BonFIRE: Testbeds for Services Experimentation

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Overview
What is BonFIRE?
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.
Three Scenarios

1. Multi-site clouds connected through normal internet
2. Cloud scenario with emulated network
3. Extended Cloud scenario with controlled network (implies *federation* with network facility)
BonFIRE scenarios and sites

- **Scenario 1** (normal internet)
  - EPCC (Edinburgh)
  - HP (Bristol)
  - INRIA (Rennes)

- **Scenario 2**
  - Emulab (Virtual Wall)
  - Wellness (Sevilla)

- **Scenario 3**
  - GEANT AutoBAHN and Federica
  - PSNC (Poznan)
  - iMinds (Ghent)
  - HLRS (Stuttgart)

Permanent (>450 cores / 45TB) & On-Request (+1,500 cores) infrastructures
What makes BonFIRE?
Four pillars of BonFIRE
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
Infrastructure metrics
Observing inside the cloud

bonfire.epcc.ed.ac.uk

OpenNebula v 2.0.1

Xen Hypervisor v 3.0.3

3.6 TB

vmhost1
128 GB RAM, 48 2.3 MHz cores

vmhost2
128 GB RAM, 48 2.3 MHz cores

OpenNebula event logs

vmhost1 metrics

vmhost2 metrics
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.
Exclusive physical machines and controlled placement

Location: INRIA
Cluster: 34563
Host: p40

Resource Manager
Open Nebula

Give me 3 physical machines from 26/11/12 10:00 to 28/11/12 20:00

Cluster: 34563
P23
P40
P92

INRIA

node1 node2 node3
node5 node6 node7
node8 node9

Cluster: 34563
p23 p40 p92

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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

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**Contention Template 1**

**Contention Template 2**
Supported Experiments

- Exclusive use of physical machine and controlled placement
  - Experiments using external schedulers
Controlled (EMULAB) networks with Virtual Wall

- Network C: Bandwidth: 100 Mbps, Latency: 10ms, Loss rate: 1%, Traffic: 10 Mbps
- Network D: Bandwidth: 1 Gbps, Latency: 100ms, Loss rate: 20%, Traffic: 200 Mbps
- Network A: Bandwidth: 1 Gbps, Latency: 0, Loss rate: 0, Traffic: 200 Mbps
- Network B: Bandwidth: 1 Gbps, Latency: 0, Loss rate: 0, Traffic: 100 Mbps

Last mile client connection

The internet

High bandwidth server connection
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)
FEDERICA interconnection

- FEDERICA deploying NOVI SFA interface

- BonFIRE will soon have:
  - A pair of BonFIRE sites connected to FEDERICA PoPs
  - Access to resources from up to four router-based, FEDERICA PoPs.
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
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
Ease of Use
Ease of Use

• If it’s not easy, it won’t be used

• But what is easy?

• BonFIRE interpretations:
Experiment Descriptor

```json
{
  "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"]} ]  
      }  
    }  
  ]
}
```
Welcome

This is the user documentation of the BonFIRE service. A PDF version is also available.

Background
- About BonFIRE
- An overview of BonFIRE features
- Infrastructure

Getting Started
- Steps To Getting started
- Registering a BonFIRE Account
- Setting Up SSH
- Uploading SSH Key to BonFIRE
- SSH Gateway Configuration
- Getting Support

Running Experiments in BonFIRE
- Introduction
- Using the BonFIRE Testbeds
- Quota and Usage
- Creating Experiments
- Tutorials and Experiment Scenarios

Client Tools
- Overview of Client Tools
- Experiment Descriptors
- BonFIRE Portal
- OCCI/API via HTTP(CURL)
- Command Line Interface Tools
- Restfully

290 pages of User Doc
Building service testbeds on FIRE

Research on BonFIRE
Example experiment categories

1. Service applications experiments (non-cloud)
   - Including distributed peer to peer applications

2. Cloud (or multi-cloud) applications
   - e.g. cloud bursting scenarios with private and public clouds.

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

4. Application-and-network experiments
   - Experimenters configuring network to support applications
   - Bandwidth on demand
   - Application-specific routing

5. What will *you* run on BonFIRE?
Impact

- **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
Summary

- Multi-cloud experimentation facility for services community
- Founded on:
  - Observability
  - Control
  - Advanced Features
  - Usability
- Supports a wide range of experiments
- Open call experiments delivering impact
- Open for general use
Thank you for your attention
Acknowledgements

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www.bonfire-project.eu