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D10.3 – Report on second open call and SME experiments

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Abstract	This deliverable represents a collection of individual deliverables provided by the Fed4FIRE experimenters, joined the project after the 2nd Open Call for Innovative experiments: CloudCONFetti, FCD-Scal+, HyCEP, MaSTeR, MH-ScaE2, SILVERWoLF, EVIDENCE, MyFIRE, and ENGAGE-F4F. Furthermore, the document includes reports from experiments performed through the specific SME Open Calls; from Call: 2 AGROFIRE, SAFE, TUNeR, U-M-SHOP and from Call 3: KeMSE, LIVEstats-on-FIRE, Polytest, VPrimeNet.
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	P	Prototype	
	D	Demonstrator	
	O	Other	
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	PP	Restricted to other programme participants (including the Commission)	
	RE	Restricted to a group specified by the consortium (including the Commission)	
	CO	Confidential, only for members of the consortium (including the Commission)	

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Contents

1 Introduction

This deliverable represents a collection of individual deliverables provided by the Fed4FIRE experimenters, who joined the project after its 2nd Open Call for Experimenters, which was open and concluded in 2014, so that the following experiments formally joined the project in December 2014:

- CloudCONFetti
  - Partner: PSNC
  - Used testbeds: PlanetLab Europe, w-iLab.t, and FuSeCo
- FCD-Scal+
  - Partner: Be-Mobile
  - Used testbeds: Virtual Wall
- HyCEP
  - Partner: Nissatech
  - Used testbeds: BonFIRE
- MaSTeR
  - Partner: Liblog
  - Used testbeds: BonFIRE
- MH-ScaE2
  - Partner: TelTek
  - Used testbeds: BonFIRE, PlanetLab and Virtual Wall
- SILVERWoLF
  - Partner: Televic
  - Used testbeds: Virtual Wall and Emulab
- EVIDENCE
  - Partner: CNIT
  - Used testbeds: Virtual Wall
- MyFIRE
  - Partner: Create Net
  - Used testbeds: i2cat and Virtual Wall
- ENGAGE-F4F
  - Partner: SSSA
  - Used testbeds: Ultra Access and Virtual Wall

The following experiments have been performed in the scope of 2nd Open Call for SME experimenters:

- AGROFIRE
  - Partner: AGROESTUDIO
  - Used testbeds: Virtual Wall, PlanetLab, BonFIRE, BonFIRE Virtual Wall
- SAFE
  - Partner: RedZinc Services Limited
  - Used testbeds: Virtual Wall, FuSeCo, and PerformLTE
- TUNeR
  - Partner: InnoRoute GmbH
  - Used testbeds: Virtual Wall and FuSeCo

- U-M-SHOP
  - Partner: EUROB CREATIVE SLNE
  - Used testbeds: Smart Santander and BonFIRE

The following experiments have been performed in the scope of 3rd Open Call for SME experimenters:

- KeMSE
  - Partner: Invenia AS
  - Used testbeds: Virtual Wall
- LIVEstats-on-FIRE
  - Partner: Planet Media Studios S.L
  - Used testbeds: Virtual Wall, NITOS and w-iLab.t
- Polytest
  - Partner: Talaia Networks, S.L.
  - Used testbeds: Virtual Wall and OFELIA (both Bristol and i2CAT islands)
- VPrimeNet
  - Partner: Incelligent
  - Used testbeds: NETMODE

Within the Fed4FIRE WP10, specific project tasks and activities have been created for each of the experiments, which included the following phases:

1. Detailed design of the experiments
2. Experiment setup and implementation within the Fed4FIRE testing environment, by using the Fed4FIRE testbeds and tools
3. Experiment execution and validation

Reporting on the related activities in WP10 has been performed individually for each of the experiments and the related deliverables are provided as annexes of this document as separated deliverables. Brief summaries of main objectives of the experiments are provided below.

2 Brief Descriptions of Experiments from 2nd Open Call for additional project partners

2.1 CloudCONFetti - Algorithms for intelligent routing of multimedia streams by a distributed bridge in high quality videoconferencing

The main objective of the CloudCONFetti experiment was to extend the high definition (HD) videoconferencing platform developed with the participation of Poznań Supercomputing and Networking Center (PSNC) with innovative Future Internet functionality and evaluate the resulting system using testbeds gathered in the Fed4FIRE community. Besides answering questions about various aspects of the system's performance, running those tests produced feedback concerning the usefulness of the Fed4FIRE architecture and the utilised research facilities.

The videoconferencing solution adopted for the CloudCONFetti experiment was based on HDVIPER, an open and scalable HD videoconferencing platform equipped with functionality linked to telemedicine as well as augmented reality and stereoscopic (3D) video. The CloudCONFetti experiment aimed to implement and research the innovative feature of intelligent routing of videoconferencing streams using a set of distributed packet reflectors. The system resulting from this addition to the HDVIPER project was evaluated in three testbeds gathered in the Fed4FIRE community.

The experiment has been performed by PSNC, where PlanetLab Europe, w-iLab.t, and FuSeCo testbeds have been used.

2.2 FCD-Scal+

With this experiment, Be-Mobile was given the unique opportunity to evaluate the performance of two of its solutions under controlled but realistic conditions.

The first solution is a key component of our production services: the SmartMove Traffic platform. It transforms raw location samples provided by connected vehicles into rich traffic information. In this part of the FCD-Scale+ experiment, it was investigated how the service provided by the this platform can be improved from a scalability point of view, both in terms over covering larger geographical areas and in terms of covering new applications that require processing the data of more vehicles in the same area. Several instances of the platform were deployed on the Virtual Wall, each adopting a different load balancing strategy: current approach, geographical load balancing, load balancing on the vehicle ID, and hybrid load balancing. Delay characteristics towards the location of our mostly used data centres were mapped using PlanetLab Europe, but their relevance was questioned because Be-Mobile cannot make use of the Geant network for its production services. Actual real-time data for the Turkish area was forwarded to the Virtual Wall instances, and through detailed monitoring of the most important service KPI's we were able to determine that it is more beneficial to load balance based on vehicle ID than on geographical basis, because this leads to a more even spread of the load between the different worker nodes. However, from a traffic scientist point of view, this requires more intelligence to combine the output of the results of both workers into a single traffic state estimation. This lesson learned allows us to vastly improve the performance of this critical technical component.

The second solution was a prototype middleware component that allows geo-broadcasting of connected vehicle data over an IP-based cellular network. It is called a Geo-Messaging Service, or GMS. Originally our intention was to evaluate the performance of our Local Dynamic Map (LDM) implementation in the second part of the FCD-Scale+ experiment. However, the relevance of the LDM

had strongly decreased from a business point of view by the time we were ready to start the experiment. Therefore we decided to actually evaluate its successor (the GMS), which also facilitates vehicle-to-vehicle and vehicle-to-infrastructure communication in the context of cooperative ITS systems. But that successor relies on a cellular networks as the wireless medium, instead of IEEE 802.11p technology.

The experiment has been performed by Be-Mobile, where the Virtual Wall testbed has been used.

2.3 HyCEP - Framework for Developing Highly Distributed Dynamic Complex Event Processing for real-time Future Internet Scenarios

The MCA2 (MyCardioAdvisor2) system is designed to handle a wide range of resources related to patients' health record and lifestyle, accompanied with security and privacy features. It belongs to the next generation of mHealth systems which support proactive management of diseases through remote real-time monitoring of a patient health status. In order to make the system widely applicable we defined component-based architecture consisting of the advanced FrontEnd and complex BackEnd, whose validation was become a challenge. Indeed, a flexible Backend system has a lot of "moving parts" that are configured and setup independently. Another challenge is the nature of the application since it works with big (personal) data and it is designed to support thousands of patients in one hospital. This is where systematic testing plays a significant role, verifying the robustness and usability of a complex structure. MCA2 works with three different kinds of data: high-frequency sampled, low-frequency periodic and low to medium frequency aperiodic data. The three data types are handled in a CQRS/ES1 architecture with three different pipelines and different destinations, with respect to their nature. Very importantly, the Backend should be able to support a larger number of clients, since it is deployed as a SaaS.

The most interesting issues addressed by the experiment:

- Which parts of the systems are under biggest load and we expect them to need to scale first;
- Baseline performance and maximum supported clients with a certain resource pool proven with a stress test;
- Behaviour under overload;
- Fail-safety in case of node/communication malfunction.

The experiment has been performed by Nissatech, where BonFIRE testbed has been used.

2.4 MaSTeR - Test of a Cloud App Marketplace Scalability&Robustness on Fed4FIRE cloud computing testbed

The objective of MaSTeR (Test of a Cloud App Marketplace Scalability&Robustness on Fed4FIRE cloud computing testbed) is to exploit the IaaS resources of the Fed4FIRE cloud testbed (compute, storage, networking) to execute authoritative performance measurements and service experiments for a new cloud product developed during two R&D projects, ClouDesire.

ClouDesire is a two-sided cloud marketplace, whose aim is to solve the cloud-related technological issues, faced especially by small and mid-sized software companies, while streamlining their Go-To-Market on the supply side. It does not require any coding or modification to the applications, and ensures the full portability between several cloud providers. The platform supports the full life cycle of SaaS-ification, from setting up a private store-front for any software application, to deploying applications on any cloud provider, up to selling and distributing them as-a-service, with integrated upgrading/patching, monitoring, and billing tools.

The experiment has been performed by Liblog, where Virtual Wall, Inria, EPCC, and BonFIRE testbed have been used.

2.5 MH-ScaE2 - Automated lectures recording Matterhorn platform scalability experimentation

The provision of automated lecture recording services based on Opencast-Matterhorn (OC-MH) platform over the cloud instead of the traditional deployment at campuses requires an analysis of the advantages (and complexities) that this model might introduce regarding to:

- Elasticity of the system: reducing resources (thus reducing costs when the resources are not required) or, on the other side, increasing the resources provided to satisfy specific customer demands.
- Scalability of the system and access to the service: Better scale when the number of customers increase and also to provide better access to the service to users worldwide.

For this experiment, two optimizations of the OpenCast-MatterHorn/Galicaster automated lecture recording system have been deployed in order to obtain higher scalability and reduction of costs when the number of recording clients grow and are geographically distributed.

- Optimisation 1. Elastic worker nodes provisioning system optimisation
- Optimisation 2. Storage system optimisation

The experiment has been performed by TelTek, where BonFIRE and Virtual Wall testbeds have been used.

2.6 SILVERWoLF - iSync Integral VERification With Large Fleets

Train to wayside (ground) communication becomes more and more available for train operators and related companies like train constructors (e.g. Bombardier, Siemens) and integrators (e.g. Televic Rail). Main focus for companies in the rail market is often recapitulated by the four C's. They represent Customer focus, Carbon reduction (green train), Capacity improvement and Cost optimization. For all these goals, more and more applications are being installed on board trains and other means of public transport. Each of these applications has a software counterpart on the wayside. These two ends need to have a robust and reliable communication path in order to exchange data over an inherently 'unreliable' wireless interconnection made available by the aggregation of cellular network technologies, WiFi, WIMAX, satellite communication or others. On the layer above, a scalable and robust provisioning system is required to keep the fleet up to date at all times with regards to software versions of on board systems. These versioned components include executable code, configurations and content.

During the project, scalability tests are executed with the application with a large amount of trains (each managing a lot of software components). In order to investigate the stability of the application failure modes , effects and mitigations have been identified. The foreseen automated mitigation scenarios can only be properly tested if the test setup approximates reality as close as possible. A last, though very important goal is to prove the robustness of the framework when addressing a large fleet and understand the requirements. This is important for Televic Rail as a stable, reliable framework will help us to roll out non-traditional business models (e.g. services towards rail operators).

The experiment has been performed by Televic, where Virtual Wall and Emulab testbeds have been used.

2.7 EVIDENCE - Validating Traffic EngineerIng in OpenFlow Data CEnter Networks for Cloud service deploymEnts

The goal of EVIDENCE has been the comprehensive performance evaluation of innovative traffic engineering solutions for Cloud DC interconnections offered by the OpenFlow-based Virtualizationaware Networking (OFVN) platform. The integrated management of VMs and network resources is performed by OFVN that is able to arrange VMs across servers taking also into account the actual traffic load across DC interconnection links, which is estimated using OF statistics from switches at both per-port and per-flow level. As result, the OFVN platform presents innovative capabilities to achieve optimal operation of VMs in Cloud DCs while addressing a cloud-fluent networking model for a streamlined data flow exchanges among VMs across DC interconnections. The large-scale SDNenabled cloud environment offered by Fed4Fire facilities allowed for experiments to be carried out to assess all aspects of the system, i.e., resource selection heuristics, actual supported load in dynamic scenario, and, especially, its readiness for an operative implementation in real environments. Indeed, cloud services deployment and traffic engineering solutions for DC networks have been validated in terms of balanced network bandwidth usage, network delay, service response time, scalability. More specifically, the proposed orchestration approach allows optimizing allocations while preventing congestion issues and, consequently minimizing possible degradations of user experience. Results show that our approach is highly promising since the resources utilization is improved while limiting the rejection rate is low and significantly reducing the risk of service quality degradation. Moreover, a preliminary analysis to investigate the impact of the estimation parameters on the system performance has been carried out, so as to derive design guidelines for our orchestrator. In this regard, a tradeoff needs to be found between accuracy and overhead.

The experiment has been performed by CNIT, where Virtual Wall testbed has been used.

2.8 MyFIRE - Providing Performance Isolation in Multi-Tenants-centers

Network virtualization sits firmly on the Internet evolutionary path allowing researchers to experiment with novel clean–slate designs over the production network and practitioners to manage multi–tenants infrastructures in a flexible and scalable manner. In such scenarios, isolation between virtual networks is often intended as purely logical: this is the case of address space isolation or flow space isolation. Logical isolation neglects the effect that network virtualization has on resource allocation network–wide.

In this experiment we had two objectives: on the one hand, we aimed at demonstrating the fundamental limitations of current network virtualization techniques in realistic setting by leveraging on a physical infrastructure. On the other hand, we aimed at providing an effective and efficient performance isolation solution for virtualized multi-tenants facilities. It is worth noticing that the proposed solution allows users of a Fed4FIRE-like facility to have a virtual networking infrastructure that is isolated at the logical and performance level from the other tenants. From the academic standpoint this allows for reproducible experiments.

The experiment has been performed by Create Net, where OpenFlow OFELIA and Virtual Wall testbeds have been used.

2.9 ENGAGE-F4F - Evaluating Next Generation optical Access enerGy Efficiency using Fed4FIRE

Although Passive Optical Networks (PONs) have the potentials to reduce the energy consumption per bit of the current copper-based access technologies they are expected to be responsible for a significant part of the wired communication network energy consumption yet (more than 60%), because of the large number of deployed Customer Premises Equipments (CPEs) and the low bandwidth utilization.

Providing broadband access at low-energy consumption is one of the objectives of the European Community. Mechanisms to reduce the energy consumption are being considered by international standardization bodies (e.g., ITU-T and IEEE) and proposed by several researchers worldwide for both current generation (e.g., 10-Gigabit-capable PON (XG-PON)) and next generation passive optical networks (e.g., Next Generation PON 2 (NG-PON2)).

The objective of the experiment was to evaluate the impact of next generation optical access network (NGOA) energy efficient schemes on metro-access network performance.

The experiment has been performed by SSSA, where Ultra Access and Virtual Wall testbeds have been used.

3 Brief Descriptions of Experiments from 2nd Open Call for SMEs

3.1 AGROFIRE - AGRiculture web service implementation On FIRE infrastructures

The agro-food sector presents one of the largest manufacturing industries in Europe; food and drink industry generated an annual turnover of €956Bbn in 2010. The field is considered a key element in the European Research Map. Nevertheless, the agro-food sector presents critical challenges to be overcome. Agricultural producers are extremely disperse and due to the European diversity, farms and crops are subdue to local conditions and languages. New information and communication technologies appeared in the field providing information to help the agricultural producers cultivate with efficiency. However, the demand of services in the field is increasing and it becomes difficult to access to all the users in a locally and specific fashion. This is the case of applications and services oriented to precision agriculture, where massive aerial images have to be processed to extract quantitative information on the quality of the crops in a growing and demanding sector.

The AGROFIRE experiment consists of testing in a cloud computing infrastructure, real-time and on-demand processing of aerial images (usually taken by planes, helicopters, satellites and by UAVs experimentally) to create Vegetation Index maps for the agricultural sector. The processing is based on the extraction of the NDVI vegetation index. This index provides information about the health of the crops, allowing the farmers to apply the correct actions and practices over each spot of its cultivated area. The processed images are on demand distributed through an Internet web service.

The experiment has been performed by AGROESTUDIO, where Virtual Wall, PlanetLab Europe, and EPCC testbeds have been used.

3.2 SAFE - An experiment with priority video traffic from first responders in a public safety use case

The SAFE experiment is motivated to study video performance in a scenario where immersive wearable live video assists first responders in public safety applications such as ambulance paramedic attending to patient. During the ‘golden hour’ after the incident pre-hospital actions taken are crucial and potentially life saving. “Eyes on’ live video from the first responder to the hospital or command center can help make more rapid decision (e.g. quick delivery of clot busting drugs).

In this experiment we evaluated the performance in the PerformLTE testbed in Malaga using Agilent radio emulation equipment and an EPC emulator from Polaris. We integrated our VPS (virtual path slice) engine to the evolved packet core control plane and wearable video solution to the LTE data plane and conducted two experiments related in video performance and quality.

The experiment has been performed by RedZinc Services Limited, where Virtual Wall, FuSeCo, and PerformLTE testbeds have been used.

3.3 TUNeR – Tuning User-driven Network Reprovisioning

In the TUNeR experiments, InnoRoute has investigated techniques in user-defined networking by characterizing quality of experience, with particular focus on latency, in relation to steered data traffic characteristics when users are empowered to reprovision the network, i.e. to dynamically reallocate capacities and throughputs by whatever control is available in the network and feasible to be exposed to users, like queue sizes, priorities or traffic shapers.

The motivation behind this goal has been to offer a technology which enables users to enjoy the benefits of service differentiation:

- without mutual interference,
- without demanding from providers a continuous process for adapting provisioning to individual demands and
- without demanding them to incur in violations of the principles of net neutrality.

The experiment has been performed by InnoRoute GmbH, where Virtual Wall and FuSeCo testbeds have been used.

3.4 U-M-SHOP – Urban M-SHOP

Urban M-SHOP (U-M-SHOP) experiment was conceived to incorporate IoT information to our MSHOP solution, which is a module for e-commerce platforms that permits geolocalized offers to smartphone users taking into account its current position and historical data. Thanks to FED4FIRE
Experiment we have been able to incorporate real time IoT sensor data into our recommendation algorithm.
The experiment has been carried out using SmartSantander and BonFIRE testbeds and has consisted of:

1. Setting up SmartSantander testbed: Accessing, subscribing and receiving information from sensors. The different city sensors have been assembled in a variable dynamic grid for the city in order to determine the best grouping of sensors for detecting events.
2. For each grid unit the information has been aggregated and mashed up in a number of states. It has allowed extracting specific status of each reticula in which the city has been divided.
3. All related operation for the sensors information processing: subscription, mashup and event detection has been carried out from an instance running from BonFIRE testbed. This cloud instance has allowed to extract additional features through analyzing historical and statistical data. This architecture would allow us also to validate potential cross scenarios in case we had several cities with sensors providing data and also its integration into heterogeneous clouds.
4. All this information has been fed to our M-SHOP server and introduced into our recommendation algorithm in order to validate the impact.
5. Finally the user has received in its smartphone the specific information for its profile and taking into account not only its actual position but also the environmental status surrounding him/her.

The experiment has included both virtualized stress tests and field trials in order to validate the system response in extreme conditions and in real usage.
The experiment has been performed by EUROB CREATIVE SLNE, where Smart Santander and EPCC testbeds have been used.

4 Brief Descriptions of Experiments from 3rd Open Call for SMEs

4.1 KeMSE – Key Management Scalability Experiment

Invenia AS is a Norwegian SME developing end-to-end encryption technology for cloud computing. We have developed a flexible and secure platform for the exchange of encryption keys in the cloud. The platform hides all complexity surrounding key management and forms the basis for simple and strong end-to-end encryption.

We designed a series of tests that would add users and files to a data share across as many test nodes as we could get our hands on. By gradually building up the amount of users and files, and recording the time it took to perform encryption operations, we hoped to be able to see a trend and uncover any scalability issues.

The experiment has been performed by Invenia AS, where Virtual Wall testbed has been used.

4.2 LIVEstats-on-FIRE - LIVEstats platform experimentation Over Fed4FIRE NITOS testbed

The experiment aimed to assess the performance of an innovative cloud-based platform for the provision of enhanced 3D interactive content during a sports event in an outdoor scenario as if it was a real Stadium, taking advantage of NITOS testbed wireless infrastructure. We wanted to overcome the difficulties of testing the provision of this content using wireless technologies to hundreds of spectators on their devices at the same time.

All of them explored the performance of the platform over NITOS with the following by:

1. Specifying the relationship among the characteristics and number of nodes of the network and the number of spectators that could be able to enjoy the service with a suitable Quality of Service.
2. Analysing the factors and characteristics of the infrastructure that are critical for the streaming experience, this is, which features make the difference about the number of spectators accepted by the system.
3. Defining the relation among the topology of the network and the Quality of service offered. Results will guide us to adapt the network distribution configuration to a specific stadium.

The experiment has been performed by Planet Media Studios S.L, where Virtual Wall and w-iLab.t testbeds have been used.

4.3 Polytest - Experimentation with Network Polygraph in the Fed4FIRE testbed

SDN is an emerging, disruptive networking paradigm that allows software components to extend the network core functionalities. SDN opens an opportunity to overcome the limitations of current network visibility solutions. We consider the confluence of SDN and network visibility a huge business opportunity. The market of network visibility is currently estimated at around 2.4B EUR with a yearly growth of 11%, but SDN is expected to outgrow it by a factor of 10 in 2018.

Talaia Networks developed a Minimum Viable Product (MVP) with SDN support based on Network Polygraph. However, the new product was only tested using network emulators (e.g., Mininet). We faced an important limitation given the lack of actual equipment and testbeds that incorporate the required technologies to evaluate our product. Evaluation in real environments is an important step before releasing our MVP, because it allow us to evaluate it under real conditions, measure its actual

performance, check its compatibility with real hardware, and test it in different environments and technologies, even over different domains and SDN controllers.
The experiment has been performed by Talaia Networks, S.L., where Virtual Wall and OFELIA (both Bristol and i2CAT islands) testbeds have been used.

4.4 VPrimeNet

The Incelligent Simulator is a piece of software that simulates Mobile and Wi-Fi Networks (LTE and 802.11b/g/a/n/ac protocols) and it is used as an aid in designing, planning, expanding and debugging cellular and Wi-Fi networks. The IncelliSIM may be used and as a network emulator/simulator by the IncelliMS. The IncelliMS can then apply management actions and measure their effectiveness. This way we can evaluate Self Organizing Network SON functions across many different setups and network usage scenarios.
Our initial plan, described in our experiment proposal to the Fed4FIRE consortium, was to study Wi-Fi traffic generated by the NTUA students and develop SON functions fit for the WLAN usage of the future. However, the NETMODE Wi-Fi testbed does not accommodate user traffic. Since, we could not study and act on real traffic, we decided to improve the Incelligent Wi-Fi Simulator. With the Wi-Fi Simulator/Emulator we can develop and evaluate SON functions based on traffic models for which we have data e.g. an office or an airport. We are planning to get data from University Campuses and schools so we can study traffic models seen in WLANs used by young users. We decided to use some of our time in the testbed to experiment with WIDS/WIPS designs. A WID/WIP system will add value to our software suite. Access to the NETMODE Wi-Fi testbed is a good opportunity to experiment with WIDS/WIPS designs.
The experiment has been performed by Incelligent, where NETMODE testbed has been used.