BonFIRE

Federating Clouds for Research and Experimentation

Juan A. Lorenzo del Castillo / July 3rd, 2013

About me

Juan A. Lorenzo del Castillo

Ph.D. in Computing Engineering from the University of Santiago de Compostela (Spain).

M.Sc. in Information Technologies. Inter-university Doctorate Program, USC-UDC (Spain).

M.Sc. in Telecom Engineering from the University of Valladolid (Spain).

B.Sc. in Telecom Engineering majoring Electronics from the University of Valladolid (Spain).

Research Engineer in the Cloud and Security Lab, HP Laboratories.

Performing Cloud building and integration tasks at the FP7 EU BonFIRE project.

Research interests:

- Virtualisation
- Performance monitoring
- Data Profiling
- Improvement of data locality on multiprocessor systems

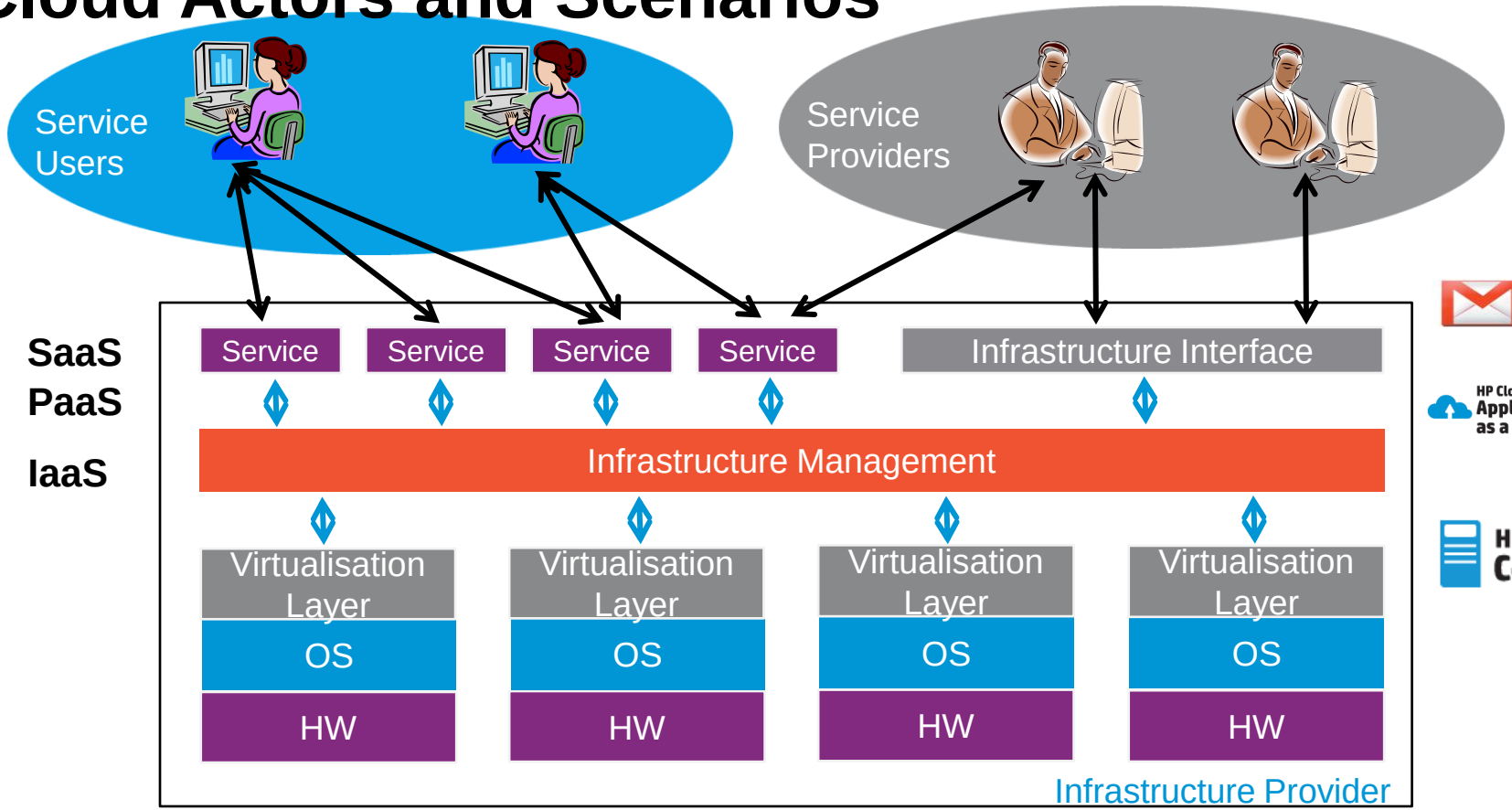
Cloud 101

Cloud Computing

A Cloud is...

- A pool of computing resources (servers, storage, applications, etc.)
- Pay-per-use
- Eliminates the need for on-site equipment, maintenance, and management.
- Ubiquity
- Scalability and Elasticity
- SLAs

Cloud Actors and Scenarios



Cloud Computing for Experimentation

Testbeds for Services Experimentation

BonFIRE project

The BonFIRE project is designing, building and operating a multi-cloud facility to support research across applications, services and systems targeting the services research community on Future Internet.

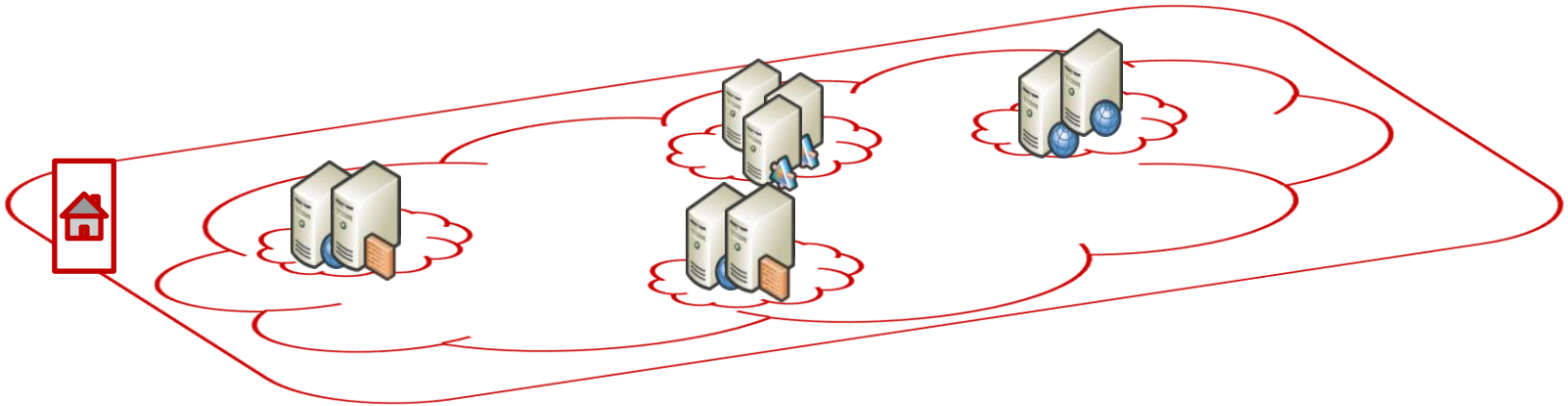
Why BonFIRE

Traditional cloud facilities are not suitable for research and testing

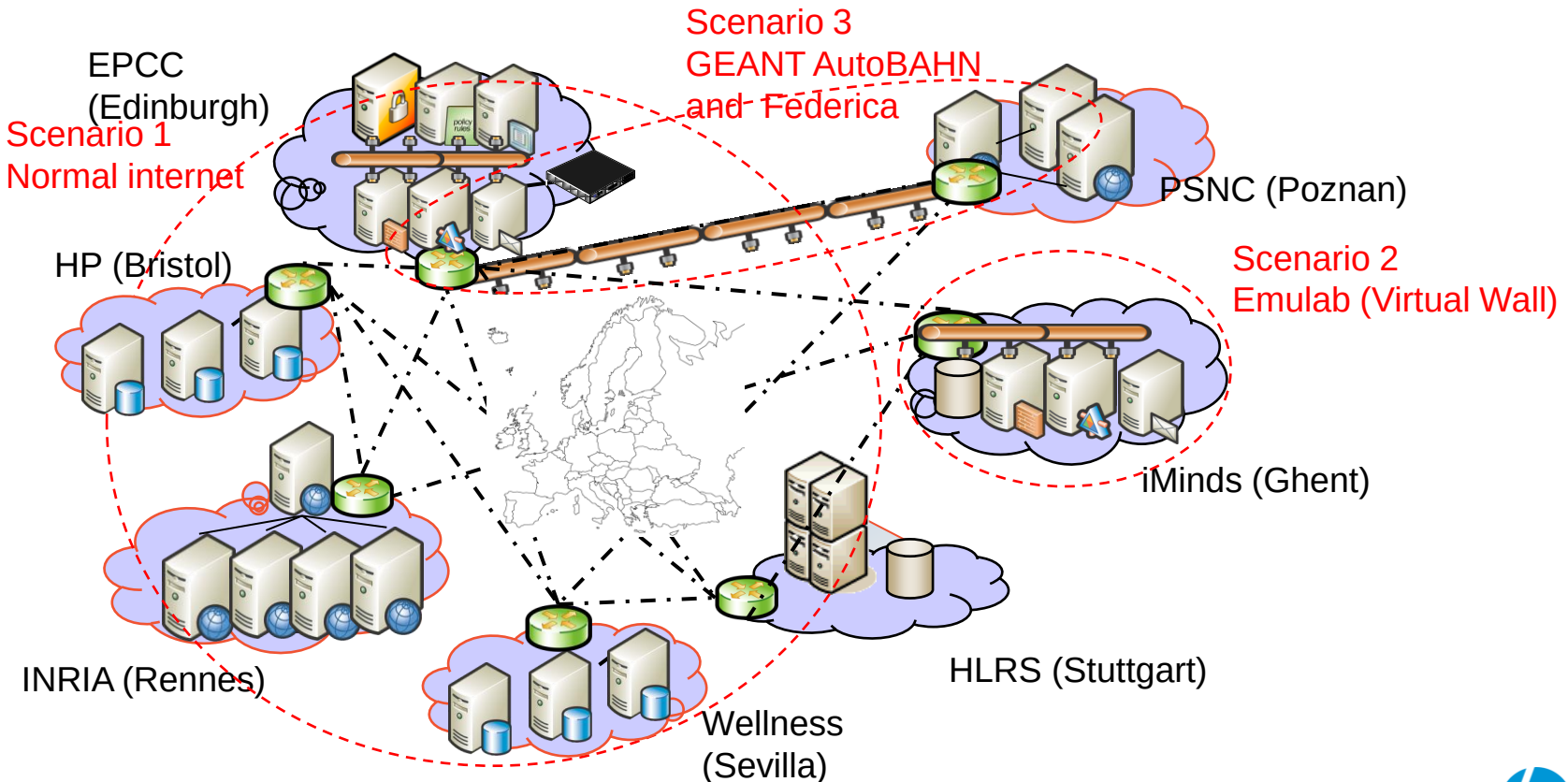
- They do not provide low-level metrics at infrastructure level.
- They do not allow users to monitor the execution of their applications to a high degree.
- Users cannot control most of the many variables that affect performance (e.g. VM allocation).
- They provide a flat network, without possibility of controlling network QoS parameters (latency, packet loss, etc.).
- They do not provide testbed heterogeneity to test reproducibility of results.

Three scenarios

1. Multi-site clouds connected through normal internet
2. Cloud scenario with emulated network
3. Extended Cloud scenario with controlled network (federation with network facility)

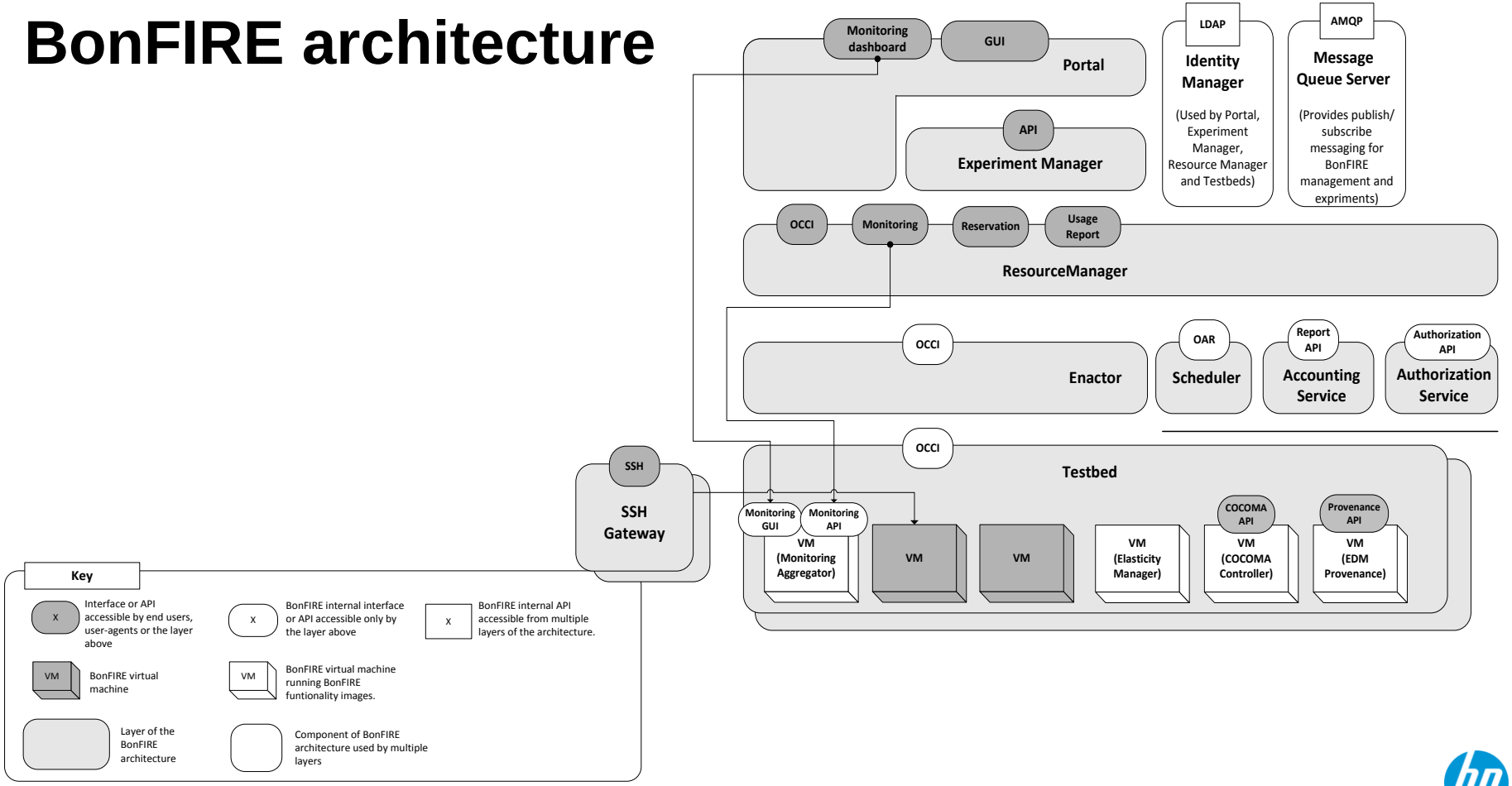


BonFIRE scenarios and sites



Permanent (>450cores / 45TB) & On-Request (+1,500 cores) infrastructures

BonFIRE architecture



Four pillars

Observability

Control

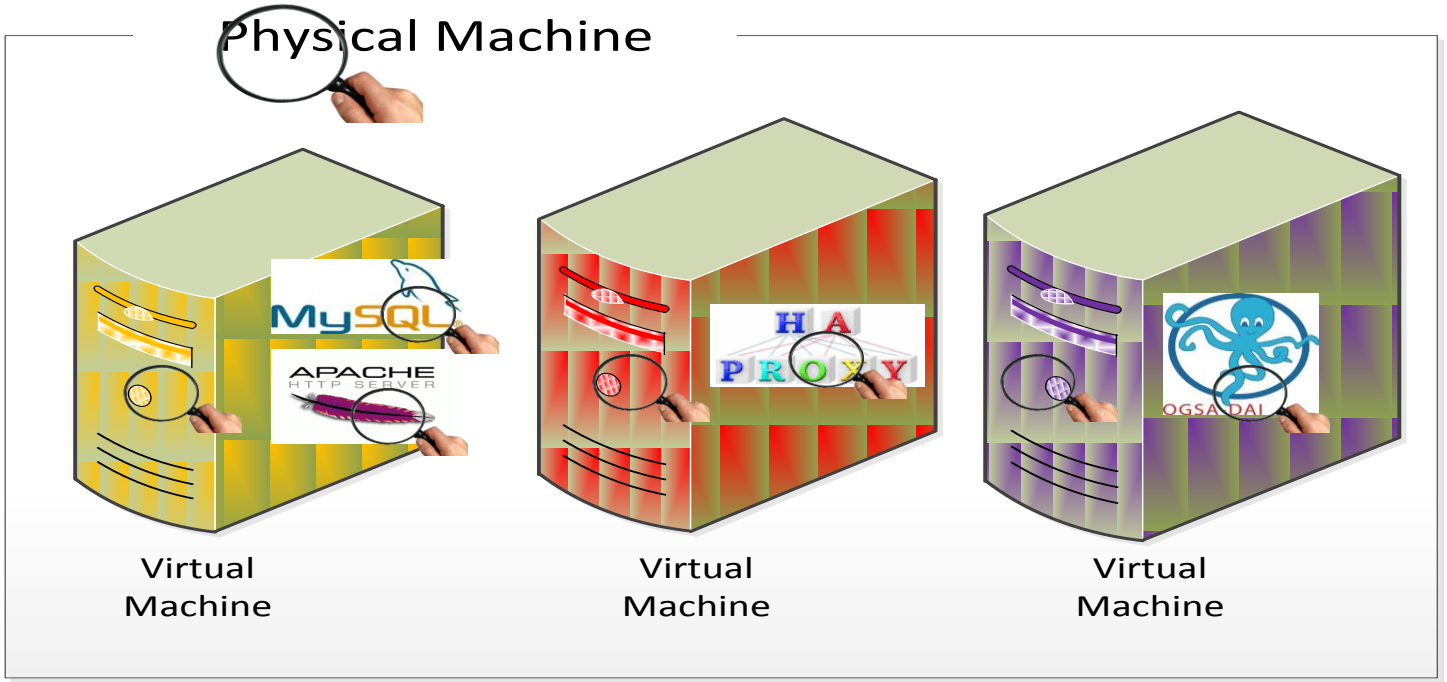
Advanced Features

Ease of Use

Observability

To understand the behaviour of the system you need to see inside the abstractions normally provided by clouds.

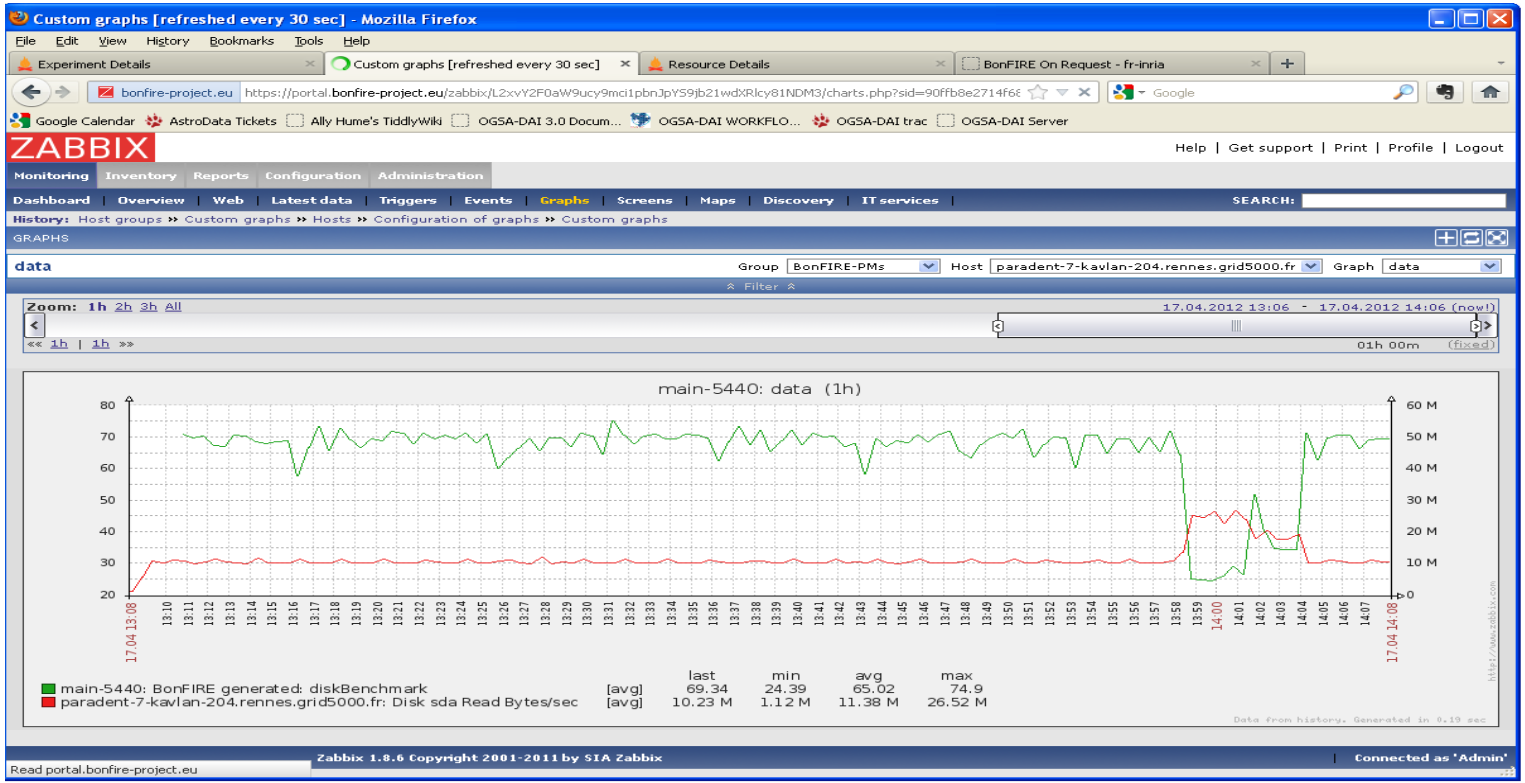
Application, VM and Physical machine metrics



Observability

ZABBIX
MONITORING SYSTEM

Infrastructure metrics



Observability

Experiments supported

Passive use of infrastructure metrics

Understanding of contention and its impact on:

- Application performance
- General VM performance

Active use of infrastructure metrics

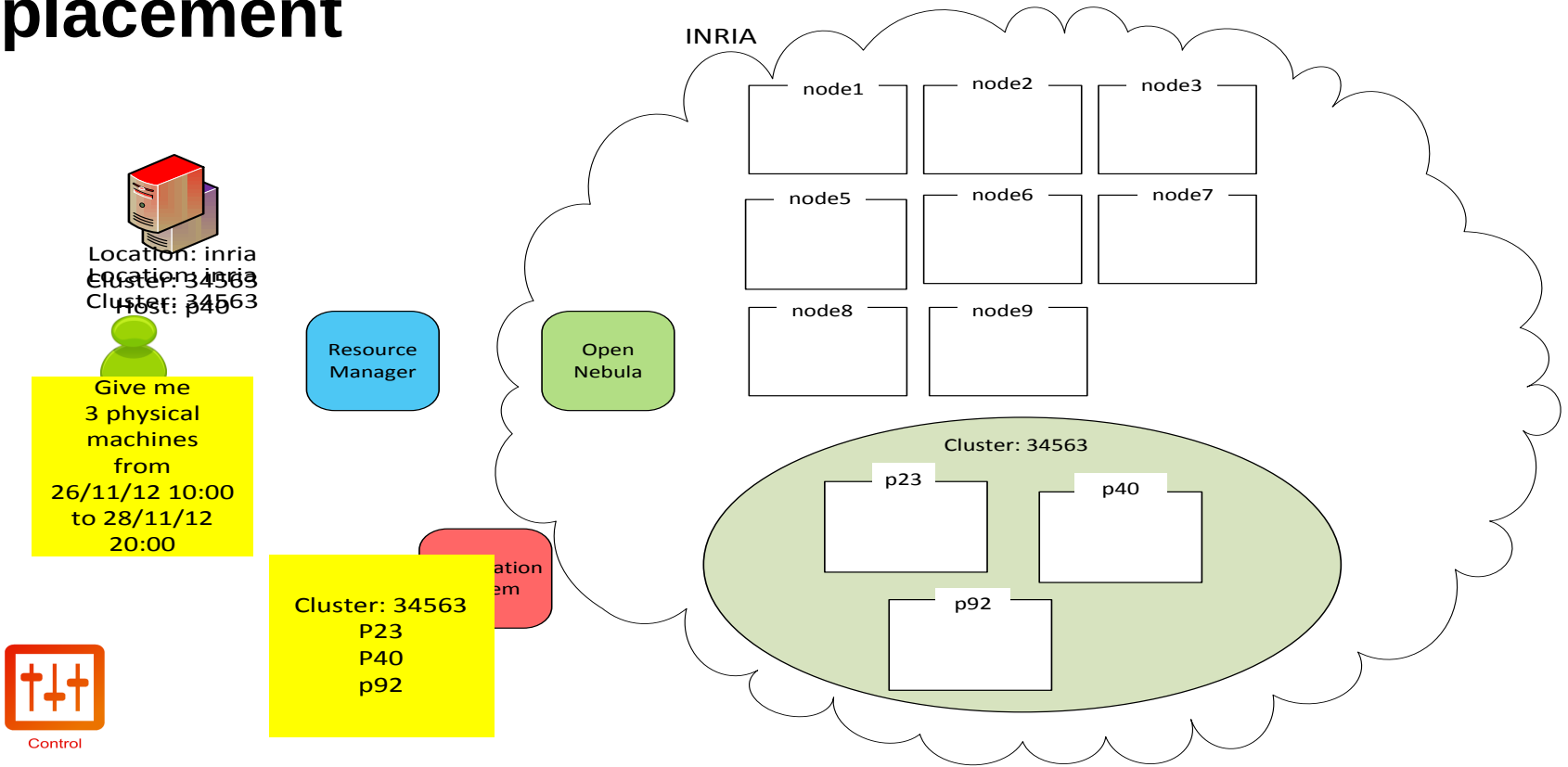
- By a cloud scheduler to **co-locate VMs** to minimise contention
  - e.g. by collecting statistics of the previous usage patterns of an image
- By a cloud application to **react** to the contention currently in the system

Control

Observing is good but control is even better.

Control

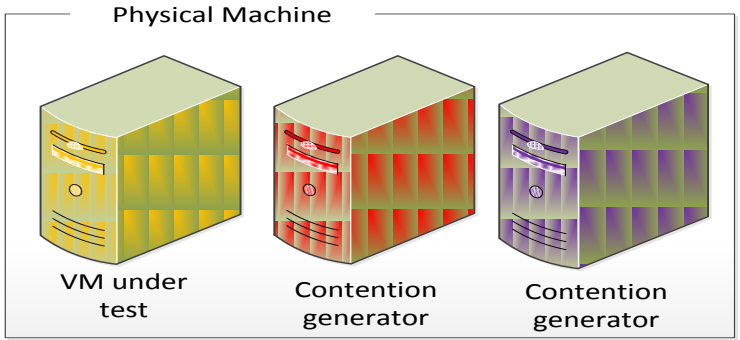
Exclusive physical machines and controlled placement

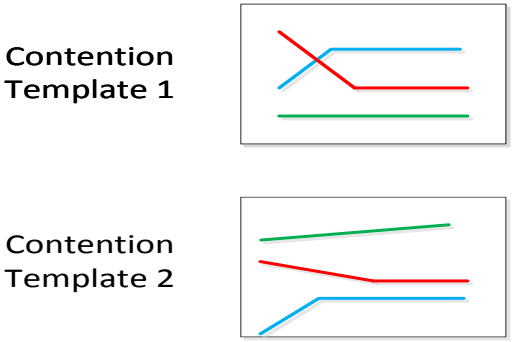


Supported Experiments

Exclusive use of physical machine and controlled placement

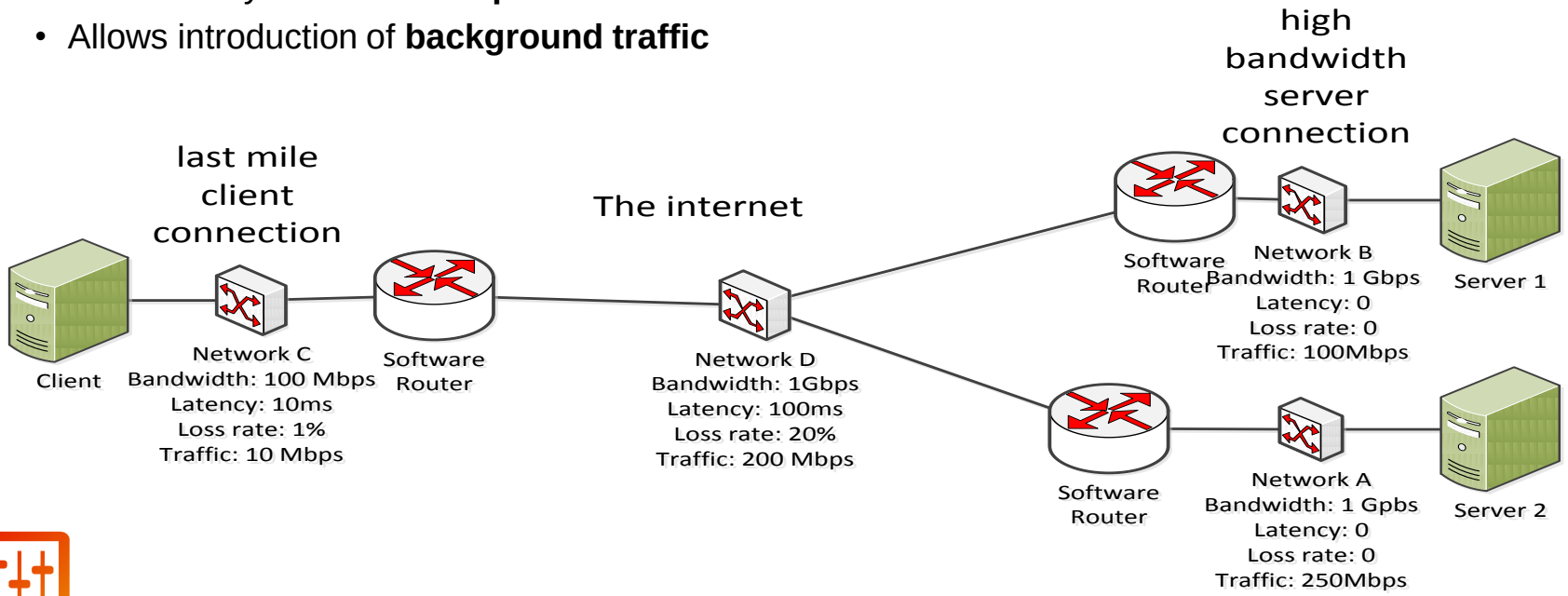
- Supports elimination of **unwanted contention**
- Increases experiment **repeatability**
- Supports the implementation of **controlled contention**
  - possible via common contention templates





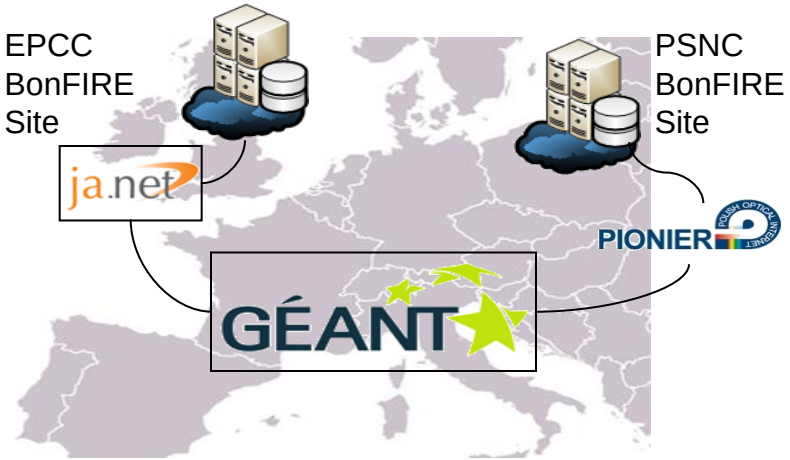
Controlled networks with Virtual Wall

- Setup of any desired **network topology**
- Allows study of **network impairments**
- Allows introduction of **background traffic**



Integration with AutoBAHN

Integrate BonFIRE with the GÉANT Bandwidth-on-Demand interfaces (AutoBAHN)



This allows network-aware experiments with requirements for guaranteed bandwidth

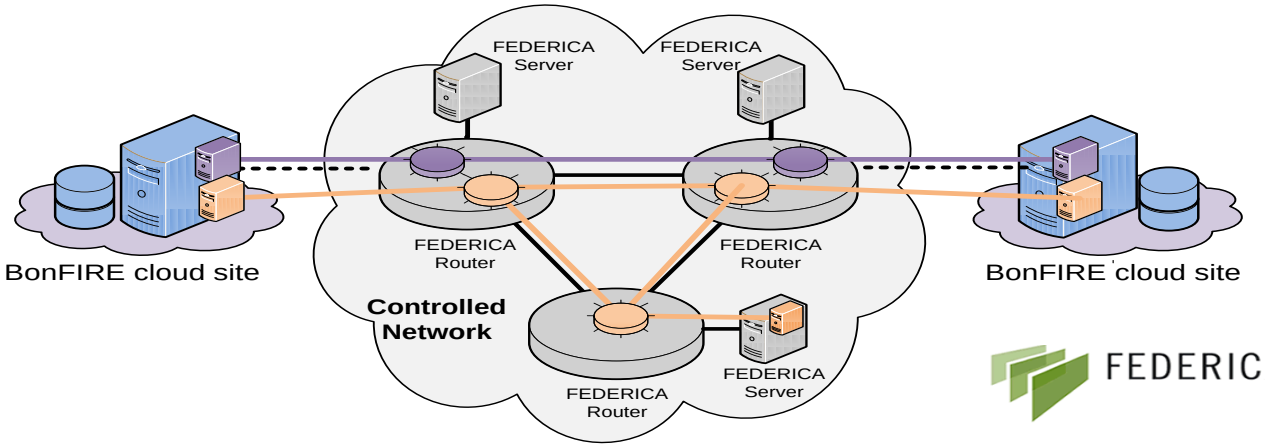
- Control
- Future service

Why AutoBAHN?

- Reference BoD system for European NRENs and GÉANT
- Most mature solution in terms of specification, implementation and deployment in the multi-domain environment interconnecting some of the sites
- Handles both on demand and advance requests

FEDERICA offering

- FEDERICA is an e-Infrastructure based on virtualization of compute and network resources
- BonFIRE experimenters to request slices of network resources and be able to:
  - Select network topology
  - Configure static routes and dynamic routing protocols (OSPF, BGP)



Supported Experiments

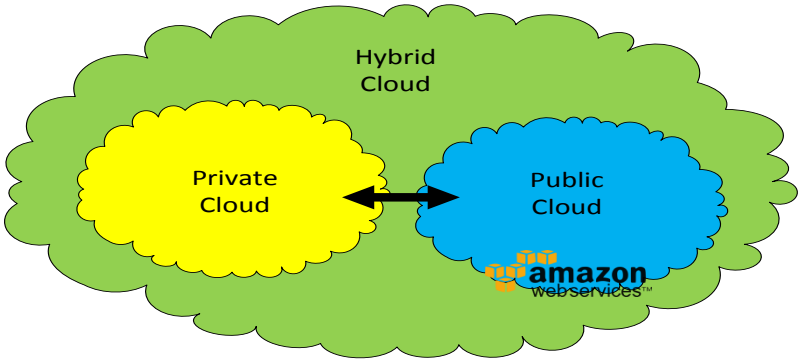
Controlled network quality of service

- Testing streaming applications
- Testing Services distributed applications
- Multi-cloud applications
- Experiments into how bandwidth on demand services could be used by cloud applications

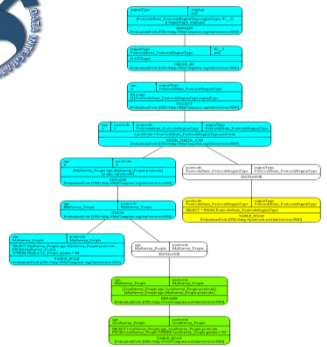
RedZinc

cloudiumsystems
accelerating virtualization

Control



ADMIRE



Advanced features

Advanced Features

Advanced features

Intra-site VM migration

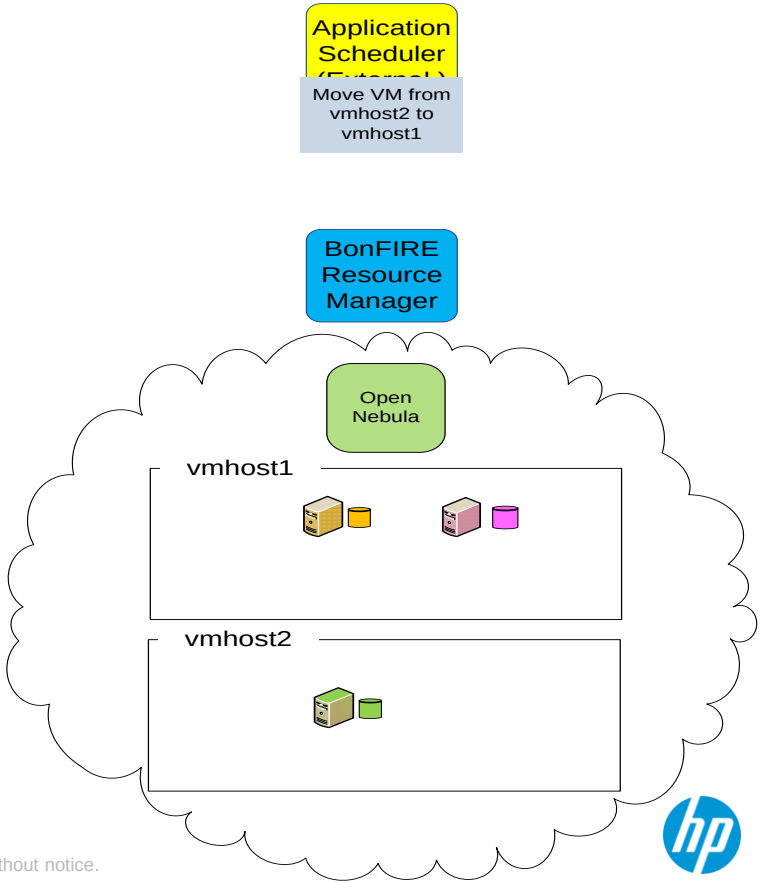
- Move VM from host to host
- Shut down physical hosts for energy saving

Bandwidth on demand services

- As well as being control tool, BoD services can also be used by network-aware applications

Connectivity to Amazon EC2

- Through the portal or our API.



Advanced Features

Ease of Use

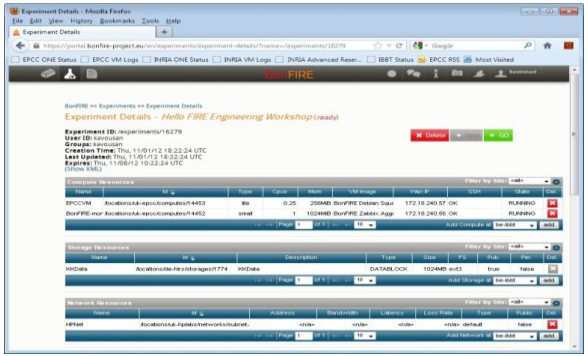
Ease of Use

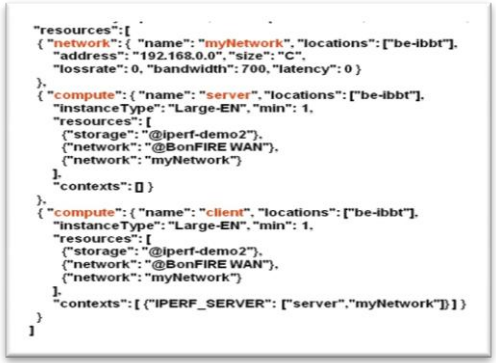
Ease of Use

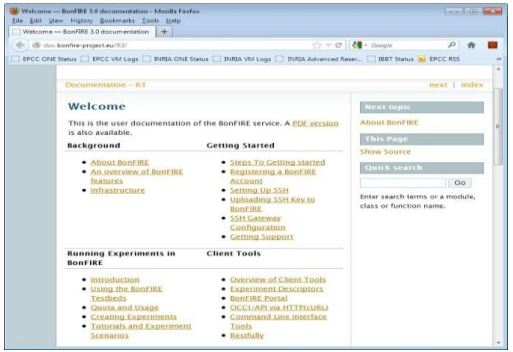
If it’s not easy, it won’t be used

But what is easy?

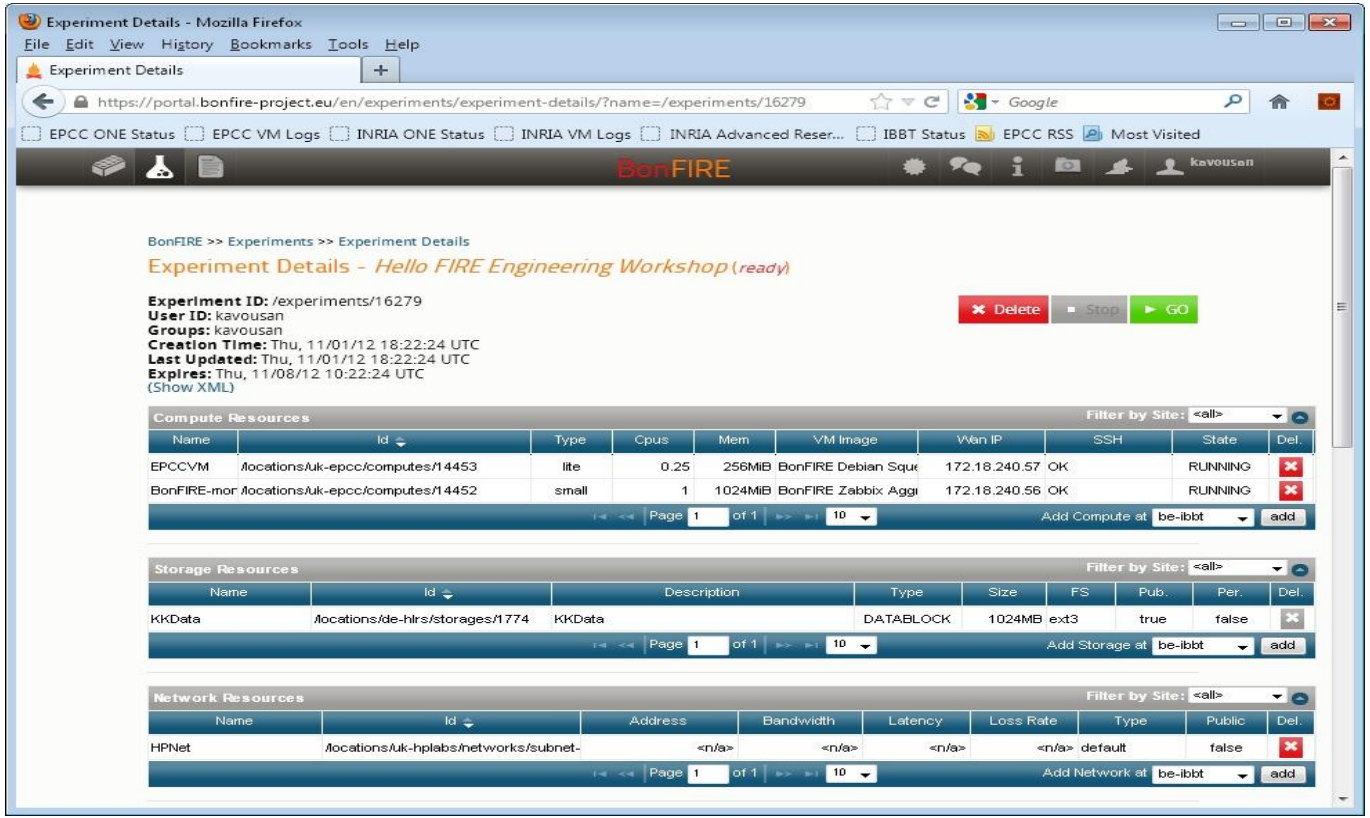
BonFIRE interpretations:







BonFIRE Portal

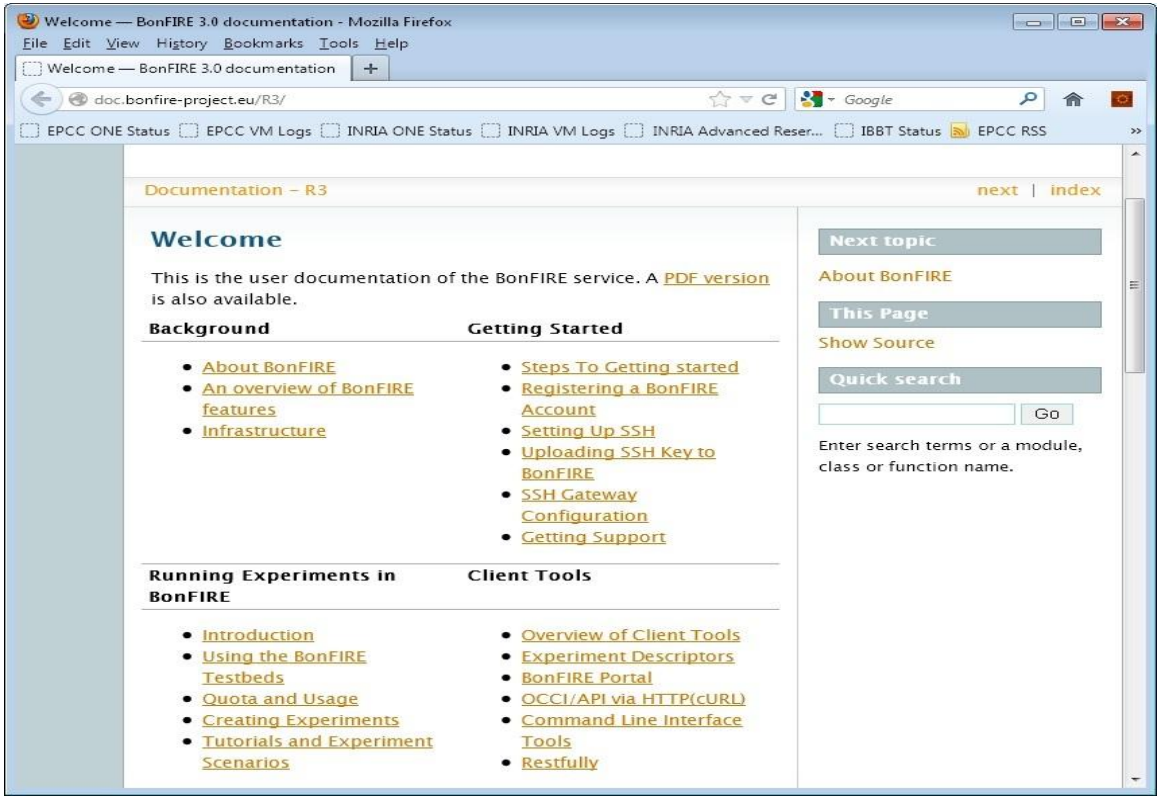


Ease of Use

Experiment Descriptor

```
{
  "name": "myExperiment",  "description": “Controlled Network", "duration": 60,
  "resources": [
   { "network": {  "name": "myNetwork", "locations": ["be-ibbt"],
       "address": "192.168.0.0", "size": "C",
       "lossrate": 0, "bandwidth": 700, "latency": 0 }
   },
   { "compute": { "name": "server", "locations": ["be-ibbt"],
       "instanceType": "Large-EN", "min": 1,
       "resources": [
         {"storage": "@iperf-demo2"},
         {"network": "@BonFIRE WAN"},
         {"network": "myNetwork"}
       ],
       "contexts": [] }
   },
   { "compute": { "name": "client", "locations": ["be-ibbt"],
       "instanceType": "Large-EN", "min": 1,
       "resources": [
         {"storage": "@iperf-demo2"},
         {"network": "@BonFIRE WAN"},
         {"network": "myNetwork"}
       ],
       "contexts": [ {"IPERF_SERVER": ["server","myNetwork"]} ] }
   }
  ]
}
```

295 pages of User Doc



Ease of Use

Effectiveness

Several ways of interacting with BonFIRE:

- Portal
- Experiment descriptor
- Restfully: a client library for RESTful APIs
- Command Line Interface tools: *curl* and *bftools*

```
$ bfcompute create LittleComputeAtHLRS /locations/de-hlrs/storages/2090 21738 -I lite -G m30review
```

```
curl -ki --user ahume --header Content-Type:application/vnd.bonfire+xml
https://api.bonfire-project.eu/experiments/21738/computes -X POST -d'<compute
xmlns="http://api.bonfire-project.eu/doc/schemas/occi">
<name>LittleComputeAtHLRS</name> <groups>m30review</groups>
<instance_type>lite</instance_type> <disk> <storage href="/locations/de-
hlrs/storages/2090"/> <type>OS</type> <target>hda</target> </disk> <nic> <network
href="/locations/de-hlrs/networks/90"/> </nic> <link href="/locations/de-hlrs"
rel="location"/> </compute>
```

Hands on BonFIRE!

Research on BonFIRE

Example experiment categories

Service applications experiments (non-cloud)

Including distributed peer to peer applications

Cloud (or multi-cloud) applications

e.g. cloud bursting scenarios with private and public clouds

Cloud infrastructure experiments

e.g. schedulers on top of BonFIRE, new live-migration strategies, contention minimisation

Application-and-network experiments

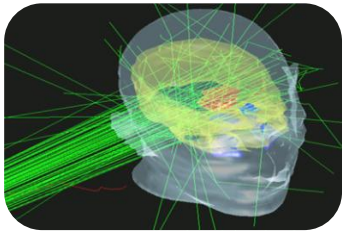
Experimenters configuring network to support applications

Bandwidth on demand

Application-specific routing

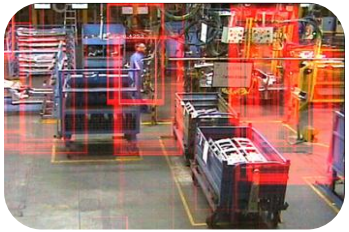
Impact of BonFIRE

Tested radiotherapy cancer treatment service copes well with loss of compute cluster



SMEs validated network boundary conditions under which to market their video-streaming solution

Evaluating if QoS-oriented service management enables real-time computer vision in large-scale industrial environments



Impact of BonFIRE

3+4+5 funded experiments; one commercial Cloud

Two open calls; **50** proposals

Worthwhile research, powered by BonFIRE. E.g.:

- **Media:** two **SMEs**; video-streaming system.
  - Identified the boundaries of their solution.
  - Know the conditions under which they can market it.
  - CityFlow STREP **builds** on these results.
- **eHealth:** Supercomputing centre; service to improve radiotherapy **cancer** treatment.
  - Tested scaling as hospital demand increases
- **Security:** Research centre; security results from **IoS** projects
  - Examine scalability of continuous security monitoring in a heterogeneous cloud infrastructure

Far reaching impact:

- Application Benchmarking, Service Engineering & Optimisation, QoS, Home Automation, Anti-plagiarism, P2P protocols

Free access to BonFIRE

Get free access to the BonFIRE resources

Three simple steps:

1. Visit www.bonfire-project.eu/involved
2. Spend 15 minutes to specify your needs
3. Apply to the BonFIRE Open Access

What you get:

- Cloud resources
  - Up to 50 virtual cores
  - Up to 250 Gb storage
- Advanced emulated network functionality
- BonFIRE's unique monitoring and control features

Summary

Multi-cloud experimentation facility for services community

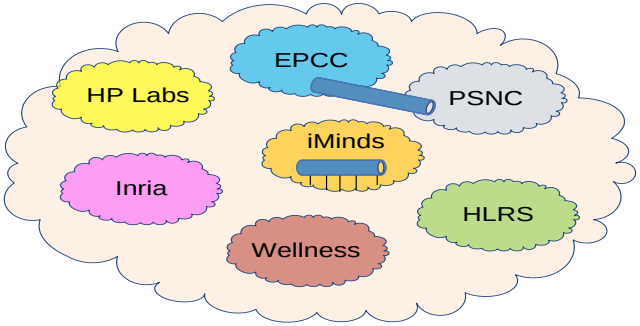
Founded on:

Observability

Control

Advanced Features

Usability



Supports a wide range of experimentation

Open call experiments delivering impact

Open for general use

Acknowledgements

BonFIRE is funded by the European Union Seventh Framework Programme (FP7/2007-2013) under grant agreement numbers 257386 and 287938.

www.bonfire-project.eu

Thank you