1.1.1 WP 4: Cloud Hosting

Once the deadline for contributions is long passed this document was ported to the draft version of the 3rd Yearly report that will be kept in word format for now on.

The snapshot was taken on March, 26 and this document is closed for edition now.

If you need a copy the current 3rd Report or need to ask for changes, please contact Telefónica adding these 3 people to the loop:

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1. Progress towards objectives and details for each task

WP Objectives:

The main goal of WP4, led by IBM, is to provide computational, storage and network resources that can be easily accessed and consumed by Future Internet service providers. A wide range of hosting capabilities will be provided, ranging from individual resources to complex service configurations, and from resources allocated from a centralized pool within a data center to resources at the edge of the cloud, close to the users.

The reference implementation of the FIWARE Cloud developed in WP4 is heavily relying on OpenStack and OpenDaylight open source code, aiming at increased levels of sustainability (compared to proprietary code solely maintained by a single vendor).

WP tasks and interrelations:

WP4 is led by IBM-IL and consists on task 4.1 led by Intel, task 4.2 led by IBM-IL, task 4.3 led by Technicolor, task 4.4 led by Telefonica and task 4.5 led by Telefonica.

These tasks are strongly interrelated in the Work Package and also interact with WP5, WP6, WP7, WP8.

More specifically, the main interactions WP4 has with each of these WPs are the following:

- The IoT GEs (WP5) deployed close to the sensors/users can be hosted on the Cloud Proxy GE co-developer in WP4 and WP7.
- The middleware GEs developed in WP6 have high scalability requirements, and hence are leveraging the Blueprints management capabilities introduced in WP4.
- WP4 provides a multi-tenant cloud hosting solution, integrating with Identity Management GE developed in WP8.
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Overall, the tasks in WP4 provide a comprehensive set of GEs, which together with Cloud Proxy and Identity Management GEs comprise a complete Cloud Hosting solution.

Main Progress in the period:

The main progress in WP4 are:

- Successful delivery of Release 3 of the FIWARE Cloud reference architecture, comprising 10 Generic Enablers:
  - IaaS Data Centre Resource Management
  - IaaS Service Management
  - Object Storage
  - Self-Service Interfaces
  - PaaS Management
  - Software Deployment and Configuration
  - Policy Management
  - Monitoring
  - Cloud Proxy
  - Edgelets Management
- For each Generic Enabler, the team contributed to the following deliverables:
  - Architecture
  - Roadmap
  - Open Specifications
  - Backlog
  - Code
  - Validation and testing artifacts
  - User and programmer guide
  - Installation and administration guide
- Delivery of Cloud Hosting capabilities in FIWARE Lab, extensively used by Use-Case projects as well as the broader community of FIWARE Lab users.
- Contribution to dissemination of Cloud GEs at various events, notably hackatons, Campus Party events, bootcamps, etc.
- Active engagement with the OpenStack open source community, including code contributions, involvement in design activities, participation of face-to-face and online conferences and meetups - notably for DCRM GE and Object Storage GE.
- Active engagement with the Open Daylight open source community, including code contributions, involvement in design activities, as well as various interlocks and meetups.

Overall, the partners made good progress towards the goals of WP4, according to the planned roadmap.

1.1.1.1 *Task 4.1: Virtualization Layer*

Task Objectives:

The overall objective of task 4.1, led by Intel, is to provide a consistent virtualization layer to manipulate all required virtual resources including compute, storage and networking. This task will provide the capabilities to offer such resources on-demand and the usage of such resources can be monitored for the purposes of billing, auditing and compliance. This task works very closely with Task 4.2 Data Centre Basic Management to ensure that virtualised resources can be managed efficiently and effectively

Task Activities during the period:

The breakdown of the **contribution, results, deviation and proposed corrective action** of each partner in this task 4.1 are:

- **03-IBM-IL:**
  Contribution and results:
  - Active contribution to OpenStack Swift open source community, including code contributions, involvement in design activities, ongoing community interactions to promote FIWARE design goals and implementation approach. In particular:
    - Enablement for enhanced secure multi-tenancy by introducing apache web server as the REST front end, with an extensive set of modules that can be used to delivera more secure and controlled solution.
    - Enhancements to objects metadata in OpenStack Swift, enabling a richer interface for developers, resulting in more powerful object storage capabilities.
  - Active contribution to the deliverables associated with the 3rd release of the Object Storage GE
    - Architecture
    - Open specifications
    - Roadmap
    - Backlog
    - Reference implementation (code)
    - Validation and testing artifacts
    - Testbed integration
    - Documentation
      - User & programmer guide, installation & administration guide
    - Training materials
    - Catalogue entry
    - On-site support at FIWARE events
  - Active involvement in Agile planning and tracking for the Object Storage GE

  Deviation and proposed corrective action:
  There is no deviation nor proposed corrective action regarding the activities of this partner in this task.

- **19-INTEL:**
  Contribution and results:
  - Regarding Virtualised Storage, the Object Storage GE was progressed as follows:
    - Installation and Administration Guide received minor updates refining instructions
    - User and Programmers Guide received significant updates, including complete python and bash scripts to facilitate third party developers. These needed ongoing refinement as enhancements to IDM were introduced.
    - Unit Testing Plan updated reflecting all additional unit tests
    - Catalogue entry updated to reflect updates to the code and supporting documentation
    - Webinar materials prepared and presented both in person (e.g. London

Campus party) and online (various webinars).
- Videos created to support consumers of ObjectStorage on the FILAB environment
- Client side helper libraries developed to simplify invocation of objects storage from python code and from the command line.
- Client side helper library developed to support client side encryption of data before transfer - the code leveraging AES-NI capable cpus where available.
- GE tested and updated as OpenStack releases Grizzly through Juno were released.
- Possibility of introducing the GE into the core OpenStack projects was raised with the OpenStack community at various OpenStack community events in Ireland, and in the OpenStack summit in Paris. Audience much much more receptive than previously when it had to be factored out into a standalone python egg. Discussions ongoing.
- Complementary efforts by Intel to enhance Swift Object Storage were introduced to OpenStack. These include Erasure Codes, Storage policies and COSBench.

Deviation and proposed corrective action:
- There is no deviation nor proposed corrective action regarding the activities of this partner in this task

1.1.1.2 *Task 4.2: Data Centre Basic Management*

Task Objectives:

The objective of task 4.2, led by IBM in close cooperation with Intel is to provide the fundamental virtualized resources management functionality that comprises the lifecycle management of compute, storage, and network resources.

Task Activities during the period:

The breakdown of the **contribution, results, deviation and proposed corrective action** of each partner in this task 4.2 are:

- **03-IBM-IL:**
  Contribution and results:
  - IBM-IL has been coordinating the contributions to deliverables associated with the 3rd release of the DCRM GE.
  - Active contribution to OpenStack Nova open source community, including code contributions, involvement in design activities, ongoing community interactions to promote FIWARE design goals and implementation approach. In particular:
    - Support for host evacuation in OpenStack Nova, required for implementation of high availability of virtual machines.
    - Enhancements to Nova Scheduler to enable differentiated scheduling policies for different underlying resource pools.
  - Active contribution to OpenDaylight open source community, contributing the IBM's implementation of OpenDOVE network virtualization product.
  - Integration of OpenDOVE components within the OpenStack Networking

(Neutron) solution, as well as with the rest of FIWARE Cloud GEs (including network virtualization capabilities required for PaaS Management GE).
- Development and delivery of additional features to PIVOT scheduler, as well as their end-to-end integration into the FIWARE Cloud solution. This includes:
  - Host evacuation scheduling
  - Resiliency-aware VM placement
  - Affinity-aware VM placement
  - Ongoing placement optimization
  - Adaptive scheduling of idle versus active VMs
- Active contribution to the deliverables associated with the 3rd release of the DCRM GE
  - Architecture
  - Open specifications
  - Roadmap
  - Backlog
  - Reference implementation (code)
  - Validation and testing artifacts
  - Testbed integration
  - Documentation
    - User & programmer guide, installation & administration guide
  - Training materials
  - Catalogue entry
  - On-site support at FIWARE events
- Active involvement in Agile planning and tracking for the DCRM GE

Deviation and proposed corrective action:
There is no deviation nor proposed corrective action regarding the activities of this partner in this task.

- **19-INTEL:**

Contribution and results:
- Regarding Data Centre Resource Management, the Intel DCRM GE was progressed as follows:
  - GE refactored and retested as OpenStack releases Grizzly through Juno were released.
  - Possibility of introducing the GE into the core OpenStack projects was raised with the OpenStack community at various OpenStack community events in Ireland, and in the OpenStack summit in Paris. Audience much much more receptive than previously when it had to be factored out into a standalone python egg. Discussions ongoing.
  - Webinar materials prepared and presented both in person (e.g. London Campus party) and online (various webinars).
  - Catalogue entry updated to reflect updates to the code and supporting documentation
  - Complementary efforts by Intel to enhance OCCI were worked by Intel. These included co-chairing discussions at various OGF summits and online. Editing the refinements of the OCCI standard throughout this period, and the management of refinements and extensions to the OCCI standard generated by the community.

Deviation and proposed corrective action:
- Due to the comprehensive nature of the IBM DCRM, and the inability to install

the Intel DCRM on the FILAB infrastructure due to challenges in upgrading the underlying OpenStack installation, investment in the Intel DCRM was deprioritised during this period of the project. However the open-source OCCI interface to OpenStack continues to be evolved by Intel, in synch with both OpenStack and OCCI developments.

1.1.1.3 *Task 4.3: Network Edge / Cloud Proxy Management*

Task Objectives:

The objective of task 4.3, led by Technicolor, is to provide hosting capabilities on Cloud Proxy devices located at the cloud edge, close to the end users, so that specially designed components of Future Internet services can run on cloud proxy devices and leverage local capabilities (compute/storage). The Cloud Proxy is made available as a real HW box running an IaaS platform. The box is “CE marked” and can be used for field tests in normal users premises (electrical safety and electromagnetic compatibility are guaranteed).

The Edgelets Management GE provides the means to deploy and manage a set of software services (called “edgelets”) packaged as containers to hosting devices close to the user (such as “Cloud Proxies”).

Task Activities during the period:

The breakdown of the **contribution, results, deviation and proposed corrective action** of each partner in this task 4.3 are:

- **05-THALES:**
  Contribution and results:
  - The Edgelets Management GE development has been continued and a new version has been delivered. Its main features are:
    - Improved lifecycle management of the edgelets via the Edgelets master.
    - Implementation of the Edgelets catalogue (catalogue of available and deployable edgelets)
    - Availability of the Edgelets web portal software which allows in a human-friendly way to deploy, manage and monitor the edgelets.
    - Packaging of the GE via a set of instructions rather than a pre-configured VM, like in the first release. This includes the deployment of the Edgelet Master and the instructions to run devices as Edgelet clients.
  - The associated documentation (architecture, manuals, unit testing plan, open specification, etc) have been delivered.

  Deviation and proposed corrective action:
  There is no deviation nor proposed corrective action regarding the activities of this partner in this task.

- **12-TRDF:**
  TRDF activities stopped after M36
  Contribution and results:
  - The Cloud Proxy was made available to the partners before M36:
    - as a HW box running the SW (around 15 were delivered, to FI-WARE

partners (DT; TI; Intel; Thales etc …) as well as to use-cases partners (FINESCE; FI-STAR)
        - As an open-source software
    - Support was provided to the partners:
        - "hotline" support answering to precise questions and helping partners to start their implementation
        - by providing documentation and many examples of virtual machines running on the Cloud Proxy (ranging from simple "Hello World" type of VM to a complex multimedia server. All examples are freely available (copyleft).

Deviation and proposed corrective action:

There is no deviation nor proposed corrective action regarding the activities of this partner in this task. (The Cloud Proxy developments stopped @ M36. Only support to users has been provided after this date)

1.1.1.4 *Task 4.4: Advanced Service Management*

Task Objectives:

The objective of this task 4.4, led by TID, is developing the advanced services management functionality that drives the basic resource management of task 4.2 and 4.1. In particular, advanced management is related with the extension of functionalities provided by the data center resource management by managing service elasticity and deployment of complex services in the cloud. Another aspect of the advanced resource management is related to capacity planning by leveraging statistical multiplexing of resources among elastic workloads.

The resulting processed information is used and turned into knowledge by the generic enablers defined as part of task 4.5 *Cloud Portal and PaaS hosting enablement* in order to develop the new functionalities of Pegasus - PaaS Manager, Sagitta - SDC Manager and Cloud Portal.

Task Activities during the period:

The breakdown of the **contribution, results, deviation and proposed corrective action** of each partner in this task 4.4 are:

- **01-TID**

  Contribution and results:
    - Finalization of the last features related to the IaaS Service Manager in order to freeze the component. Some functionalities was translated to the Cloud Portal and other one was translated to the Pegasus - PaaS Manager. The functionalities related to the auto scalability was translated to a new GE (Bosun - Policy Manager).
    - This period continues with the adoption of Bosun - Policy Manager as scalability solution as Telefónica's Advanced Service Management asset in replacement of the discontinued IaaS Service Manager and the translation of the features to the implementation of the Pegasus - PaaS Manager, Bosun - Policy Manager and Cloud Portal
    - Regarding Policy Manager, these are the main developed features:
        - Choose Rule Engine based on analysis of different Rule Engines

available.

- Define the policy API of the new GE.
- Define the policy rule format and implement the Rule Engine based on the selected framework.
- Define and generate the the architecture documentation of the GEi.
- Implement REST interface to collect data from the Monitoring GE in HA based on NGSI-10 and connect the component with the Monitoring GE solution developed in the project.
- Implement REST interface to process the subscription to the GE in order to evaluate the scaling up and down of a server.
- Management of security access to the information following the same schema of the REST of OpenStack service.
- Increase the security performance of the component.
- Implement a stability signal solution of the facts received in order to provide an activation of the rule when the facts have stable values.
- Analysis and possible contribution to Congress and Tetris projects of the OpenStack Community. Participation in the OpenStack Summit in Paris in order to disseminate our contribution and analyse a possible integration/contribution to these projects..
- Increase the overall performance of the solution in order to allow more transactions per seconds.
- Automatic computing of the Policy Manager in order to check that all the architectural components are working properly.
- Increase the number of actions defined in the Policy Manager in order to have a bigger database of actions to be triggered by a certain activated rules (condition).
- Security improvement on the Pegasus - PaaS Manager in order to take the advantages of the IdM and Keystone-Proxy solution of the Security Chapter.
- Bugs fixing.
- Update of the different manuals related to the Architecture, User & Programmers Guide, Installation and Administration Guide and Unit Testing report.
- Two versions of this component were published during this period.

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- Regarding the IaaS Service Manager, the final development:
  - Ability to provision and manage the life cycle of Virtual Appliances.
  - Ability to allocate virtual network as part of a Virtual Appliance.
  - Ability to allocate volume resources associated to a Virtual Appliance.
  - Ability to invoke DCRM capabilities via OpenStack APIs.
  - Ability to specify placement policy rule associated to a Virtual Appliance.
  - Security improvement of the IaaS Service Manager in order to integrate

it with the IdM and Keystone-Proxy of the Security Chapter.
- Realization of Webinars about the use of the IaaS Service Manager component.
- Bugs fixing.
- Update of the different manuals related to the Architecture, User & Programmers Guide, Installation and Administration Guide and Unit Testing report.
- Two versions of this component were published during this period.

Deviation and proposed corrective action:

There is no deviation nor proposed corrective action regarding the activities of this partner in this task

- **03-IBM-IL:**
  Contribution and results:
  - IBM's role in this task was primarily around ensuring compatibility with the OpenStack APIs surfaced by DCRM GE (developed in task 4.2), as well as introduction of new features in Blueprints management GEs (developed in this task by Telefonica) leveraging DCRM enhancements developed in Release 3 (VM placement enhancements, network virtualization capabilities).

  Deviation and proposed corrective action:
  There is no deviation nor proposed corrective action regarding the activities of this partner in this task.

- **19-INTEL:**
  Contribution and results:
  - Intel played a minor role in this task. Essentially it liased with TID during this period to ensure that the functionality of the Object Storage GE in particular could be accommodated by the Service Manager as it evolved. As enhancements to related systems such as the IdM GE were deployed, support was given to ensure access to the Object Storage GE could still be demonstrated.

  Deviation and proposed corrective action:
  There is no deviation nor proposed corrective action regarding the activities of this partner in this task

1.1.1.5 *Task 4.5: Cloud Portal and PaaS hosting enablement*

Task Objective:

The objectives of this task 4.5 are

- Develop a secure-multi-user self-service Portal and Interfaces for allowing the customers to leverage the advanced functionality of Cloud Hosting in a user-friendly and efficient manner. This activity is led by UPM and with the collaboration of TID in the design of the User Experience.

- Develop Pegasus - PaaS GE based on the baseline assets provided by the 4CaaSt project (FP7-257928) providing the functionalities to manage platform inside the cloud allowing to scale up/down it, built-in optimization and deployment of components associated to the platform selected by the cloud user. This activity is led by TID.
- Develop Sagitta - SDC Manager GE providing the functionalities to deploy automatically software on each VM based on Chef or Puppet recipes. This activity is led by TID.
- Develop Monitoring GE in order to make continuous analysis of the infrastructure used in the FIWARE Lab Spain node and integration with the FIWARE Lab through the federation of Monitoring GE solutions. Specification and Design of the Federated Monitoring solution for the FIWARE Lab in conjunction with the XIFI project (FP7-604590).

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Task Activities during the period:

The breakdown of the **contribution, results, deviation and proposed corrective action** of each partner in this task 4.5 are:

- **01-TID:**
  Contribution and results:
  - Pegasus - PaaS Manager:
    - Network Management: The user is able to specify the networks where the VM in the tier are going to be deployed in terms of:
      - Creation of new networks
      - Reusing current networks
      - Obtaining a public IP
    - Configuration Management: The user can specify software properties to be taken into account in deployment. It involves:
      - Macro resolutions, some software properties need to be resolved in runtime, e.g. IP
      - Software properties translation into recipes
    - GE Identification: VM are identified with the GEs ID (NID) which are installed on top of it using the metadata service.
    - BD migration, some technologies have been included for managing Pegasus - PaaS Manager database which include the migration from Tomcat to Jetty.
    - Automatic installation. Pegasus - PaaS Manager can be installed by using rpm packages.
    - Design and implementation of multiregion support of the Pegasus - PaaS Manager in order to allow the deployment of multi-tier solution in several FIWARE Lab instances.
    - Integration and development of new functionalities related to the new versions of OpenStack (Grizzly, Havana, Ice-house), specially due to the inclusion of the Neutron component in the OpenStack architecture (management of multi-tenancy networks).
    - Security improvement on the Pegasus - PaaS Manager in order to take the advantages of the IdM and Keystone-Proxy solution of the Security Chapter.
    - Murano Migration Analysis. Pegasus - PaaS Manager code is going to be migrated into the Openstack project Murano. Some analysis have been realized in terms of Blueprint identification and Architecture definition. Participation in the OpenStack Summit in Paris in order to set the contribution

of FIWARE into the OpenStack Murano project.
- Bugs Fixing.
- Update of the different manuals related to the Architecture, User & Programmers Guide, Installation and Administration Guide and Unit Testing report.
- Support to the FIWARE HELP&DESK project in Jira in order to resolve any problem with the use of this component by the FIWARE Lab users.
- Three versions of this component were published during this period.

o Sagitta - SDC Manager
- Puppet Aware: Puppet is also supported in FIWARE, so that, GE can be coded in Puppet. It involves:
  - the generation of a wrapper to translate requirements into puppet manifests.
  - inclusion of puppet modules in Sagitta - SDC Manager.
- Provide a multi-regions solution of the Sagitta - SDC Manager in order to increase the performance of this component with the distribution of the Chef Server and Puppet Master on each FIWARE Lab node (Federation of Sagitta - SDC Manager).
- Software metadata, software can be defined by metadatas in terms of ports to open, images where to be deployed the software and so on.
- Configuration Management: The software properties configuration requires the translation from PaaS Manager requirements into the recipes. Concretely:
  - Software Properties configurations in chef nodes
  - Software Properties configurations in puppet
  - Inclusion of hieradata for puppet configuration
- GE Identification: software has the GE identification by using metadata.
- BD migration, some technologies have been included for managing the SDC database.
- Automatic installation. The SDC can be installed by using rpm packages.
- Security improvement on the Pegasus - PaaS Manager in order to take the advantages of the IdM and Keystone-Proxy solution of the Security Chapter.
- Bugs Fixing.
- Update of the different manuals related to the Architecture, User & Programmers Guide, Installation and Administration Guide and Unit Testing report.
- Support to the FIWARE HELP&DESK project in Jira in order to resolve any problem with the use of this component by the FIWARE Lab users.
- Three versions of this component were published during this period.

o Monitoring GE
- Work closely to the XIFI projects in order to deploy a Federation Monitoring solution based on the Monitoring GE Architecture.
- Analysis of existing monitoring and metering systems.
- Definition of the Montioring Architecture to be implemented.
- Implementation of a subsystem gathering data from heterogeneous monitoring and metering systems in order to constantly check the status and performance of the cloud infrastructure. Consists of the following components:
  - NGSI Adapter: Generic adapter to transform monitoring data from probes to NGSI context attributes.

        - NGSI Event Broker: Module to forward plugin data to NGSI Adapter from de-facto industry standard "Nagios" monitoring system.
    - Information ("context") about entities being monitored is updated regularly into Orion Context Broker GE, so that such data can be received by subscribers.
    - Production of training material about the Monitoring GE:
        - Presentation.
        - Webinar available at FIWARE Academy.
    - Production of a report about choices regarding a global artifact repository for FIWARE:
        - Repository hosting and indexing software packages.
        - Repository hosting and indexing libraries, webapps and any other components.
    - Deployment of Monitoring GE:
        - Finished deployment in Spain infrastructure.
        - Prepared deployment in Brazil infrastructure.
        - Prepared deployment in Mexico infrastructure (XIFI relationship).
    - Four versions of this component were published during this period.
- Support and training for Pegasus - PaaS Manager and Sagitta - SDC Manager users, both through private channels (e.g. direct emails, meeting at developers events, etc.) and public channels (mainly in StackOverflow, slideshare and webinars).
- Several dissemination events: Campus Party London, Brazil and México, Santander Hackathon, Las Palmas Hack4good, Sevilla event with SMEs (ETICOM), Hamburgo and Valencia Startup Weekends, CeBIT 2014, OpenStack Summit 2014 in Paris.

Deviation and proposed corrective action:

There is no deviation nor proposed corrective action regarding the activities of this partner in this task

- **22-INRIA:**
  No activity in this task during this reporting period.

- **23-UPM:**
  Contribution and results:
  - Cloud Portal:
    - Compatibility with Pegasus PaaS Manager: development of all the tools and user interfaces needed to manage PaaS APIs from the Cloud Portal
    - Improvements in SDC
        - Compatibility with releases in products
        - Image filtering
        - Recipes APIs
    - Compatibility with OAuth2 protocol
    - Communication with Identity Management GE
    - Single sign out
    - Integration with FIWARE Lab Portal
    - Support for multiple Openstack regions

- Compatibility with new Opestack versions
  - Grizzly
  - Havana
  - Icehouse
- Networks management tools and interfaces
- Monitoring tools
  - VM real time monitoring
  - VM historical data monitoring
  - Monitoring networks
- HTTPS support
- Cookies policies management
- Improvements in CSS performance adding SASS
- Improvements in quotas management
- Improvements in user experience and interfaces
  - Tables sort
  - Wizards
  - VNC modal view
  - Regions filtering
  - Image categories
- Improvements in project compilation
  - Grunt and Hint
- Improvements in general performance
  - Global data models
  - Sockets management
  - Keystone communication
- Added time use stats and Google Analytics
- Bug fixing.

o IdM

- Creation and GE documentation.
- Oauth2 compatibility
- SCIM support
- XACML integration
- Pep-Proxy creation
- Different requirements implementation regarding the usage into FiLab
- Federation of several nodes supported.
- Compatibility with different KeyStone versions
  - Grizzly
  - Havana
  - Icehouse

Deviation and proposed corrective action:

There is no deviation nor proposed corrective action regarding the activities of this partner in this task

2. Significant results

During the reporting period, the work in WP4 resulted in development and delivery of a comprehensive Cloud Hosting solution, based on a strong open source foundation -- OpenStack and OpenDaylight, augmented by a unique set of value-add capabilities developed by the partners involved in WP4. The Cloud Hosting solution has been deployed across the FIWARE Lab nodes, hosting large number of VMs and GE instances used by the rapidly growing FIWARE community. In particular:

- Third release of FIWARE Cloud Hosting solution comprised 10 GEs, ranging from foundational resource provisioning services (DCRM, Object Storage), to advanced application life cycle management (Blueprints management GEs), to hosting capabilities targeting the cloud edge.
- All the FIWARE Lab deployments running FIWARE Cloud infrastructure based on OpenStack, hosting all the other GEs used by use-cases and the broader experimentation community.
- FIWARE Cloud enhanced to support the federated FIWARE Lab environment, comprising a large number of FIWARE Lab nodes.
- FIWARE Cloud tools are used to automate provisioning and life cycle of the various FIWARE GEs, making it possible to deliver a flexible solution of various combinations of GEs available ‘as a service’, through either shared/global or dedicated GE instances deployed in one or more FIWARE Lab nodes.
- Significant contributions to OpenStack community, notably in Nova Scheduler and Swift projects.
- Significant contributions to OpenDaylight community, notably in OpenDOVE network virtualization project.

3. Deviations from Annex I and impact on other tasks, available resources and planning (if applicable)

No significant deviations.

4. Reasoning for failing to achieve critical objectives and/or not being on schedule (if applicable)

No significant deviations.

5. Use of resources

Note: The following info below is expected to be included as part of section 2.3.8 Use of resources for Project Management (WP1) of the periodic report by Javier de Pedro (TID). Figures below are being updated by Javier with the info corresponding to current period.

General valuation of the effort and status of the WP have to be updated by the WPL below (XXX).

Planning of effort in WP4:

This WP has a weighted rate by month of the linear distribution of total effort per partner as follows:

M1-M9: 50 % of its linear distribution in 36 months

M10-M33: 100 % of its linear distribution in 36 months

M34-M36: 50 % of its linear distribution in 36 months

M37-M44: Extension of the project: Each partner has provided their own planning.

As result of the amendments, planning has could be changed due to its recalculation based in the new effort per partner in the DoW.

However, there is some variance in the exact ramp-up as applied by the various partners, due to constraints derived from specific project tasks.

Follow-up of effort in WP4:

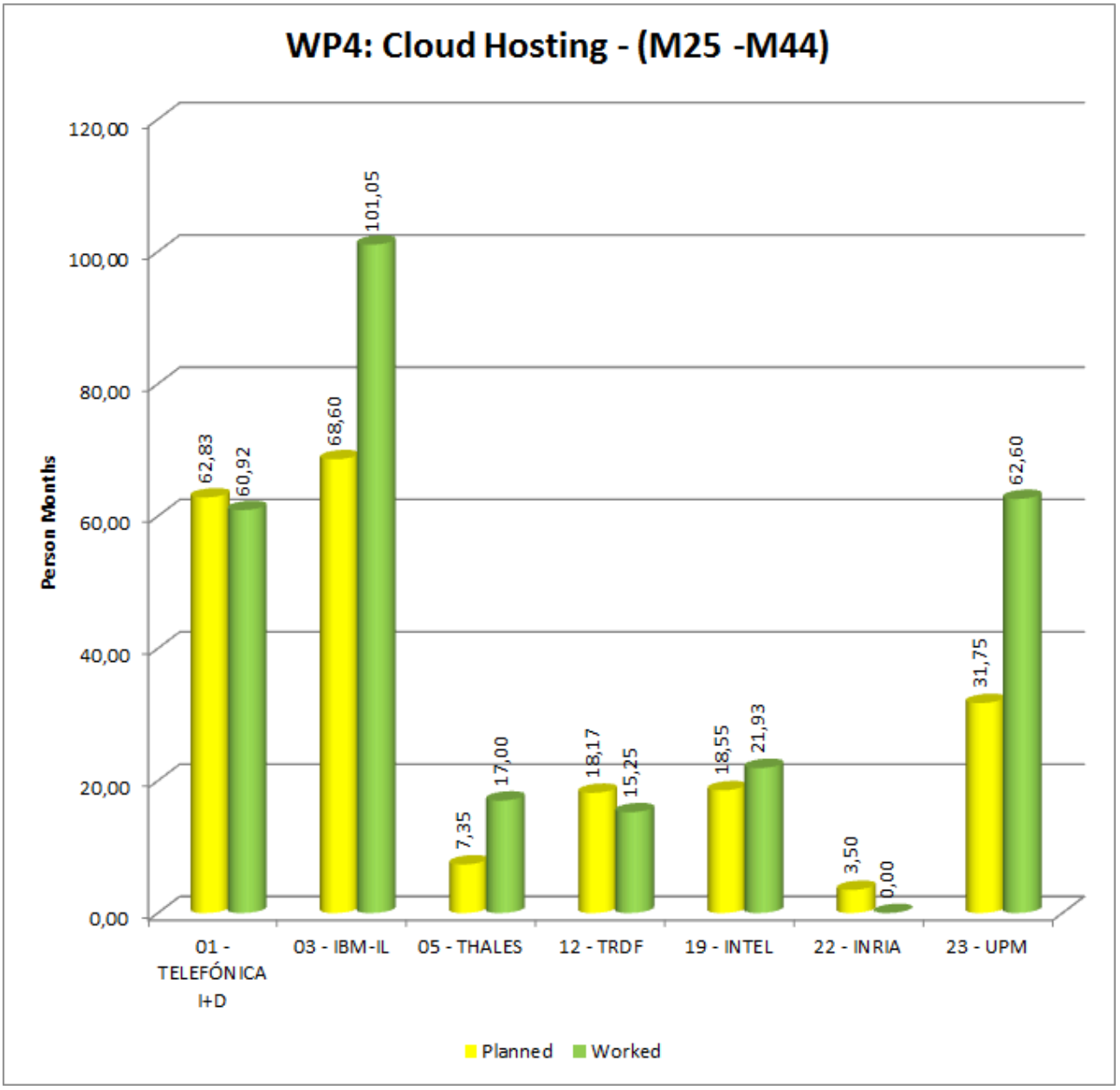
The following table depicts the planned resources vs. real resources (in PMs) for whole the project in WP4:

WP4	Y1	Y2	Y3	Y1	Y1+Y2	Y1+Y2+Y3
DoW: 510	**M1-M12**	**M13-M24**	**M25-M44**	**M1-M12**	**M1-M24**	**M1-M44**
Planned	131	206	211	131	337	548
Worked	125	267	279	125	392	671

Note: Worked cell contains the accumulative declared effort.

In general, the consumption of resources in this WP4 is slightly above plan, primarily due to emphasis on open source and QA activities, as outlined below.

The following image depicts the planned resources vs. real resources (in PMs) during period M25-M44 in WP4 by partner:



Explanations of significant deviations (±10%) are explained in the “Explanation of the use of the resources -> Effort per partner” section.

Note: The above reference (explanations) is currently managed by the

consortium in the following shared document: https://docs.google.com/document/d/1NoS4-7DjKbAlPc98c3lHCMgHkoNk3G7VSiNTDMkoQ_c/edit

In summary, the status of this WP4 is on track.

6. Corrective actions proposed (if applicable)

No corrective actions proposed.