Key Facility Features

A multi-site cloud facility for applications, services and systems experimentation

Large-scale heterogeneous and virtualised compute, storage and networking resources

Full control of your resource deployment

In-depth monitoring and logging of infrastructure and application

Advanced cloud and network features including bandwidth on demand and cross site elasticity

Ease of use for experimentation through portal and client tools

About the BonFIRE Project

The **BonFIRE** (Building service testbeds for Future Internet Research and Experimentation) Project is providing a state-of-the art multi-site cloud facility for applications, services and systems research. The facility gives researchers access to large-scale virtualised compute, storage and networking resources with the necessary control and monitoring services for detailed experimentation of their systems and applications. The facility allows the evaluation of cross-cutting effects of converged service and network infrastructures and the assessment of socio-economic impact.

BonFIRE is about trusted partnership and collaboration: BonFIRE brings together experimenters and test bed providers working on innovative service technologies. The BonFIRE consortium consists of leading service providers and cloud technologists who will work in consultation with users of the facility to ensure strong experiment hypothesis, design and execution

BonFIRE is about state-of-the-art cloud technologies: BonFIRE does not replace current public cloud offerings but does offer something different. BonFIRE provide experiments access to heterogeneous cloud resources with advanced low-level control and monitoring APIs and the ability to scale beyond current research project testbeds. In addition, the experimental process is supported by tools that ensure results are verifiable and reproducible.

BonFIRE is about efficiency: The BonFIRE project reduces costs allowing researchers to achieve more by focusing on innovation rather than testbed operations.

BonFIRE experiments

BonFIRE has funded experiments selected through two open calls (€1,34M) in March 2011 and 2012. The public case studies highlight the challenges and results of each experiment, and the added value of the BonFIRE facility.

Open Access

From November 2012 you can apply for open access to the BonFIRE infrastructure. Each request for access is evaluated on a case-by-case basis considering business, infrastructure, quality and coverage impact criteria. Please contact bonfire@bonfire-project.eu for more information

The research leading to these results has received funding from the European Commission's Seventh Framework Programme (FP7/2007-2013)

SEVENTH FRAMEWORK PROGRAMME

Contact information

Project contact

Josep Martrat
Atos Spain
Av. Diagonal 200
08018 Barcelona (Spain)

Tel: +34 93 486 1818
Fax: +34 93 486 0766

bonfire@bonfire-project.eu

Experiment contact information

- Dr. Cesar Marin
  cesar.marin@manchester.ac.uk
- Dr. Usman Wajid
  usman.wajid@manchester.ac.uk
- Prof. Nikolay Mehandjiev
  n.mehandjiev@manchester.ac.uk

Experiment case study

BonFIRE

Testing Optimization in Service Ecosystems

Organisation:

Manchester Centre for Service Research – The University of Manchester

Industry:

Research and higher education

Number of employees:

10,000 employees (approx.) + 40,000 students (approx.) at university level

Challenge

- Generate Service Ecosystems as a valid scenario of the Future Internet using existing multi-site Cloud facilities
- Validate current technology on service composition optimisation for Service Ecosystems

Solution

- BonFIRE allows us to emulate Service Ecosystems by geographically distributing components and services
- BonFIRE provides resources on demand thus creating the dynamism of a Service Ecosystem

Testing Optimization in Service Ecosystems

The challenge

The Manchester Centre for Service Research (MCSR) investigates the creation of innovative services resulting from fruitful interactions between technology, organizations and people. Our academics are specialists in each of these three areas, and work together in multi-disciplinary teams, focusing on three key research themes: service innovation, service networks and relationships, and service design.

The main focus of service design is to identify service structure and components so that they can be changed and managed to satisfy specific requirements. Yet, service design is a challenge because today's services interact and integrate with other systems, including people, products, businesses, economics, social systems, political systems, and IT systems.

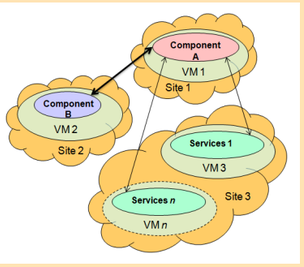
The rapid developments in Internet technologies and the popularity of service-oriented architectures (SOA) have not only changed the perception of services but in effect also changed the way in which services are offered and consumed. Moreover, the proliferation of different types of services and the proposition of Internet as a service delivery mechanism have allowed the emergence of Service Ecosystems. A service ecosystem is a dynamic virtual space inhabited by digital entities (for example, software agents, Web services, components, etc.) offering, composing and consuming services, distributed across networks and geographical areas. In other terms, a service ecosystem is an open environment where services appear, disappear and change their properties at any time with no warning.

"The Internet of Things (IoT) is a clear example of a service ecosystem," says Dr. Cesar Marin, a senior computer scientist and expert in service ecosystems at MCSR. "Yet with the vast number of devices and services expected to exist in the IoT, how are we going to find and compose services for our individual and specific needs? Do we have the technology to cope with such dynamism?"

While trying to answer such questions, the challenge was to generate a service ecosystem using existing technology, permitting 1) components to be geographically distributed, 2) large amounts of services, and 3) dynamism as in an open environment. Once a service ecosystem was created, service composition had to be carried out in order to validate current technology on service composition optimization under service ecosystem conditions.

"We were looking for a multi-site Cloud facility which enabled us to use resources on demand and in locations specified by us at runtime in order to create the dynamism of a service ecosystem."

Dr. Usman Wajid
Researcher in service systems
MCSR



Components distribution on BonFIRE

"From the beginning we suspected there were limitations in our technology, but in our lab experiments we could not see them. Thanks to BonFIRE we are now able to see them and concentrate our effort on future improvements."

Prof. John Keane
Expert in high performance and parallel computing
MCSR

The solution

"We were looking for a multi-site Cloud facility that can enable us to use computational resources on demand and at distributed locations at runtime in order to create the dynamism of a service ecosystem," says Dr. Usman Wajid, an experienced researcher in service systems at MCSR. "In the end it is not just finding the facility with such capability, but also finding one that allows you to easily monitor what is going on in the virtual machines where your application is deployed."

After careful consideration, MCSR chose BonFIRE as a facility for creating service ecosystems and testing service composition optimization technologies. BonFIRE comprises a number of federated Cloud sites distributed across Europe. Using BonFIRE allowed MCSR to deploy various components of their service composition optimizers on geographically distributed sites and use on demand computational resources according to different experimental configurations.

The diverse number and types of virtual machine available at BonFIRE provides the chance to stress the capabilities of optimizer components in terms of memory consumption and processing power. This permitted the creation and testing service ecosystem properties with thousands of services.

Furthermore, to create dynamism in a service ecosystem MCSR needed a mechanism to create and use computational resources (or virtual machines) at runtime. In this respect, the capability of BonFIRE to support spawning virtual machines on specified locations at runtime provided useful. This allows experimenters to add resources to running experiments in a dynamic manner. Since network communication in BonFIRE is set up automatically and seamlessly across sites, this enabled MCSR to create the dynamism necessary to emulate a service ecosystem.

The service composition optimisation approaches develped at MCSR can be characterised as global optimisation and local optimisation. The first one, SOA4All optimiser, developed within the EC-funded project SOA4All (http://www.soa4all.eu), computes the optimisation of a service composition by analysing end-to-end interactions between services taking into account their quality of service. In contrast, the second optimisation model called DAEM (Dynamic Agent-based Ecosystem Model) is able to compute local optimisations of service compositions by allowing one-to-one interactions between any service provider and any consumer to create emergent service chains providing composite services that are resilient to changes.

Testing these novel service composition optimisation approaches in near real services ecosystems is a decisive step towards determining whether current technology is ready for the Future Internet. This is only possible thanks to the capabilities offered by BonFIRE.

Results

Experiments on a number of service ecosystem configurations and scenarios using BonFIRE allowed the validation and characterization of MCSR's service composition optimization approaches. "We noticed that SOA4All optimizer is faster and more scalable than its local optimization counterpart" says Dr. Wajid. "SOA4All also works better when the service ecosystem is set up in one single Cloud site rather than distributed in multiple sites."

"However, DAEM optimizer's solutions are more stable and resilient to changes in the service ecosystem than SOA4All" indicates Dr. Marin. "In addition, DAEM functions faster when the service ecosystem is distributed across multiple Cloud sites, contrasting with SOA4All."

The latter result came as a surprise to the MCSR team since usually distributed systems tend to have an additional overhead due to communication over a network. "DAEM, from its conception, operates under natural ecosystem principles which allow it to evolve at different paces depending on the actual distribution" explains Dr. Marin, also creator of DAEM. "As a result, the more distribution of components the faster it is."

Finally, limitations on these service composition optimization approaches were found indicating necessary improvements. "From the beginning we suspected there were limitations in our technology, but in our lab experiments we could not see them" says Prof. John Keane, expert in high performance and parallel computing. "Thanks to BonFIRE we are now able to identify them and try to concentrate our efforts on future improvements."

BonFIRE has allowed the creation of service ecosystems, an expected scenario in the Future Internet. Experiments on service composition have allowed MCSR to identify strengths and weaknesses on current technology. The question is can we cope with the dynamism of a service ecosystem using current technology? The answer is yes but to a certain extent. "Definitely more research and development need to be done on service ecosystems, but in our current stage nothing stops us from applying our optimizers in other domains" indicates Prof. Nikolay Mehandjiev, head of the service design group.

Added value of using BonFIRE

"An important aspect of our tests was to evaluate BonFIRE in a Future Internet scenario. Based on our results we can report that the provision of multi-site computational facilities, user friendly interfaces and the availability of easy to use monitoring mechanisms make BonFIRE a suitable testbed for Future Internet technologies" says Dr. Wajid.

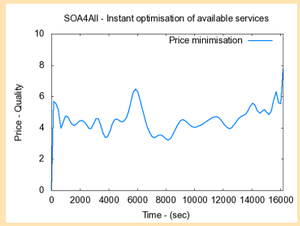
"And the standard of support we received from BonFIRE was outstanding"; adds Dr. Marin, "I think it is quite important for any experimentation-based study to get proper support from the testbed and that is a big plus for using BonFIRE".

Next steps

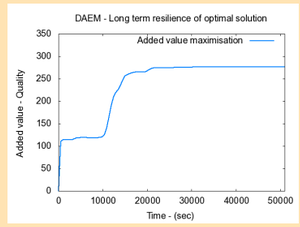
The nature of MCSR findings allows them to make recommendations about the suitablity and use of an optimiser in different application domains. For example, SOA4All optimiser can be used in situations where a) an instant optimised service composition is required such as holiday booking application involving services from airlines, hotels, car hire, travel insurers, etc.; b) the service composition involving huge number of services, for example financial applications that bring together huge number of services to draw a business decision.

On the other hand, DAEM can be used in situations where optimised solutions must be resilient to changes and are constantly required such as in traffic control centres, manufacturing plants and business ecosystems. Moreover, DAEM is faster when using resouces/services deployed across various (geographical) locations.

In future we are interested in conducting research on how factors such as sustainability and privacy can be taken into account when developing dynamic service composition and optimization in future internet scenarios, therefore raising significantly the complexity of the distributed optimization problem addressed currently by the optimization approaches.



SOA4All is faster than DAEM



DAEM is more resilient to changes than SOA4All

MANCHESTER 1824
The University of Manchester