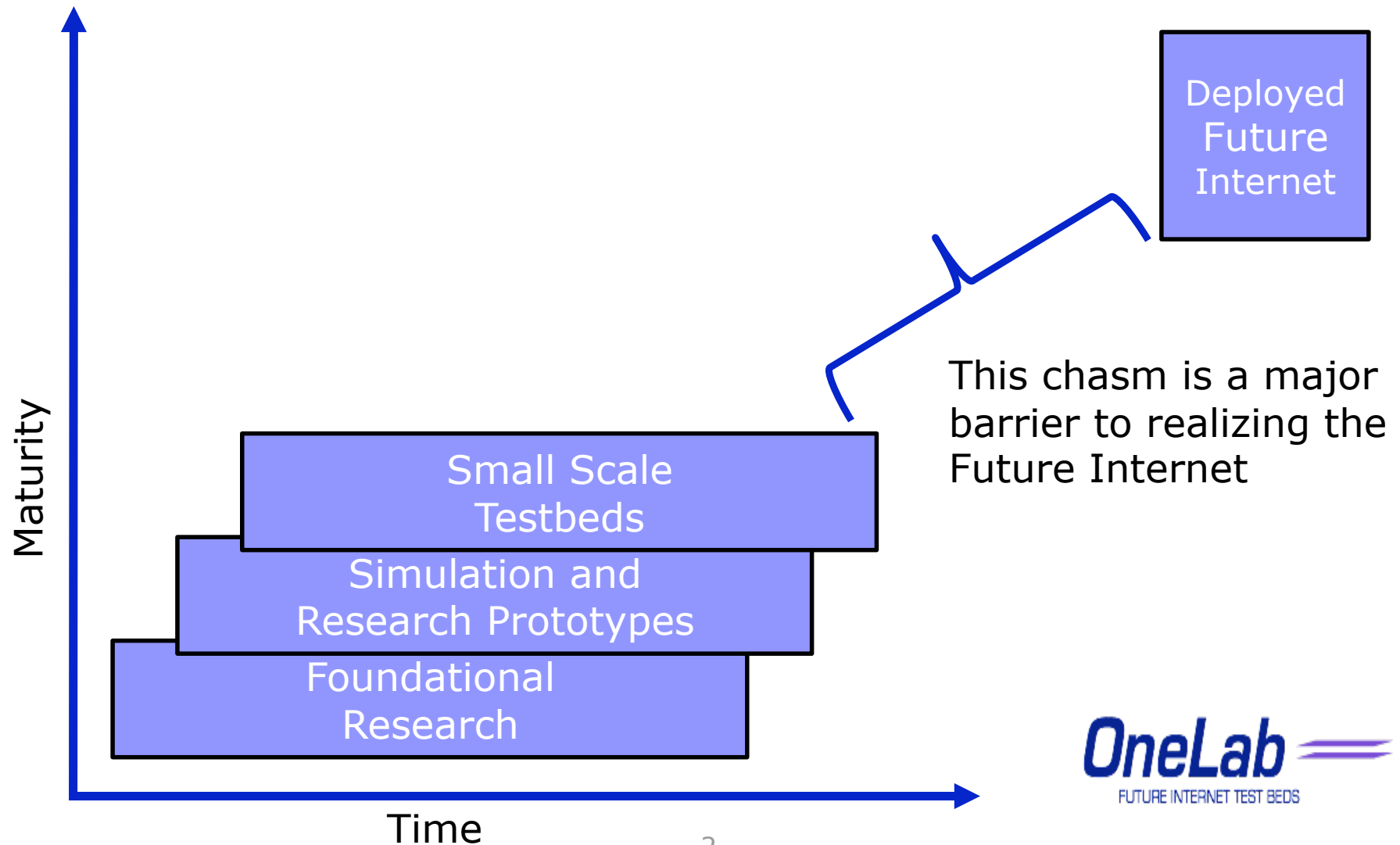

PlanetLab Europe Basics

An open, shared platform for developing, deploying, and accessing planetary scale applications

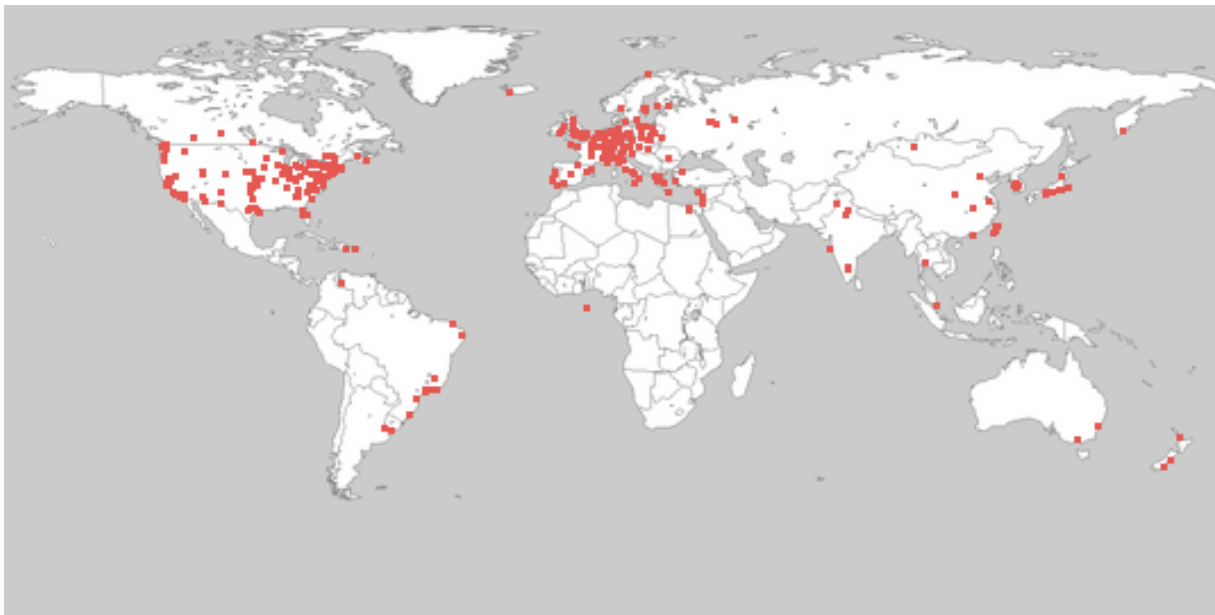


Case for PlanetLab



Overview

- Global distributed system infrastructure
 - platform for long running services
 - testbed for network experiments
- Launched in March 2002



Why Use PlanetLab?

- Access to large scale distributed resources
- Run experiments with complete control over each node
- Scale from one to few to many nodes
- Monitor CPU and network traffic
- Deploy long-running experimental services

Why Use PlanetLab?

- How do I build a content delivery network?
- Proof: Does it work?
- Start with a few nodes, for content delivery system. Build up. Test to see if the system works as the system builds and grows, and is a large scale testbed

Example: CoDeeN (Princeton)

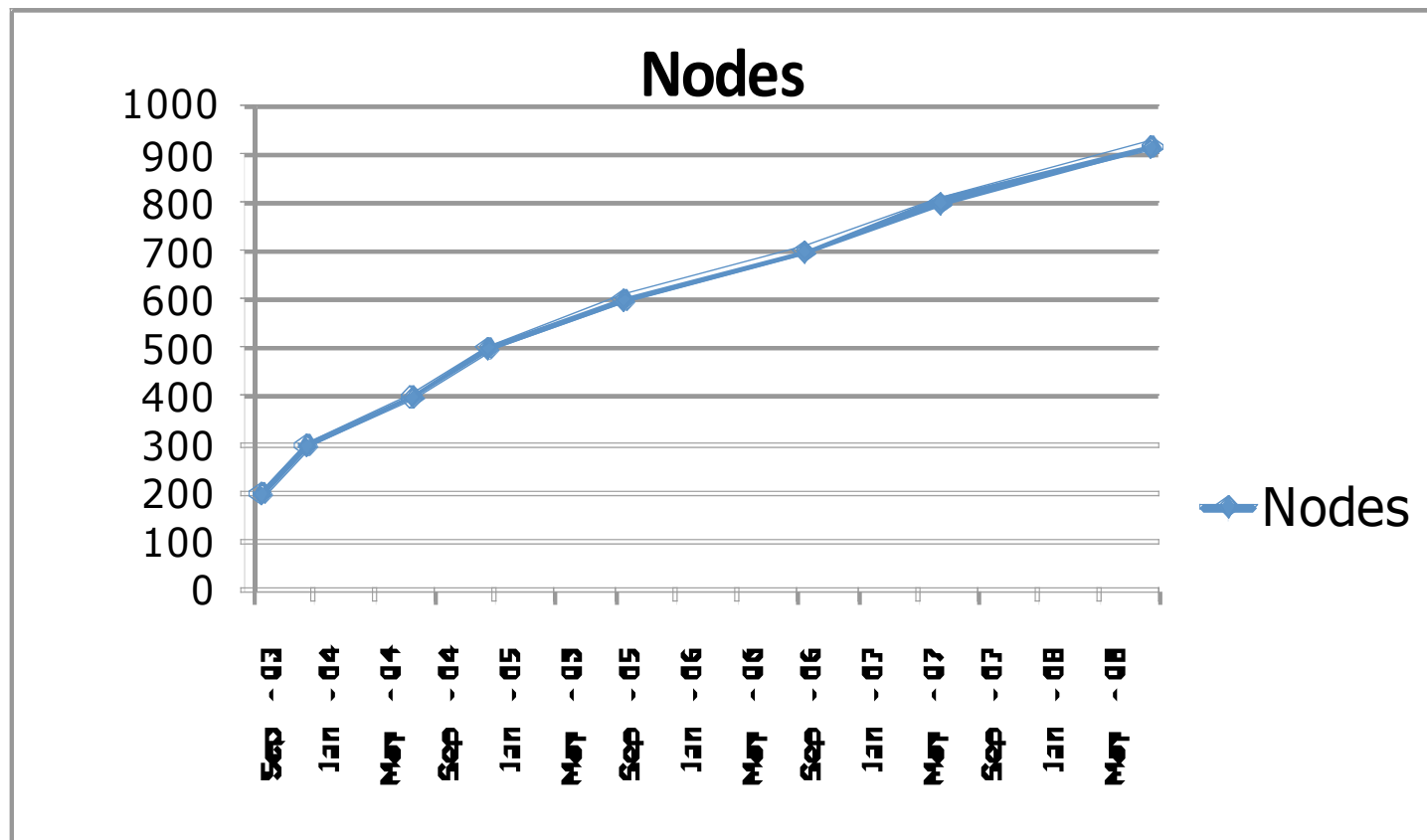
- Content Distribution Network
 - ~330 (open) caching proxy servers
 - Open to all users (see URL)
- Highly available (after lots of work!)
- Spawned many subprojects / services:
 - CoBlitz, scalable distribution of large files.
 - CoDeploy, efficient synchronization for slices.
 - CoDNS, fast and reliable name lookup.
 - CoMon, node monitoring for PlanetLab
 - CoTest, login debugging tool for nodes
 - PlanetSeer, distributed network anomaly tracing
- Illustrates how deployment of a real service spurs research
 - <http://codeen.cs.princeton.edu/>

Example: Overlay Routing

- Packets on the Internet are routed invisibly
- “A distributed system is one in which the failure of a computer you didn't even know existed can render your own computer unusable” --Leslie Lamport
- What if applications performed routing as an overlay of the existing Internet?
- PlanetLab is a perfect testbed for this type of research

PlanetLab History

- March 2002: Larry Peterson (Princeton) and David Culler** (UC Berkeley and Intel Research) organize an "underground" meeting of researchers interested in planetary scale network services, and propose PlanetLab as a community testbed



About PlanetLab

- 1011 nodes around the world
 - 35 countries
 - 476 sites (universities, research labs)
 - more than 1000 researchers
- A collection of machines distributed over the globe
 - Most of the machines are hosted by research institutions
 - All of the machines are connected to the Internet Software
 - All PlanetLab machines are administered by a system called MyPLC
- The software is based on Fedora Core 8



Organizational Challenges

- PlanetLab Consortium Licensing Agreement
- Organization is responsible for the activities of their researchers
- Users may not use PlanetLab to disseminate copyrighted material
- PlanetLab tracks resources usage and maintains a list of published intentions
- Otherwise, PlanetLab is a free for all

The PlanetLab Consortium

- The consortium manages the responsibilities and the resources of PlanetLab Europe
- The OneLab2 project provides an open federated laboratory, built on PlanetLab Europe, which supports network research for the future internet
- The OneLab2 Consortium consists of 26 distinguished networking research teams from university and industrial laboratories: 21 from the European Union, two from Switzerland, two from Israel, and one from Australia
- A large-scale integrating project (IP) grant from the European Commission's FP7 IST program's FIRE initiative funds 6.3 million euro of OneLab2's 8.9 million euro budget. The project started September 1st, 2008, and runs for 27 months, following directly on its predecessor, the OneLab project



The PlanetLab Consortium

Membership

The Consortium includes eight membership levels

- Charter (300k € annual dues)
- Full (75k € annual dues)
- Associate (25k € annual dues)
- Sponsor (10k € annual dues)
- SME (1k € annual dues)
- Director (no annual dues)
- Academic (no annual dues)
- FP7 (no annual dues)

Charter Member 300k €

Benefits

- Invitation to attend Steering Committee meetings
- Direct Relationship with Director Members
- Unlimited Access to PlanetLab Europe Events
- Slices: Unlimited
- PlanetLab Europe Public Relations
- Author PlanetLab Europe Design Notes

Responsibilities

- Active Participation in Steering Committee
- Active Participation in PlanetLab Europe Events
- Node Contribution
- Research Participant (Optional)

Full Member 75k €

Benefits

- Invitation to attend Steering Committee meetings
- Access to Director Members
- Unlimited Access to PlanetLab Europe Events
- Slices: 10
- PlanetLab Europe Public Relations
- Author PlanetLab Europe Design Notes

Responsibilities

- Annual Steering Committee Participation
- Node Contribution
- Research Participant (Optional)

Associate Member 25k €

Benefits

- Unlimited Access to PlanetLab Europe Events
- Slices: 2
- PlanetLab Europe Public Relations
- Forum/Channel for Research Publication
- Access to Research Papers

Responsibilities

- Node Contribution
- Research Participant (Optional)

Sponsor Member 10k €

Benefits

- Access to PlanetLab Europe Events
- Access to Research Papers

Responsibilities

SME Member 1k €

Benefits

- Participation in annual Steering Committee meetings is by invitation of the Director
- Access to Director Members
- Unlimited Access to PlanetLab Europe Events
- Slices: Negotiable
- PlanetLab Europe Public Relations
- Author PlanetLab Europe Design Notes

Responsibilities

- Annual Steering Committee Participation
- Node Contribution
- Research Participant (Optional)

Director Member 0 €

Benefits

- Decision making for the PlanetLab Europe strategy and implementation
- Invitation to attend Steering Committee meetings
- Direct Relationship with Director Members
- Unlimited Access to PlanetLab Europe Events
- Slices: Unlimited
- PlanetLab Europe Public Relations
- Author PlanetLab Europe Design Notes

Responsibilities

- Coordination of technical, administrative, and legal aspects of Planetlab Europe
- Active Participation in Steering Committee
- Active Participation in PlanetLab Europe Events
- Node Contribution
- Research Participant (Optional)

Academic Member 0 €

Benefits

- Participation in annual Steering Committee meetings is by invitation of the Director
- Access to Director Members
- Unlimited Access to PlanetLab Europe Events
- Slices: Negotiable
- PlanetLab Europe Public Relations
- Author PlanetLab Europe Design Notes

Responsibilities

- Annual Steering Committee Participation
- Node Contribution
- Research Participant (Optional)

FP7 Member 0 €

Benefits

- Participation in annual Steering Committee meetings is by invitation of the Director
- Access to Director Members
- Unlimited Access to PlanetLab Europe Events
- Slices: Negotiable
- PlanetLab Europe Public Relations
- Author PlanetLab Europe Design Notes

Responsibilities

- Annual Steering Committee Participation
- Node Contribution
- Research Participant (Optional)

The PlanetLab Consortium

- Node resources provided by member institutions
- Small “support” team NOC in Paris (UPMC)
- R&D team in Sophia Antipolis (INRIA)
- Documentation and Dissemination (HUJI, UPMC)

What is it used for?

- PlanetLab addresses the related problems of:
 - Deploying widely distributed services
 - Evaluating competing approaches in a realistic setting
 - Evolving the network architecture to better support such services
- So far, PlanetLab is highly successful at doing this

PlanetLab is not...

- A distributed supercomputer
- A simulation platform
- An Internet emulator
- An arena for repeatable experiments
- Completely representative of the current Internet
- Grid

PlanetLab is not the Grid

- The Grid aims at location transparency for large computations
 - “I don’t care where this protein folding job runs as long as it’s done by Monday”
- PlanetLab is all about small, long running services in specific locations
 - “I need to run a new secure file cache for the next 6 months in Seoul, Sydney, and Vancouver”

PlanetLab is not the Grid

- The Grid is about standardizing one particular paradigm for large scale utility computing
- PlanetLab provides a low level platform over which many distributed computing paradigms can be tried
 - You could build the Grid over PlanetLab's abstractions if you really wanted

PlanetLab is

- A testbed to support research work in distributed & P2P systems and networking
- Shared by many simultaneous users
- Enables users to work in relative isolation
- Uses a familiar API (Linux)
- Offers networking flexibility
- Is predictable, stable, and professionally managed

Using PlanetLab

- Central Website that manages
 - All accounts
 - All nodes
 - All resources
- Registering with PLC (your PlanetLab Central)
- 3 PLC
 - PL USA (planet-lab.com)
 - PL Europe (planet-lab.eu)
 - PL Japan (planet-lab.jp)

Terminology

- **Principal Investigator (PI).** The Principal Investigator is responsible for managing slices and users at each site. PIs are legally responsible for the behavior of the slices that they create. Most sites have only one PI (typically a faculty member at an educational institution or a project manager at a commercial institution).
- **Technical Contact (Tech Contact).** Each site is required to have at least one Technical Contact who is responsible for installation, maintenance, and monitoring of the site's nodes. The Tech Contact is the person we should contact when a node goes down or when an incident occurs. This is commonly a system administrator or graduate student. Be sure that they read the Technical Contact's Guide which describes their roles and responsibilities.
- **User** A user is anyone who develops and deploys applications on PlanetLab. PIs may also be users.

Terminology

- **Authorized Official** is the person who can bind your institution contractually/legally. It is often the president or contracting officer. Even though academic and non-profit institutions do not pay a membership fee, we still require the signature of an authorized official.

PI's Roles and Responsibilities

- **Oversight** PIs are responsible for overseeing all slices that they create on behalf of the users at their site
- **Account management PIs can:**
 - Enable, disable, and delete user accounts
 - Create slices
 - Delete slices
 - Assign users to slices
 - Allocate resources to slices
- **Node management** PIs are responsible for the physical maintenance of the nodes at their site

To Use

- Join, sign up and sign the consortium agreement
- Free demonstration system

PlanetLab Architecture

PlanetLab Architecture

Terminology

- **Site** A site is a physical location where PlanetLab nodes are located (e.g. Fraunhofer Institute or UCL)

Terminology

- **Node** A node is a dedicated server that runs components of PlanetLab services

Terminology

- **Slice.** A slice is a set of allocated resources distributed across PlanetLab. To most users, a slice means UNIX shell access to private virtual servers on the some number of PlanetLab nodes. After being assigned to a slice, a user may assign nodes to it. Slices may be assigned to a user selected set of PlanetLab nodes. After nodes have been assigned to a slice, virtual servers for that slice are created on each of the assigned nodes. Slices have a finite lifetime and must be periodically renewed to remain valid. All data associated with a slice is deleted when the slice expires.

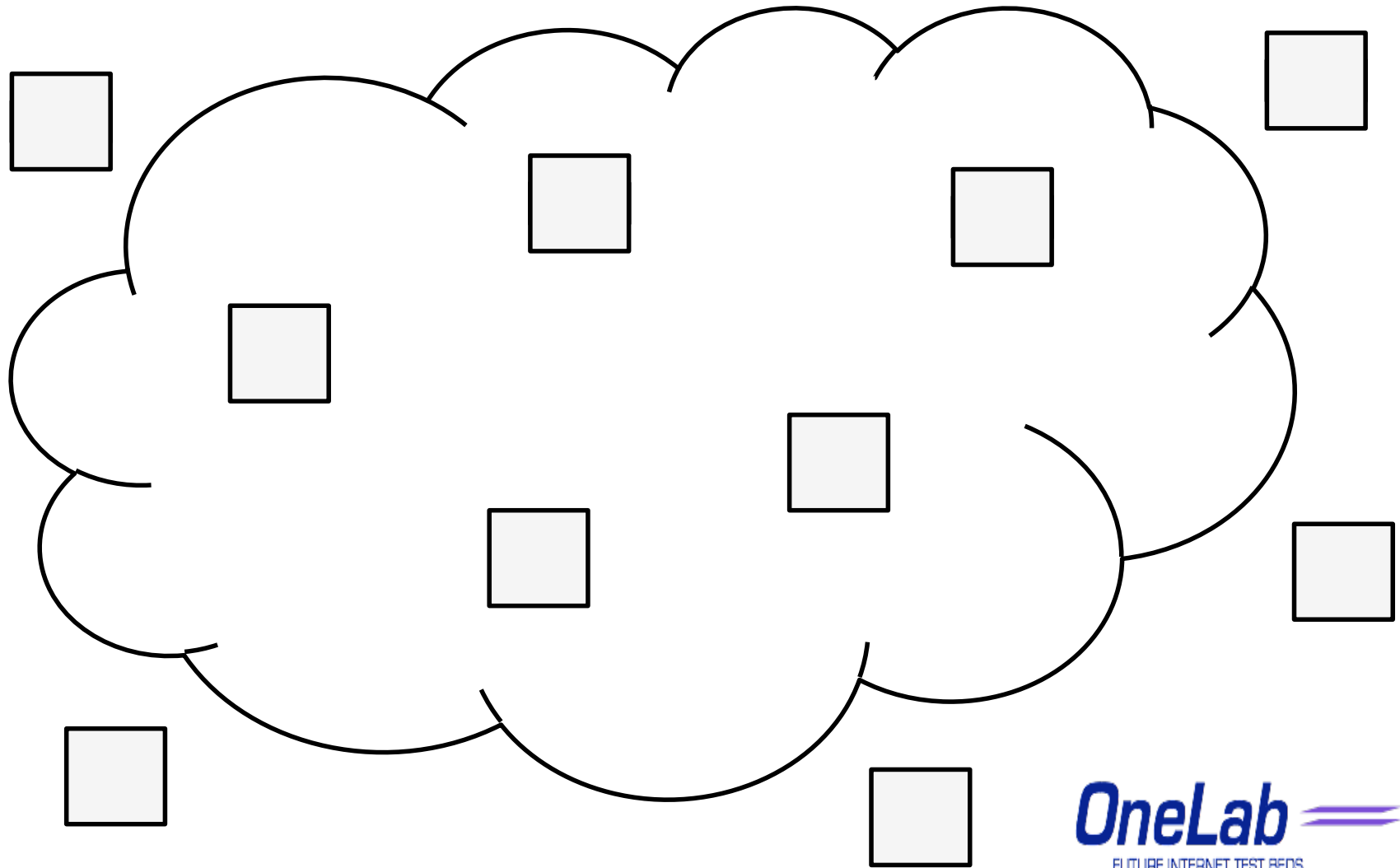
Terminology

- **Sliver** A sliver is a slice running on a specific node. You can use ssh to login to a sliver on a specific node

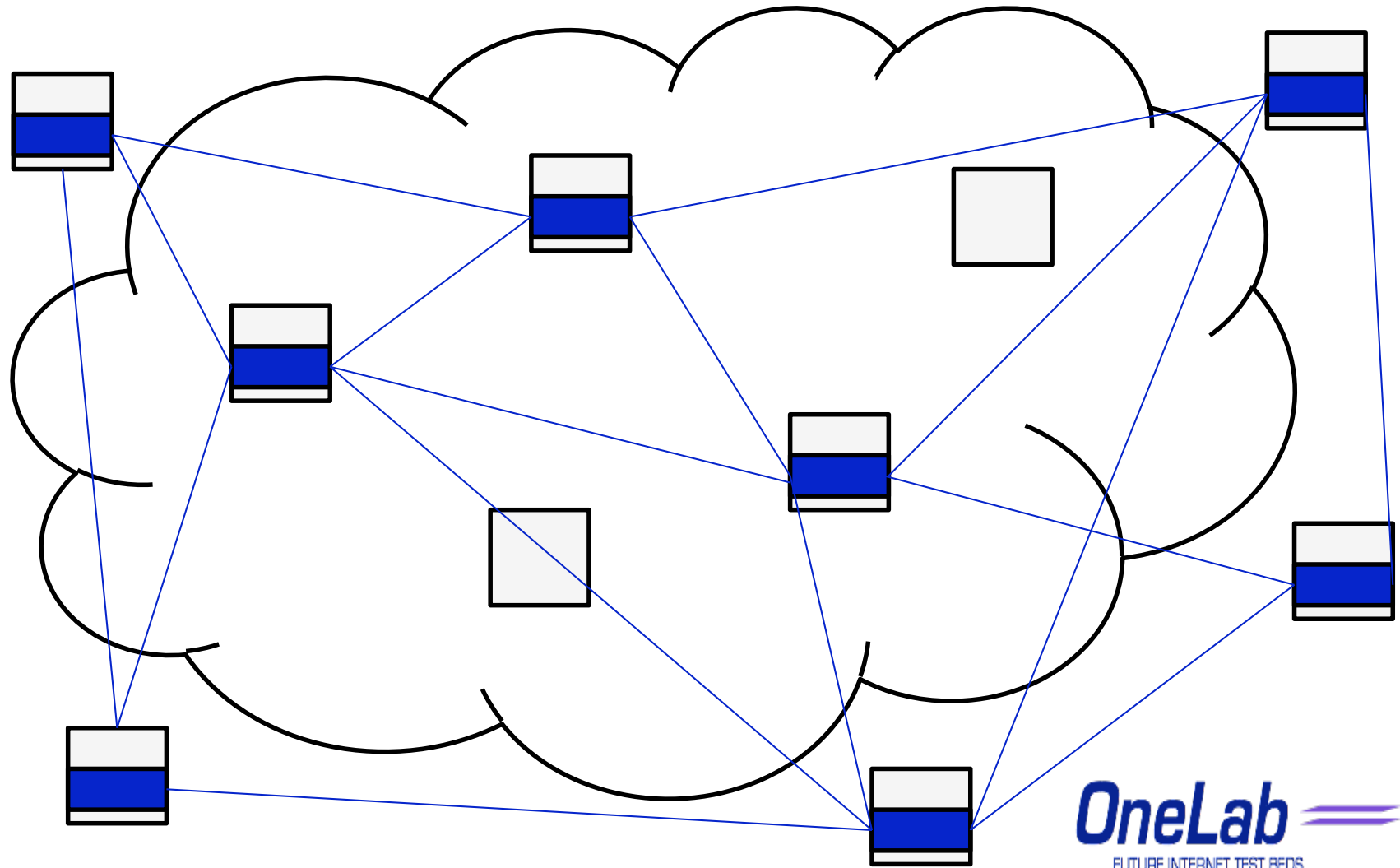
Distributed Virtualization

- As a user you want to isolate from other activities on those nodes on which you run. The PL provides a level of isolation which gives you your own file system and process control
- You share CPU cycles and network bandwidth with other active slivers on each node
- The concept of slice aggregates the presence of your slivers within the system

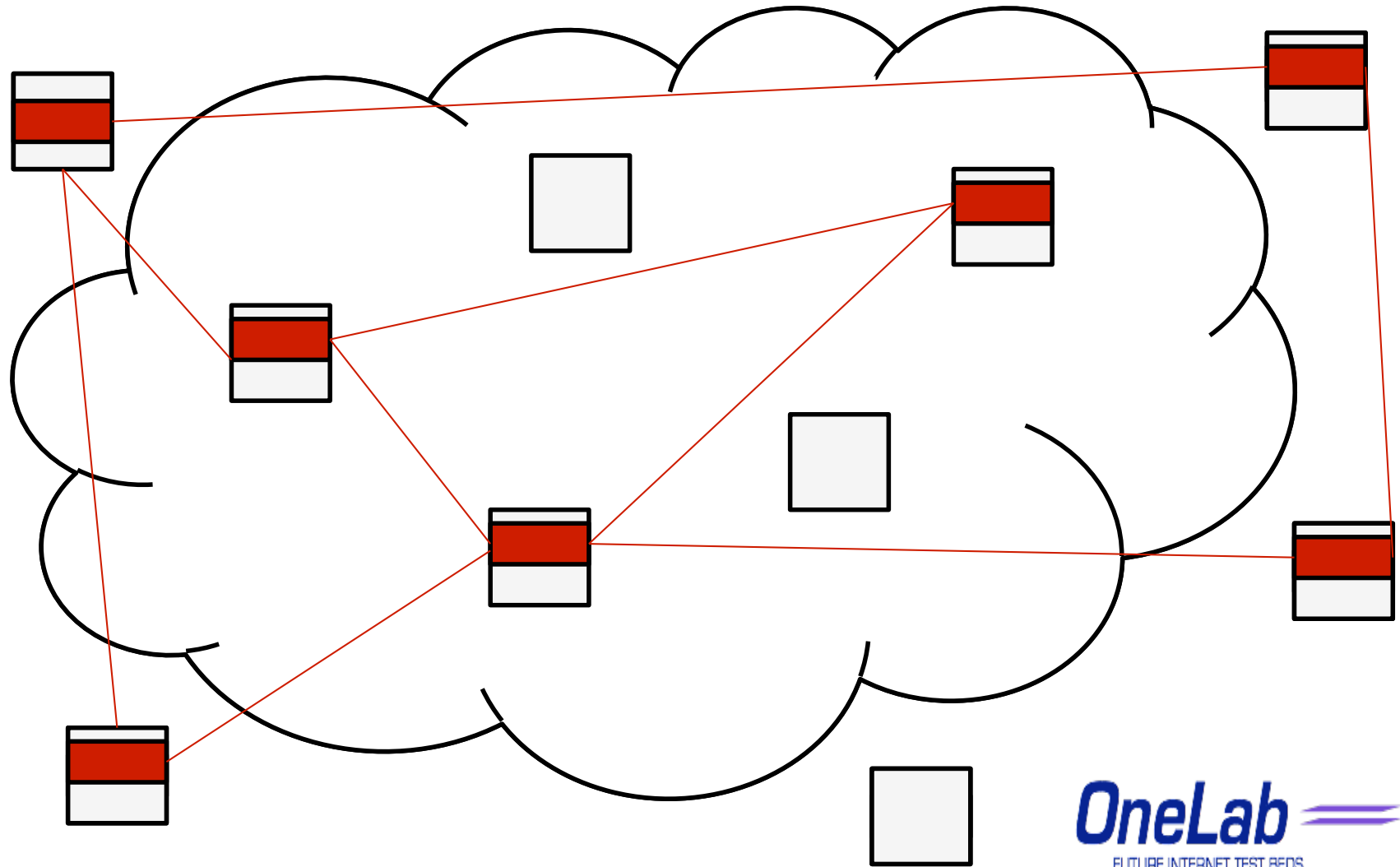
Nodes



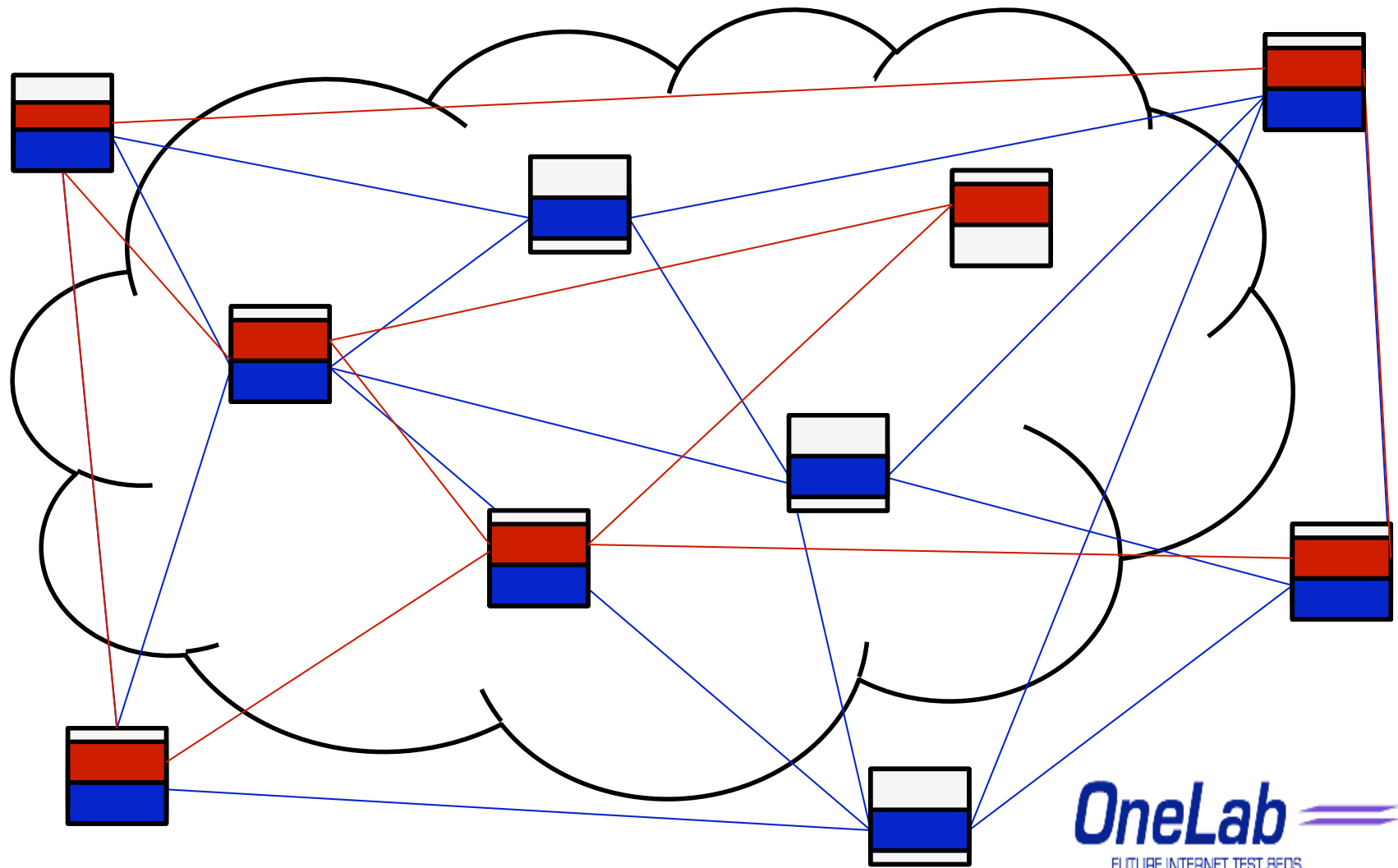
Slices – hujiple_isis



Slices – upmcple_paristr



Slices



Federation

- Local consortium agreement defines responsibilities and liabilities of each partner
- Federation integrates the consortiums into a seamless global authority
- Formal Trust Relationships are the basis for this integration

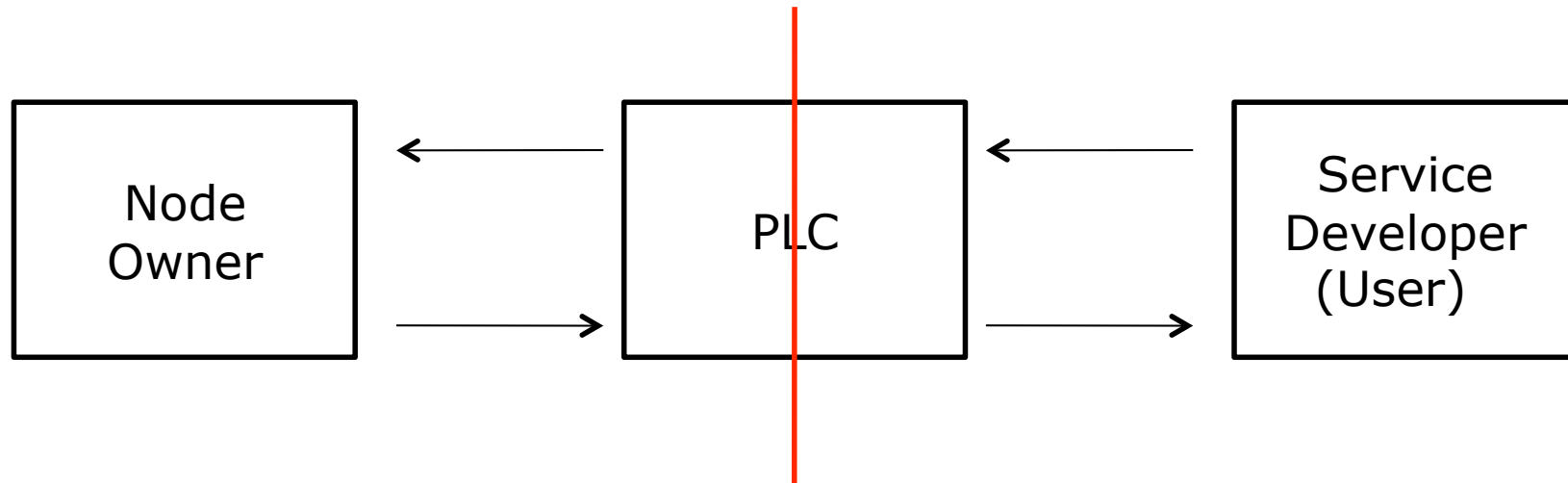
Trust Relationships

Princeton
Berkeley
Washington
MIT
Brown
CMU
NYU
ETH
Harvard
HP Labs
Intel
NEC Labs
Purdue
UCSD
SICS
Cambridge
Cornell

Trusted
Intermediary
(PLC)

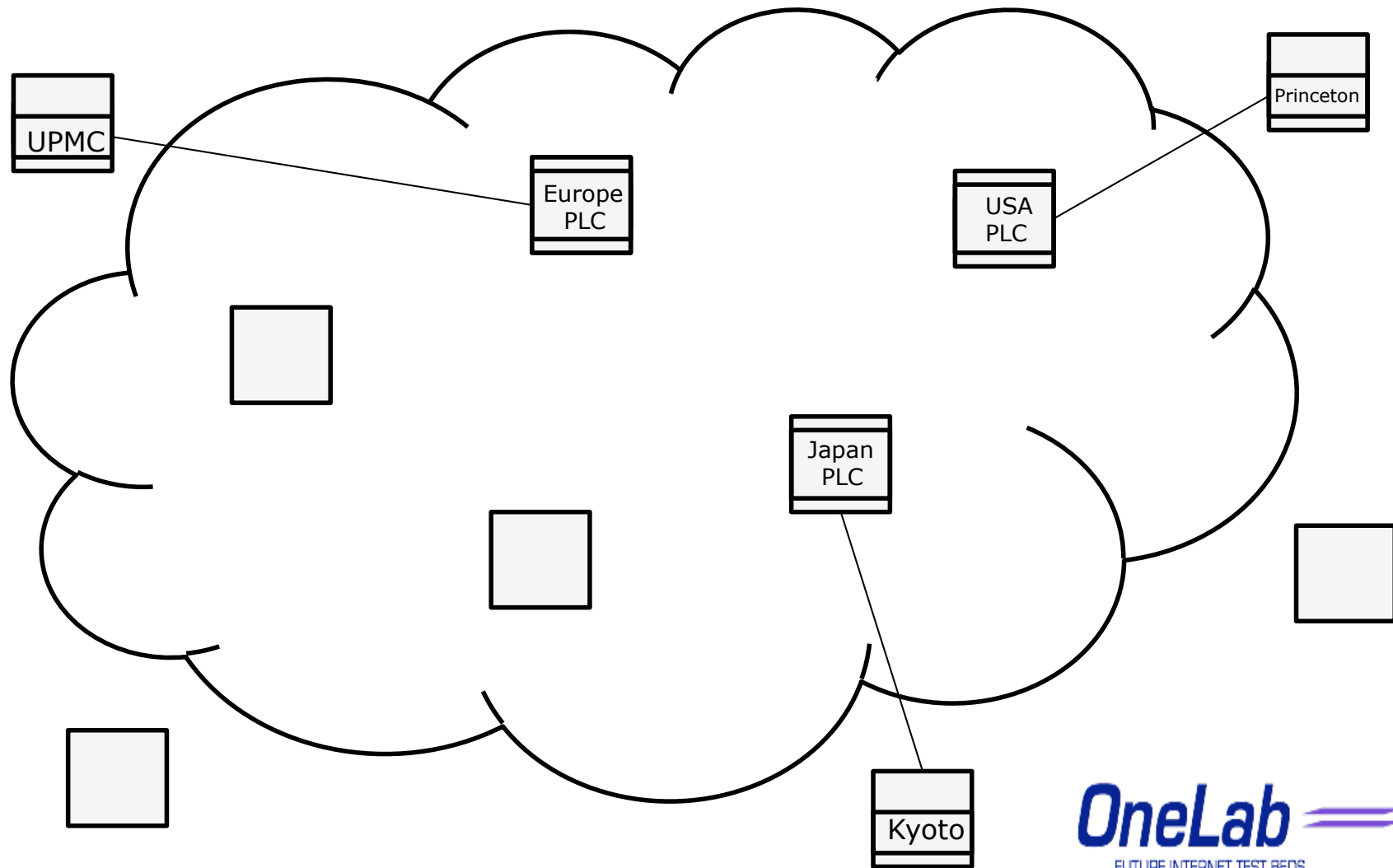
princeton_code en
nyu_d
cornell_beehive
att_mcash
cmu_esm
harvard_ice
hplabs_donutlab
idsl_psepr
irb_phi
paris6_landmarks
mit_dht
mcgill_card
huji_ender
arizona_stork
ucb_bamboo
ucsd_share
umd_scriptroute

Trust Relationships



- 1) PLC expresses trust in a user by issuing it credentials to access a slice
- 2) Users trust PLC to create slices on their behalf and inspect credentials
- 3) Owner trusts PLC to set users and map network activity to right user
- 4) PLC trusts owner to keep nodes physically secure

Global Federation



Security

- PlanetLab has been active for 6 years
- PlanetLab nodes are unfirewalled
- PlanetLab nodes have never been compromised
- Reason:

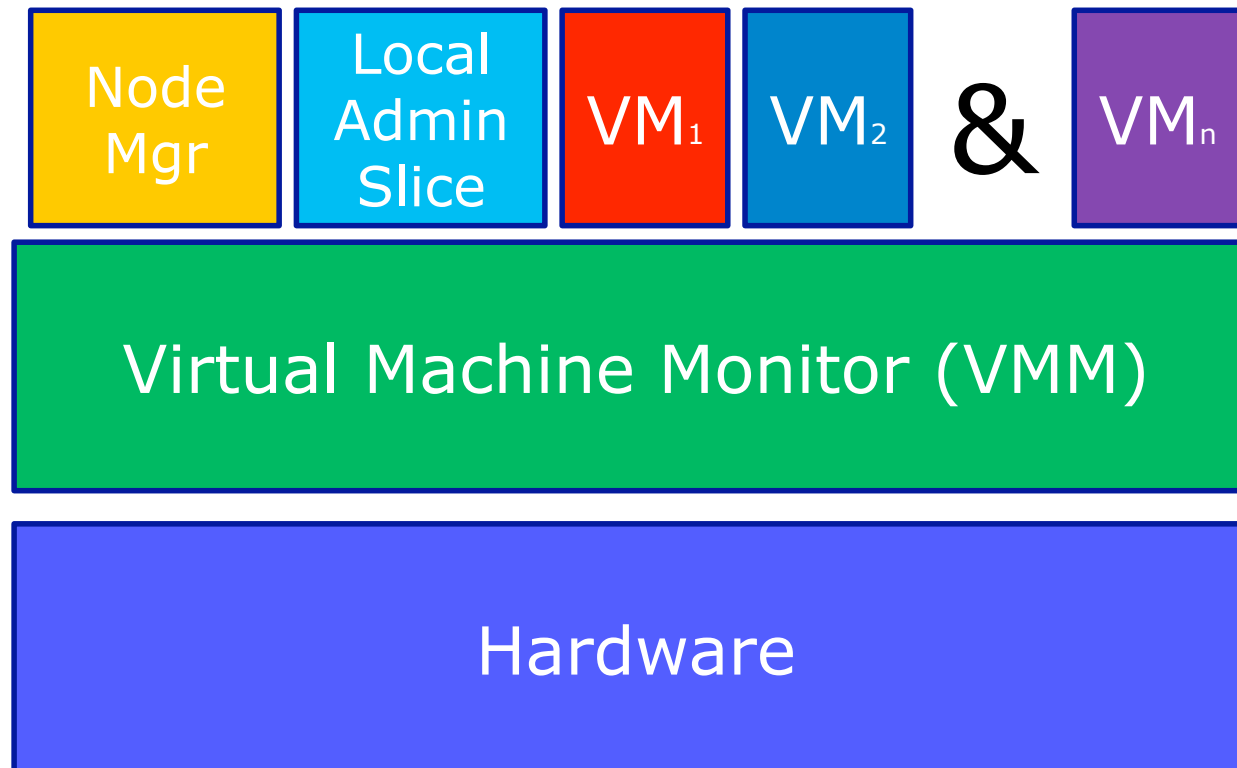
Security

- PlanetLab has been active for 6 years
- PlanetLab nodes are unfirewalled
- PlanetLab nodes have never been compromised
- Reason: Secret Powers

Security Architecture

- Node Operating System
 - isolates slivers
 - audits behavior
- PlanetLab Central (PLC)
 - remotely manages nodes
 - bootstrap services to instantiate and control slices
 - monitor sliver/node health

Node Architecture



VMM

- Linux
 - significant mindshare
- Vserver
 - scales to hundreds of VMs per node (12 MB each)

VMM

- Scheduling
 - CPU
 - fair share per sliver (guarantees possible)
 - link bandwidth
 - fair share per sliver
 - average rate limit: 1.5Mbps (24 hr bucket size)
 - peak rate limit: set by site (100 Mbps default)
 - disk
 - 5GB quota per sliver (limit runaway log files)
 - memory
 - no limit
 - pl_mom resets biggest user at 90% utilization

VMM-Networking

- VNET
 - relies on Linux's Netfilter system
 - slivers should be able to send only...
well formed IP
packets to non-blacklisted hosts

VMM-Networking

- slivers should be able to receive only...
 - packets related to connections that they initiated (e.g., replies)
 - packets destined for bound ports (e.g., server requests)
- supports the following protocols:
 - TCP
 - UDP
 - ICMP
 - GRE and PPTP
- also supports *virtual devices*
 - standard PF_PACKET behavior
 - used to connect to a “virtual ISP”

Auditing & Monitoring

PlanetFlow

- Logs every outbound IP flow on every nodes retrieves packet headers, timestamps, context ids (batched)
- Used to audit traffic
- Aggregated and archived at PLC

Auditing & Monitoring

SliceStat

- Access to kernellevel/systemwide information
- Used by global monitoring services
- Used to performance debug services

Auditing & Monitoring

EverStats

- Monitors front-end for PlanetLab systems
- Designed to monitor node and slice activity
- Retrieves public data from MyPLC
- Polls the slicestats package located on each planetlab node to gather specific performance data
- Provides daily aggregate performance data

Node Status

25 items/page

Search and ☒

| P | R | SITE | STATE | HOSTNAME | TYPE | IP | A | S | ? |
|-----|----|---------|-------|-----------------------|---------|----------------|------|-----|---|
| PLE | il | hujiple | boot | planet1.cs.huji.ac.il | regular | 132.65.240.100 | 1386 | 240 | |
| PLE | il | hujiple | boot | planet2.cs.huji.ac.il | regular | 132.65.240.101 | | 201 | |
| PLE | il | hujiple | boot | planet3.cs.huji.ac.il | regular | 132.65.240.102 | | 198 | |

Notes

R = region
A = arch
S = number of slivers
? = status
Enter & or | in the search area to switch between AND and OR search modes
Hold down the shift key to select multiple columns to sort

Node Status

| | | | | | | | | | |
|-----|-----|------------|------|-----------------------|---------|---------------|------|-----|-----|
| PLE | fr | supelecple | boot | pl1.rennes.supelec.fr | regular | 193.54.192.41 | i386 | 244 | |
| PLC | edu | iub | boot | pl1.ucs.indiana.edu | regular | n/a | n/a | 297 | n/a |

| | | | | | | | | | |
|-----|----|---------|-----------|--------------------|---------|-----|-----|-----|-----|
| PLC | in | iitd | reinstall | agni.iitd.ernet.in | regular | n/a | n/a | 257 | n/a |
| PLC | es | sevilla | boot | ait05.us.es | regular | n/a | n/a | 311 | n/a |

| | | | | | | | | | |
|-----|----|-------|----------|-------------------------------|---------|-----|-----|-----|-----|
| PLC | jp | osaka | disabled | int-pl1.ise.eng.osaka-u.ac.jp | regular | n/a | n/a | 135 | n/a |
| PLC | jp | osaka | disabled | int-pl2.ise.eng.osaka-u.ac.jp | regular | n/a | n/a | 136 | n/a |

| | | | | | | | | | |
|-----|-----|----|----------|-----------------|---------|-----|-----|-----|-----|
| PLC | edu | vt | safeboot | billy.cc.vt.edu | regular | n/a | n/a | 270 | n/a |
| PLC | edu | vt | safeboot | bob.cc.vt.edu | regular | n/a | n/a | 332 | n/a |

| | | | | | | | | | |
|-----|----|--------------|----------|---------------------|---------|----------------|-----|-----|-----|
| PLC | ch | epfl | boot | lsirextpc02.epfl.ch | regular | n/a | n/a | 340 | n/a |
| PLE | it | quantavisple | failboot | marie.iet.unipi.it | regular | 131.114.53.188 | | 35 | |

PlanetLab RPC Services

- PlanetLab has a number of built-in services
 - They are accessible via XML-RPC
 - discover available resources
 - create and configure a slice
 - resource allocation
- They are useful if you need to provision and manage long running services

PlanetLab User Services

- There are very few built-in services for users
- What you see on the web site is what you get!
- We will cover some services that will be integrated into the base system
- Most are already available on the production PlanetLab

Stork

- Package management facility for PlanetLab
- Deploy software to nodes automatically using the Stock GUI
- Saves disk space by sharing common files
- Downloads packages to a node only once (not once per slice)
- Secure repository for shared package

<http://www.cs.arizona.edu/stork>

Sirius

- What if you want the whole node for yourself
 - Or if you need multiple nodes
- Useful to minimize external factors
 - Other slivers using CPU or network
 - Very useful before paper deadlines
- Gives your slice increased CPU priority and network bandwidth on its nodes for some 30 minute period
- Other slivers on those nodes still run

PlanetLab Limitations

- PlanetLab provides administration and management
- It does not (yet) provide usability features
- In particular, no monitoring or resource discovery
- Third party systems have been developed and will be integrated into the core platform

CoTop

- Monitors local node, sliver and slice activity
- Available on all PlanetLab Nodes as:

<http://<nodename>:3121>

<http://<nodename>:3120/cotop>

CoTop: <http://<nodename>:3120/cotop>

```
cotop - 09:20:44 up 21 days, 12:10, 0 users, load average: 8.37, 7.41, 6.96
Tasks: 61 total, 1 running, 60 sleeping, 0 stopped, 0 zombie
Cpu(s): 61.6% us, 33.6% sy, 0.0% ni, 0.1% id, 0.1% wa, 0.1% hi, 4.5% si
Mem: 1033596k total, 1016580k used, 17016k free, 23492k buffers
Swap: 1048568k total, 508692k used, 539876k free, 361060k cached
```

| <u>CTX</u> | <u>TX1</u> | <u>TX15</u> | <u>RX1</u> | <u>RX15</u> | <u>#PR</u> | <u>PMEMMB</u> | <u>VMEMMB</u> | <u>%CPU</u> | <u>%MEM</u> | <u>NAME</u> |
|------------|------------|-------------|------------|-------------|------------|---------------|---------------|-------------|-------------|-----------------------------|
| 928 | 1 | 1 | 89 | 98 | 2 | 9.5 | 23.1 | 45.0 | 0.9 | arizona_stork_install |
| 531 | 7 | 6 | 6 | 6 | 6 | 9.3 | 68.9 | 37.0 | 0.9 | columbia_salman |
| 515 | 0 | 0 | 45 | 27 | 7 | 24.9 | 42.1 | 28.0 | 2.5 | cmu_abwe |
| 533 | 1029 | 1309 | 1039 | 1353 | 44 | 102.9 | 169.4 | 23.0 | 10.1 | princeton_codeen |
| 775 | 617 | 2073 | 208 | 158 | 6 | 35.8 | 267.5 | 11.0 | 3.5 | nyu_d |
| 695 | 6 | 5 | 6 | 6 | 6 | 51.6 | 692.5 | 11.0 | 5.1 | umn_mcla0181 |
| 547 | 2 | 2 | 4 | 1 | 2 | 9.2 | 59.5 | 9.0 | 0.9 | ufl_test0 |
| 0 | 0 | 0 | 0 | 0 | 98 | 95.9 | 420.9 | 6.0 | 9.4 | root |
| 663 | 5 | 6 | 655 | 785 | 9 | 27.0 | 80.8 | 2.0 | 2.7 | utexas_measure |
| 607 | 757 | 709 | 430 | 363 | 42 | 153.9 | 318.8 | 2.0 | 15.2 | princeton_coblitz |
| 558 | 18 | 21 | 21 | 21 | 3 | 26.7 | 215.9 | 2.0 | 2.6 | ucb_bamboo |
| 782 | 7 | 7 | 10 | 16 | 13 | 21.2 | 456.7 | 0.0 | 2.1 | uka_oversim |
| 527 | 0 | 0 | 0 | 0 | 3 | 10.6 | 196.3 | 0.0 | 1.0 | byu_p2pweb |
| 710 | 2 | 2 | 11 | 10 | 5 | 2.8 | 9.7 | 0.0 | 0.3 | sfu_wang |
| 794 | 15 | 15 | 9 | 9 | 3 | 6.8 | 54.2 | 0.0 | 0.7 | unimelb_p2ppar |
| 709 | 0 | 0 | 0 | 9 | 1 | 2.1 | 12.8 | 0.0 | 0.2 | cmu_scaleron |
| 887 | 0 | 0 | 0 | 9 | 1 | 2.2 | 12.8 | 0.0 | 0.2 | sics_gradient |
| 835 | 19 | 17 | 18 | 16 | 3 | 31.1 | 278.0 | 0.0 | 3.1 | cornell_meridian |
| 513 | 0 | 0 | 0 | 0 | 1 | 2.1 | 12.8 | 0.0 | 0.2 | arizona_stork_blackbox_test |
| 853 | 0 | 0 | 0 | 0 | 1 | 0.3 | 1.9 | 0.0 | 0.0 | uw_geoloc4 |
| 914 | 0 | 0 | 0 | 0 | 6 | 6.2 | 31.4 | 0.0 | 0.6 | utah_elab_24927 |
| 686 | 0 | 0 | 0 | 0 | 3 | 2.7 | 12.8 | 0.0 | 0.3 | ucsd_mortar |
| 631 | 5 | 5 | 5 | 5 | 41 | 30.6 | 292.4 | 0.0 | 3.0 | princeton_coblitztest |
| 665 | 0 | 0 | 0 | 0 | 26 | 26.6 | 97.2 | 0.0 | 2.6 | google_highground |
| 921 | 0 | 0 | 0 | 0 | 7 | 7.8 | 42.8 | 0.0 | 0.8 | utah_svc_slice |
| 575 | 0 | 0 | 0 | 0 | 2 | 5.3 | 39.4 | 0.0 | 0.5 | tsinghua_lhq |
| 834 | 43 | 41 | 3 | 4 | 59 | 97.6 | 253.7 | 0.0 | 9.6 | princeton_comon |

CoTop: <http://<nodename>:3120/cotop>

```
Date: 1221038584.542664
VMStat: 11 1 509148 50216 25336 363152 52 0 1084 1165 2438 4830 73 38 0 0 0
CPUUse: 29 100
DNSFail: 0.0 0.0 0.0 0.0
RWFS: 53
Uptime: 1858378.05
Loads: 8.61 7.59 7.05
Timer: 44.405000 10.168162
FdTestHist: 0x0
ServTest: 0.579000 0.324433
Purks: 10.00 10.00 10.00 9.99 10.00 10.00 9.98 10.01 10.00 9.99
PukPuks: 1.00 1.00 1.00 1.00 1.00 1.04 1.00 1.00 1.00 1.17
MemPress: 70
Test206: 206 0 0 0
DfDot: 20% 140.971 175.453
MemInfo: 0.985714 77.6876 48.5115
KernVer: 2.6.22.19
Burp: 23.2%
CPUSpeed: 2.99514
FCNameX: Werewolf
CPUHog:
MemHog:
TxHog:
RxHog:
ProcHog:
TxRate: 0.000000
RxRate: 0.000000
NumSlices: 0 mostrecentcotop
LiveSlices: 0
```

CoMon

- Aggregate monitoring of nodes, slivers and slices
<http://comon.cs.princeton.edu/>
- Node centric:
<http://summer.cs.princeton.edu/status/>
- Slice centric:
http://summer.cs.princeton.edu/status/index_slice.html

CoMon: Node Centric



CoMon PlanetLab Status (sort key: Name)

Part of the [CoDeS/N](#) project

Updated Wed Sep 10 05:25:02 2008 EDT (GMT -0400)

[legend](#)

Summaries: By Node ([long](#), [short](#)) By Slice ([mean](#), [average](#), [total](#), [size](#)) By Ports ([all](#)) By Site ([all](#))

Problems ([links](#), [slices](#)) Via: [Auto](#) Resources ([CPU](#), [Mem](#), [BW](#)) Efficiency ([CPU](#), [Mem](#)) Usage ([Slices](#), [Slivers](#), [Nodes](#))

| # | Name Address Location | Resp Time | Node Type | Kern Ver PC Name Def's | Date 5:25:14 -0.01 S | CPU Speed | 1 Min Load | Timer Max | Mem Size | Swap In | Disk Size | FD Test File RW | FW Limit | DNS1 udp | Raw Ports | Non 206 Eac Via | CPU Req | Proc Req | Tx Req | LPort Req | | |
|---|--|------------------------------------|--------------------------|------------------------------|---------------------------------|--------------------------------|-------------------------|-------------------------------|--------------------|-------------------------|------------------------------|--------------------|---------------------|--------------------------------|-----------|--------------------|---|-----------------------------------|--|-----------|-----------|-----------|
| | | SSE Status | Boot State | | | Best CPU | 5 Min Load | Timer Avg | Mem Act | SwapOut | Disk Used | | FD Test | Tx Rate | DNS1 tcp | | ICMP Ports | | CPU % | Tx Kb | Num LPort | |
| | | Uptime | Err DB | | | Sys CPU | Yarn Slices | Conn Max | Free Mem | Disk In | GB Free | | File RW | Rx Rate | DNS2 udp | | Long Ports | | Mem Req | Num Proc | Rx Req | SPort Req |
| | | Last CoReq | Err DB | | | Free CPU | Live Slices | Conn Avg | DiskOut | Swap Used | | | | | DNS2 tcp | | Snap Ports | | Mem % | | Rx Kb | Num SPort |
| 1 | pbb1-c705.aik.ac.at 138.252.66.194 SouthAfr | 0.36 S good 4.9 D 0.80 S | Prod boot mismatch | 2.6.22.19 Waterwolf | 9-10-2008 5:25:14 -0.01 S | 3.4 96.0% 6.0% 91.8% | 3.30 2.00 0 0 | 43.0 18.1 1.78 0.25 | 0.99 85% 52 | 50 565 450 944 | 294.6 6% 177.71 38% | 0x0 good | 4080 0 0 | 0.0% 0.0% -1.0% -1.0% | | 0 0 | | | | | | |
| 2 | pbb1-c705.aik.ac.at 138.252.66.195 SouthAfr | 0.36 S good 4.9 D 0.80 S | Prod boot mismatch | 2.6.22.19 Waterwolf | 9-10-2008 5:25:14 -0.01 S | 3.4 64.0% 38.0% 70.5% | 1.38 1.86 31 3 | 125.1 18.2 5.84 0.28 | 0.99 77% 100 | 0 0 179 580 | 294.6 5% 182.39 0% | 0x0 good | 4080 2079 938 | 0.0% 0.0% -1.0% -1.0% | | 0 0 | new d 92.0% root 76 mismatched 16.1% | new d 99% mismatched 28% | | | | |
| 3 | pbb1-itec.uni-kl.ac.at 143.205.172.11 Europe | 0.36 S good 27.6 D 0.80 S | Prod boot mismatch | 2.6.22.19 Waterwolf | 9-10-2008 5:25:14 -0.01 S | 3.8 17.0% 8.0% 94.6% | 1.14 1.00 55 1 | 38.0 18.1 0.42 0.24 | 3.71 59% 100 | 0 0 55 387 | 285.4 7% 196.61 14% | 0x0 good | none 0 0 | 0.6% 1.7% 36.8% 8.2% | | 0 0 | princeton placement 95.0% google highspeed 7.4% | google highspeed 13% | princeton stark netall 0 princeton stark netall 0 | | | |

CoMon: Slice Centric



CoMon Slice Usage Totals (sort key: Slice Name)

Part of the [CoDecN](#) project

Updated Wed Sep 10 05:30:02 2008 EDT (GMT -0400)

Summaries: By Node ([long](#), [short](#)) By Slice ([max](#), [average](#), [total](#), [site](#)) By Ports ([all](#)) By Site ([all](#))

Problems ([nodes](#), [slices](#)) Viz: [Auto](#) Resources ([CPU](#), [Mem](#), [BW](#)) Efficiency ([CPU](#), [Mem](#)) Usage ([Slices](#), [Slices](#), [Nodes](#))

| # | Slice Name | 1-min Transmit | 15-min Transmit | 1-min Receive | 15-min Receive | Num Procs | Phys Mem MB | Virt Mem MB | CPU % | MEM % | Lang Ports | Snap Ports | # Nodes |
|----|--|----------------|-----------------|---------------|----------------|-----------|-------------|-------------|--------|-------|------------|------------|---------|
| 1 | arizna_stork_blackbox_test | 0 | 0 | 0 | 0 | 15 | 52.1 | 166.6 | 0.0 | 3.9 | 1 | 15 | 13 |
| 2 | arizna_stork_install | 65 | 267310 | 12237 | 202291 | 2001 | 10320.6 | 17288.4 | 1463.0 | 689.0 | 279 | 3629 | 479 |
| 3 | ast_ncdu_ipn | 18794 | 20268 | 17448 | 18316 | 188 | 974.7 | 7868.2 | 21.8 | 47.6 | 0 | 0 | 46 |
| 4 | bin | 0 | 0 | 0 | 0 | 4 | 1.1 | 4.1 | 0.0 | 0.1 | 0 | 0 | 1 |
| 5 | brown_kns | 0 | 0 | 0 | 0 | 1 | 1.4 | 2.6 | 0.0 | 0.1 | 0 | 0 | 1 |
| 6 | byu_g2pweb | 13 | 13 | 12 | 13 | 658 | 8176.8 | 121280.7 | 8.8 | 403.8 | 0 | 0 | 277 |
| 7 | cmu_abwc | 1 | 0 | 1289 | 1118 | 486 | 2207.1 | 5045.6 | 205.6 | 126.8 | 192 | 1227 | 240 |
| 8 | cmu_scalera | 0 | 0 | 1737 | 1813 | 476 | 1952.5 | 5316.8 | 29.4 | 115.1 | 232 | 901 | 387 |
| 9 | columbia_asherman | 2 | 3 | 1 | 2 | 11 | 251.6 | 1366.1 | 0.0 | 7.3 | 0 | 0 | 9 |
| 10 | columbia_salman | 1143 | 1151 | 560628 | 425742 | 1258 | 3583.4 | 16523.2 | 2077.7 | 180.0 | 198 | 238 | 210 |

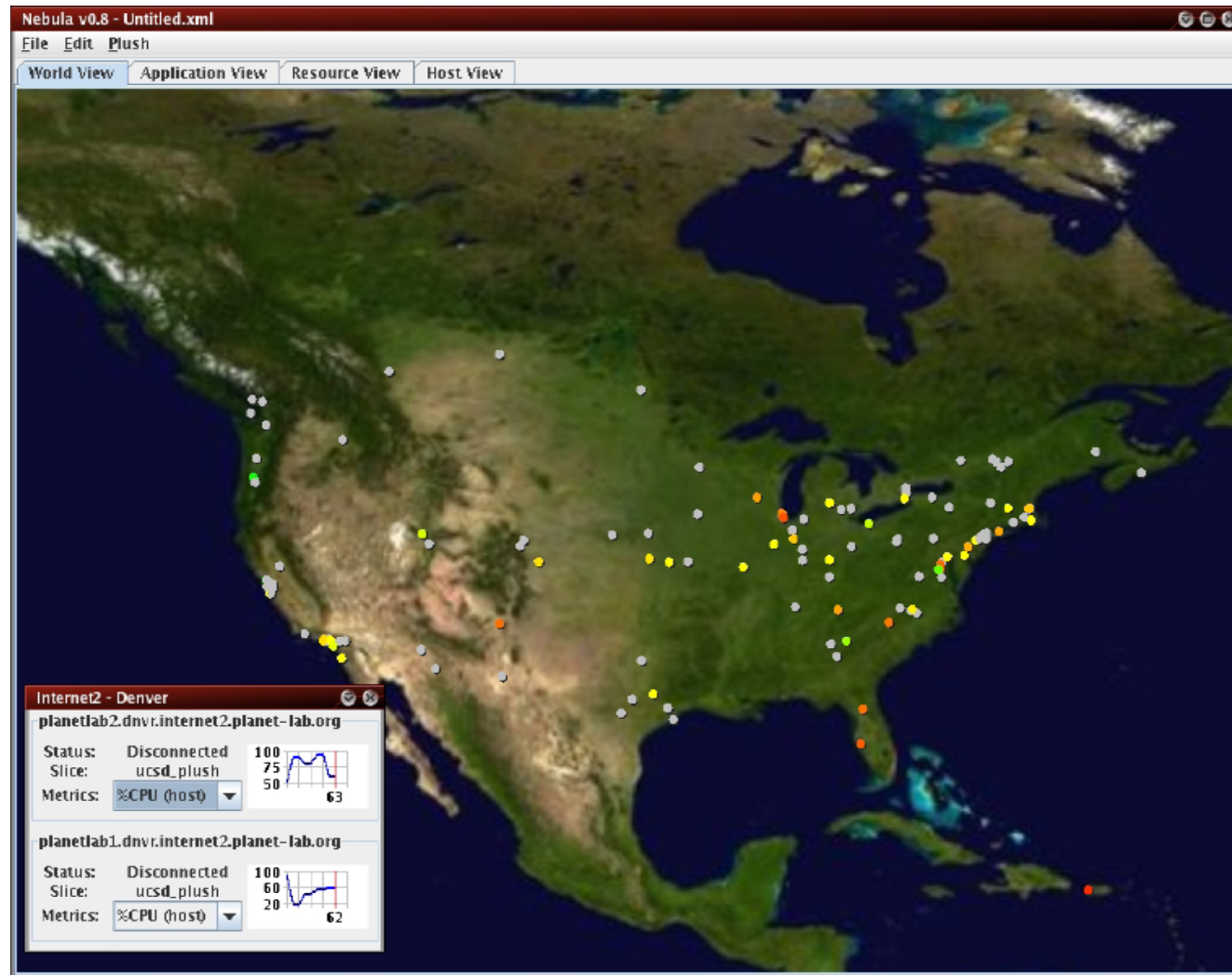
Sword

- Find out what nodes are available
- Sword builds on CoTop/CoMon
- Can query for nodes that match your needs
- Uses an XML-RPC interface
- <http://sword.cs.williams.edu/>

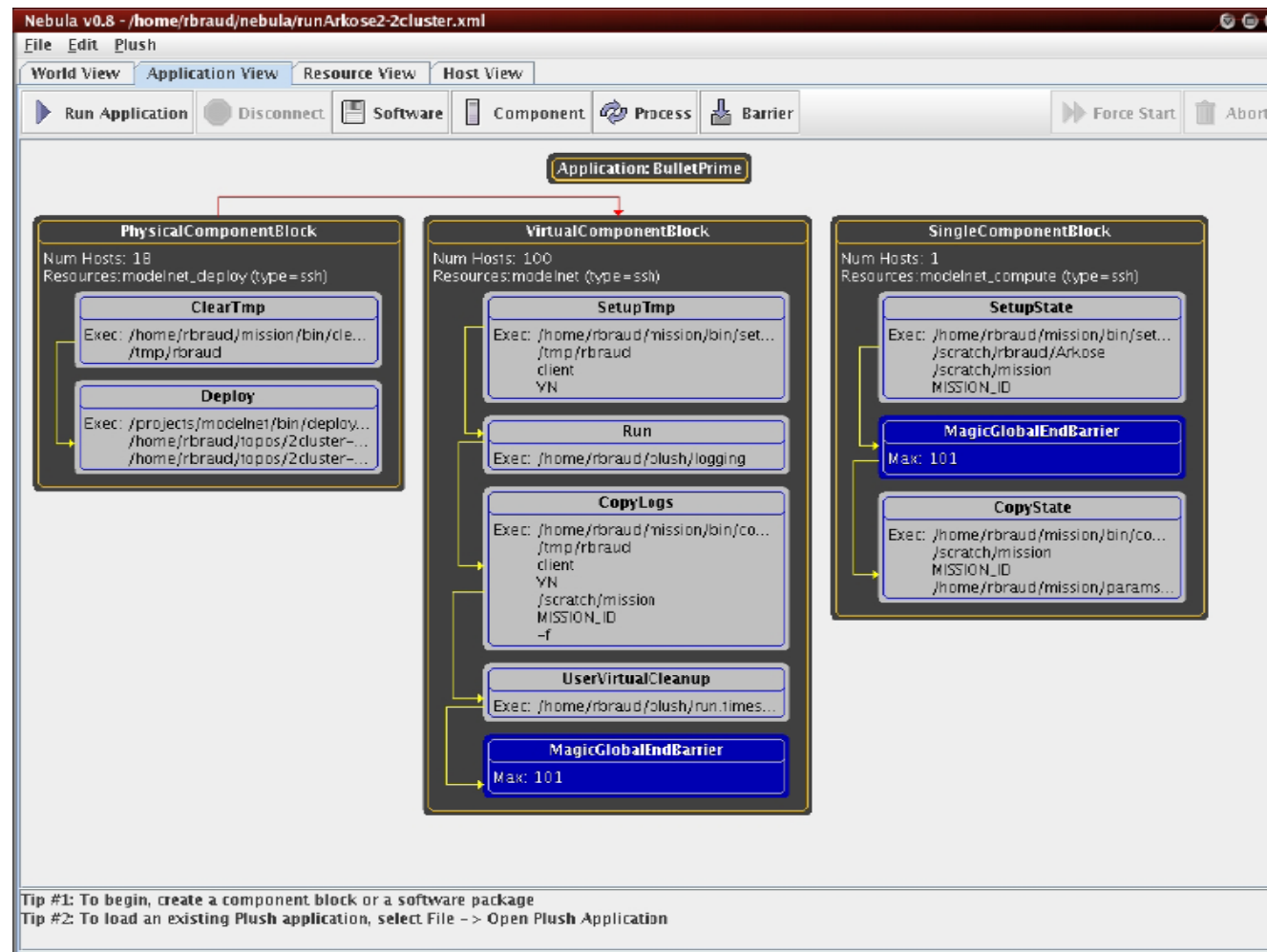
Plush/Nebula

- Integrated tool for Application management
- Integrates resource discovery, application deployment and execution in a wysiwyg environment
- <http://plush.cs.williams.edu/nebula>

Plush/Nebula



Plush/Nebula



Other Third Party Services

- Brokerage Services
 - Sirius: Georgia
 - Bellagio: UCSD, Harvard, Intel
 - Tycoon: HP
- Environment Services
 - Stork: Arizona
 - AppMgr: MIT
- Monitoring/Discovery Services
 - CoMon: Princeton
 - PsEPR: Intel
 - SWORD: Berkeley
 - IrisLog: Intel

Other Third Party Services

- Content Distribution
 - CoDeeN: Princeton
 - Coral: NYU
 - Cobweb: Cornell
- Internet Measurement
 - ScriptRoute: Washington, Maryland
- Anomaly Detection & Fault Diagnosis
 - PIER: Berkeley, Intel
 - PlanetSeer: Princeton
- DHT
 - Bamboo (OpenDHT): Berkeley, Intel
 - Chord (DHash): MIT

Other Third Party Services

- Routing
 - i3: Berkeley
 - Virtual ISP: Princeton
- DNS
 - CoDNS: Princeton
 - CoDoNs: Cornell
- Storage & Large File Transfer
 - LOCI: Tennessee
 - CoBlitz: Princeton
 - Shark: NYU
- Multicast
 - End System Multicast: CMU
 - Tmesh: Michigan

Tutorial Site

- The latest tutorial (pdf slides) are available at:

<http://www.planet-lab.eu/tutorial>

- The live system is available at:

<http://www.planet-lab.eu>

References

- PlanetLab official Web site: <http://www.planetlab.org/>
- L. Peterson, S. Muir, Timothy Roscoe, and Aaron
- Klingaman PlanetLab Architecture: An Overview. Technical Report, PlanetLab, May 2006
- L. Peterson and T. Roscoe. The Design Principles of PlanetLab.
- *Operating Systems Review (OSR)*, 40(1):11.16, Jan. 2006.