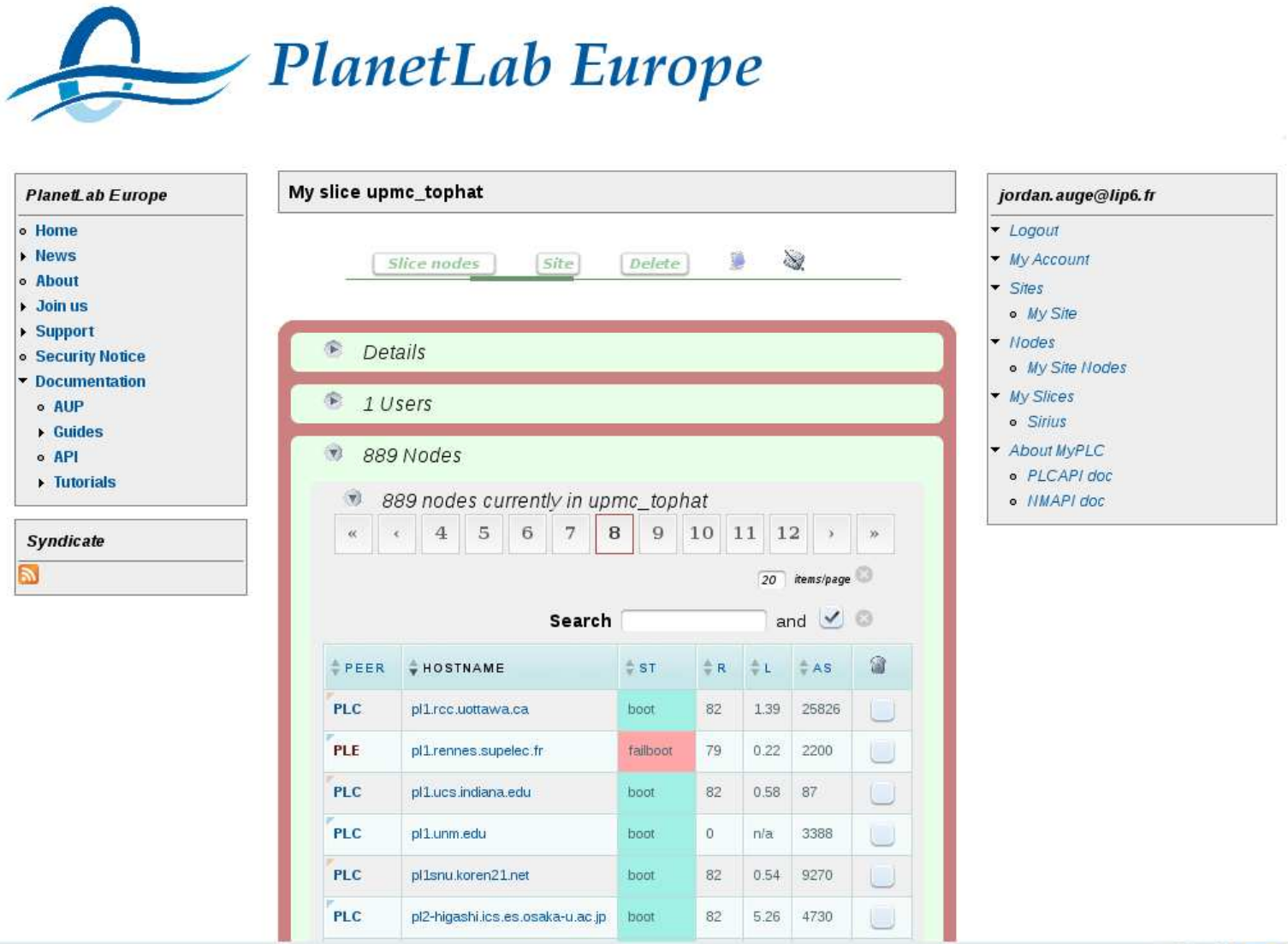

MySlice: node selection interface

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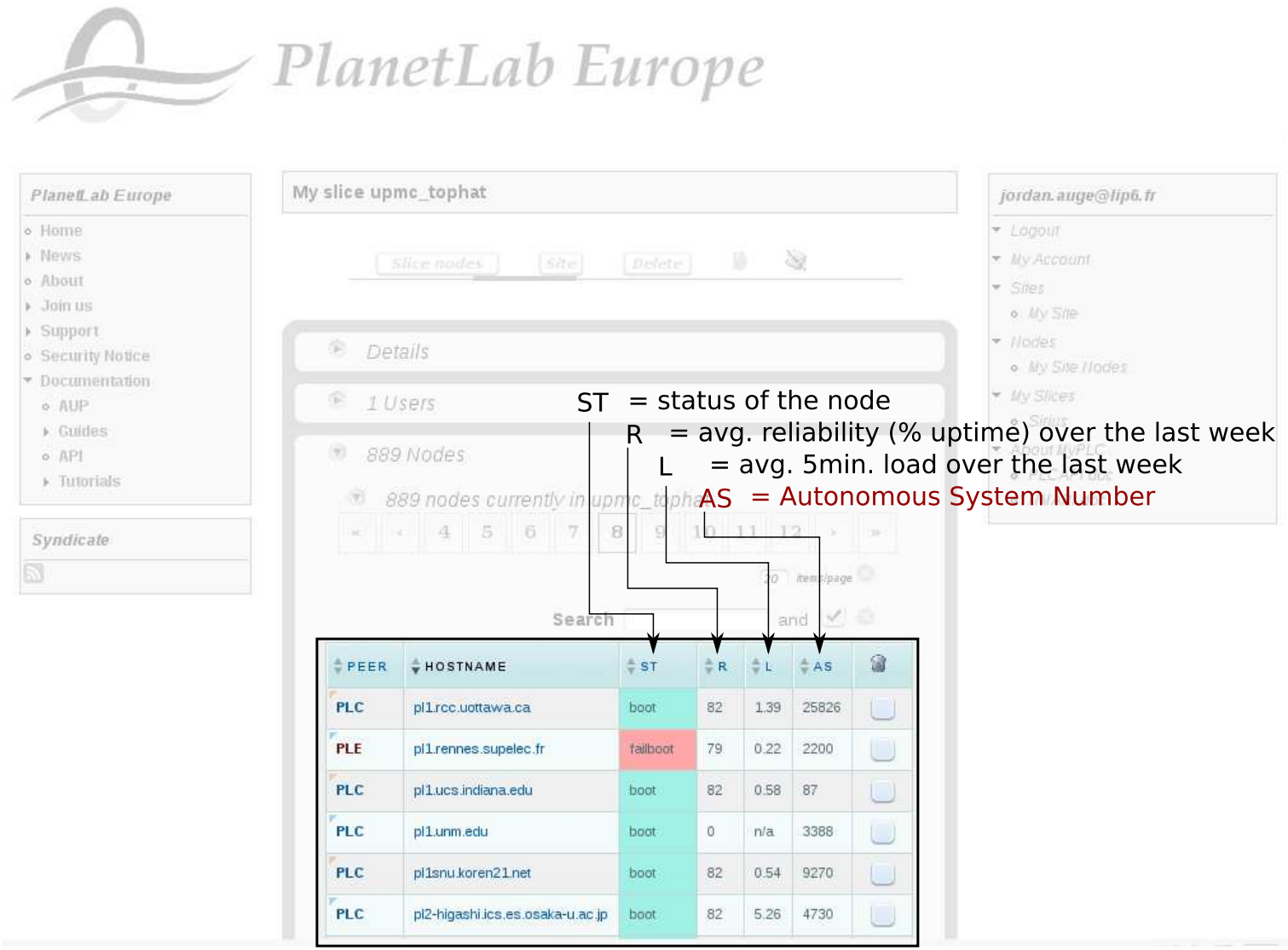

Measurement query interface

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Functions to get measurements (Get), manage the list of callbacks, etc.

Prototype of the Get function

```
RET = Get(Auth, Method, Timestamp, Input, Output, Callback)
```

Auth : authentication token (login/pass, session, etc.)

Method : *eg. traceroute*, *delay*, *active bandwidth*

Timestamp : date, interval, description (*now*, *today*, *latest*, etc.)

Input : a node/a set of nodes, a path/a set of paths

Output : subset of available fields, depends on Method

Callback : used for periodic measurements

Sample request for Setup information

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Sample query:

```
list = ['planetlab-europe-02.ipv6.lip6.fr', 'planet2.elte.hu']
Get(auth, 'latest', 'nodeinfo', {'hostname': list},
      ['hostname', 'prefix', 'asn', 'as_name', 'platform_name'])
```

Result:

```
[{'hostname': 'planetlab-europe-02.ipv6.lip6.fr',  'prefix': '132.227.0.0/16',
       'asn': '1307', 'as_name': 'FR-U-JUSSIEU-PARIS',
       'platform_name': 'Team Cymru'},
 {'hostname': 'planet2.elte.hu', 'prefix': '157.181.0.0',
       'asn': '2012', 'as_name': 'ELTENET ELTENET'
       'platform_name': 'Team Cymru'}]
```

Live: supporting running experiments

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- classical set of topological queries provided directly via the API

Akihiro Nakao, Larry Peterson, Andy Bavier,
A routing underlay for overlay networks,
in proceedings of SIGCOMM'03, pp.11–18, 2003.

- callbacks are provided for events, periodic and async. measurements
  - XML-RPC call, email, RSS, etc.

Example: alert me when the delay between two nodes changes by more than 20%

Live: measurements and interconnection

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Sample query: traceroute on two different platforms:

```
path_list = [('planet2.elte.hu', 'planetlab-europe-02.ipv6.lip6.fr'),
                 ('ape.onelab.elte.hu', 'planetlab-europe-02.ipv6.lip6.fr')]
Get(auth, 'now', 'traceroute', path_list,
    ['src_ip', 'dst_ip', 'hops.ttl', 'hops.ip', 'hops.hostname', 'platform_name'])
```

Result:

```
[{'src_ip': '157.181.175.248',  'dst_ip': '132.227.62.19',
     'hops': [
        {'ttl': '1', 'ip': '157.181.175.254',  'hostname': None},
        {'ttl': '2', 'ip': '157.181.126.45',  'hostname': 'taurus.taurus-leo.elte.hu'},
         ...],
     'platform_name': 'TDMI'},

  {'src_ip': '157.181.175.247', 'dst_ip': '132.227.62.19',
     'hops': [ ... ],
     'platform_name': 'SONoMA'}
]
```

Rewind & datasets

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- Archive of the on-demand measurements in a database
  - post-processing of experimental data
- TopHat also continuously probe the network
  - for our own purposes (network dynamics, etc.)
  - consolidate some measurements to create new metrics (for example path stability)
- importance of sharing datasets (CAIDA, DIMES, etc.)
  - privacy issues with experimental data (anonymization?)

Outline

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Some challenges (1/3)

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Authentication

- Make it easy for users to access the different platforms...
- ...but there are some constraints
  - access to sensitive data, ability to perform measurements
  - some issues have been solved for indidual systems (eg. PlanetLab AUP, traceability)
  - more challenging in an interconnected environment

Some challenges (2/3)

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Resource description

- We need a standard way to communicate information between testbeds
  - about the infrastructure (geolocalization of vantage points, etc.)
  - about the measurement abilities (tools, frequency of probing, etc.)
- A hot topic in the field of testbed federation (cf. Panos' talk)
- We can build on existing work:
  - The testbeds have their own resource specifications (PlanetLab RSpecs)
  - standardized interfaces for webservices (XML/RPC and SOAP APIs; WSDL description; UDDI directories)

Some challenges (3/3)

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Accounting

- We need to keep track of who uses the system, when, why
  - to understand usage of the system and for engineering purposes and improvements
  - we are funded for the service and need to report about the usage of the system
  - there are scientific reasons to study users' behaviour itself
- Interconnecting multiple systems makes the accounting problem harder

Conclusion

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- TopHat: a service for PL experimenters
- Also a convenient platform for getting measurement data (TDMI)
- Cooperative work with partners towards a standard interconnection framework

References


Thomas Bourgeau, Jordan Augé, Timur Friedman,
TopHat: A topology information service to support applications in a future-internet testbed,
accepted to TridentCom'2010, 18-20 May 2010, Berlin, Germany.

Website

The service will be unveiled soon: `http://www.top-hat.info`

Contact

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