FIWARE Lab Solution for Managing Resources & Services in a Cloud Federation

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http://lab.fiware.org

Agenda

- Introduction

- FIWARE Lab

- Federation Architecture Overview

- Cloud Federation Management

- Conclusion

- Discussion

Introduction (1)

- We need an **open ecosystem or platform** for **open innovation**

- **Cloud** capacity and services are of **great value** to support **open innovation** and facilitate start-up incubation through infrastructure resource

- **How to create a large distributed cloud** to boost innovation across European regions?
  - This requires
    › either large investments by a **single player** or
    › an agreement among many players (**federation**)
  - Of course, when different players team up together within a federation, they **do not want to lose all the control** on their own infrastructure.

- There are **several challenges and motivations** behind cloud federation in the literature, as well as **different federation models and approaches**

Introduction (2)

- There is **no „best" cloud federation approach**
  - Different approaches exist and each has its pros/cons
  - Depend on different requirements

- We focus on **Cloud Federation conducted within XIFI project** to build the federation of cloud infrastructures for the Future Internet Lab (FIWARE Lab)

- **FIWARE Lab**:
  - Is **an open innovation platform** to develop Future Internet (FI) applications
  - **Offers a rich catalogue of services available** either in SaaS or PaaS modality, the so called Generic Enabler implementations (GEis)
    - › FIWARE GEs: set of general-purpose **platform functions** available through **APIs**
  - **Provides also a wide offer of FI facilities** (e.g. sensor networks, 4G networks, etc.) that provide **advanced experimental capacities** to developers allowing them to **link their applications with actual infrastructures** and **test** them in **real world settings**

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FIWARE Lab

- FIWARE Lab is the Community Cloud for European FI-PPP developers enabled by advanced FI infrastructures in Europe

- XIFI, as part of the overall vision of FI-PPP and following the principle "eat your own dog food", is based on FI-PPP technologies delivered by FIWARE

FIWARE Lab: the "meeting point" where innovation takes place

App Customers and Data providers

- Connect to entrepreneurs
- Put their data at work
- Bring new innovative services to end users
- Be more efficient
- Social Reputation

Entrepreneurs, Developers

- Develop once for a large market
- Easily meet potential customers
- Marketing, promotion
- Ability to test with real data and end users
- Simple yet powerful APIs that accelerate product development
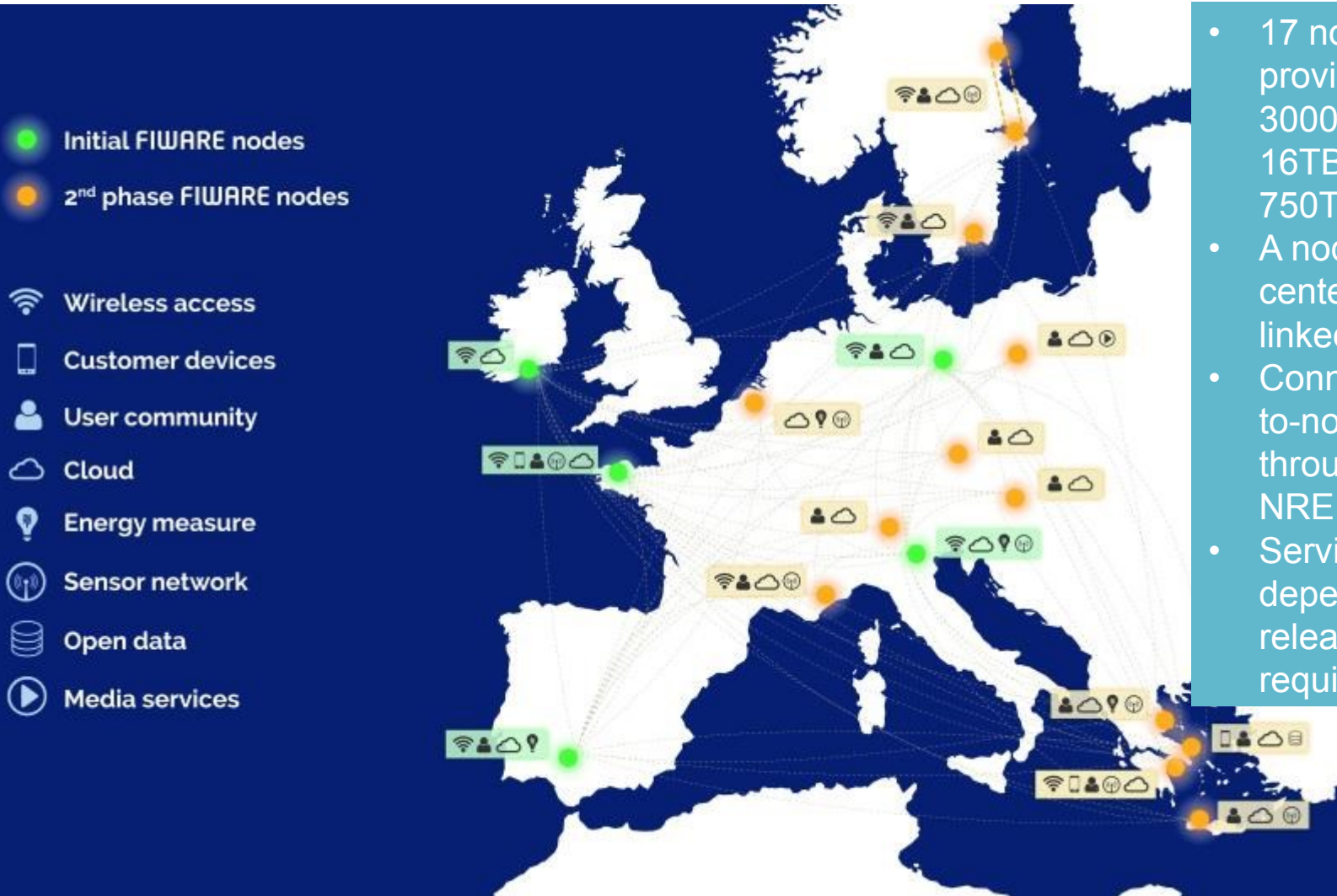
FIWARE Technology Providers

- "Competitive" approach
- Connect to entrepreneurs: jointly exploit the opportunities

- 4,2 M€ promotion campaign
  - Campus Party events
  - Startup Weekend events
  - Chambers of Commerce
  - 870 K€ in prizes
- 100 M€ of funding devoted to entrepreneurs in phase 3 of the FIWARE program

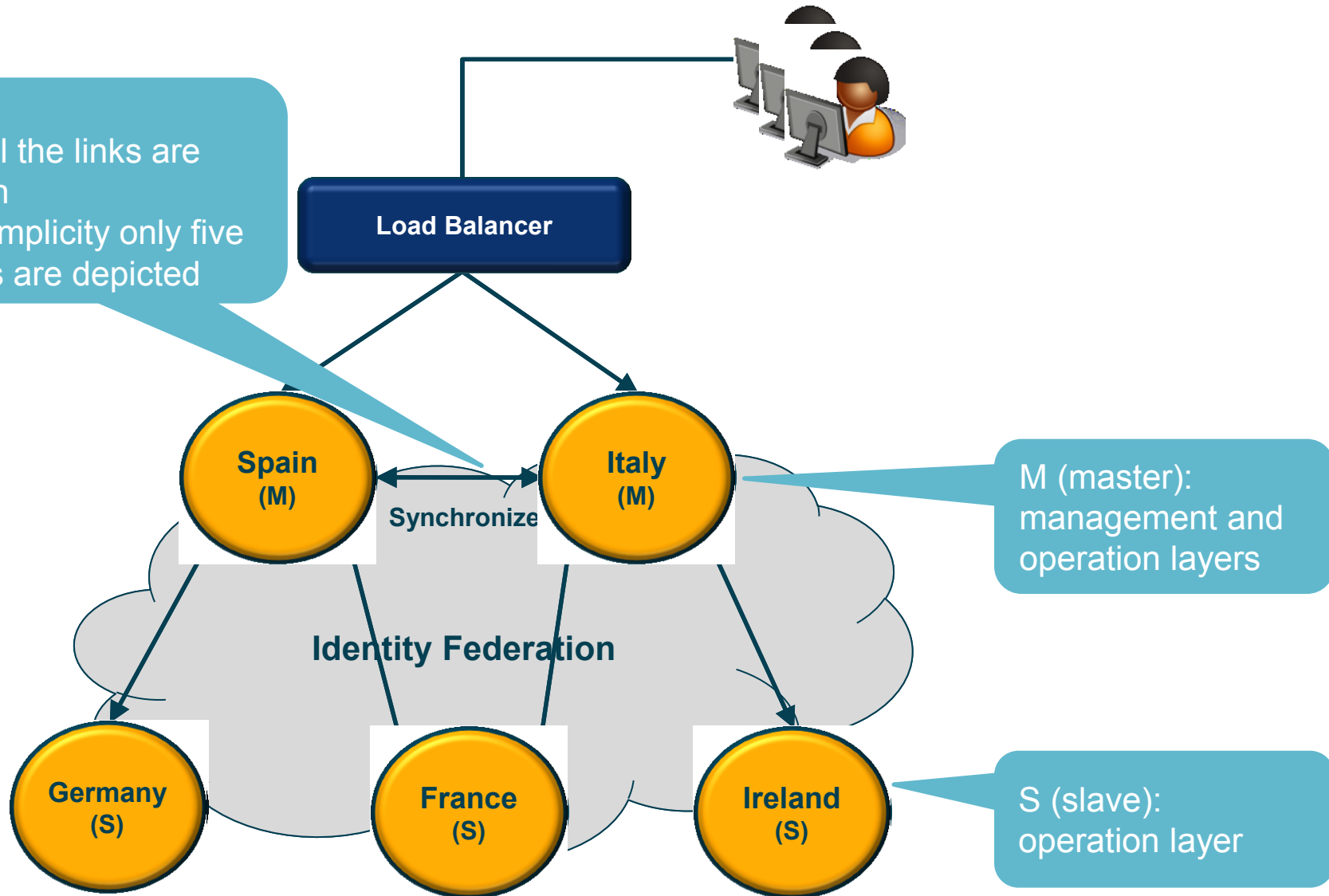# Distributed Cloud for FIWARE Lab

- 17 nodes in Europe providing up to 3000+ cores, 16TB+ Ram, 750TB+ HD
- A node is a data-center (or more linked)
- Connectivity node-to-node offered through GEANT / NRENs
- Service topology depending on GEs release and UC requirements

Legend:
- Initial FIWARE nodes
- 2nd phase FIWARE nodes
- Wireless access
- Customer devices
- User community
- Cloud
- Energy measure
- Sensor network
- Open data
- Media services

The Federation "topology"

Note:
- Not all the links are shown
- For simplicity only five nodes are depicted

Load Balancer

Spain
(M)

Italy
(M)

Synchronize

Identity Federation

M (master): management and operation layers

Germany
(S)

France
(S)

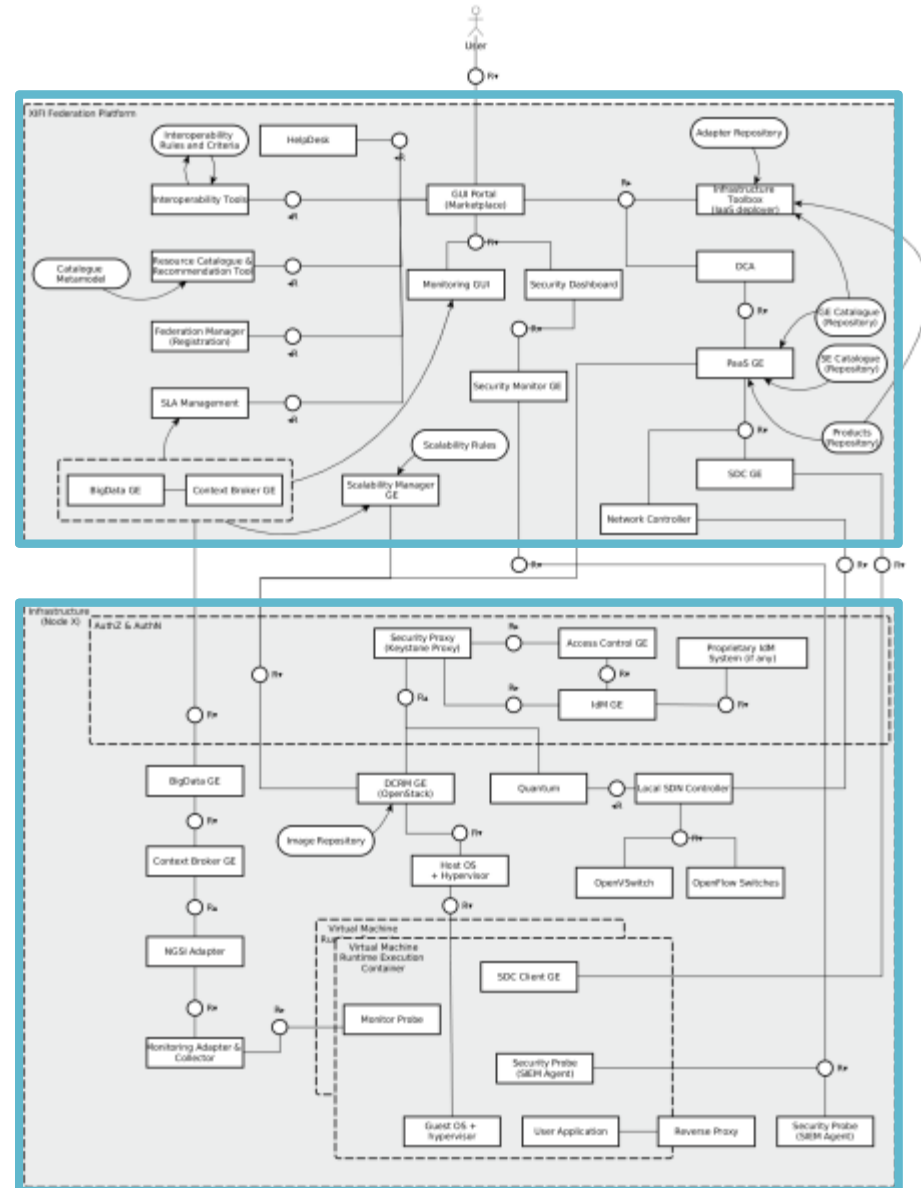Ireland
(S)

S (slave): operation layer

7

General Architecture

Centralized Federation Management
- Find available resources
- Compare resources
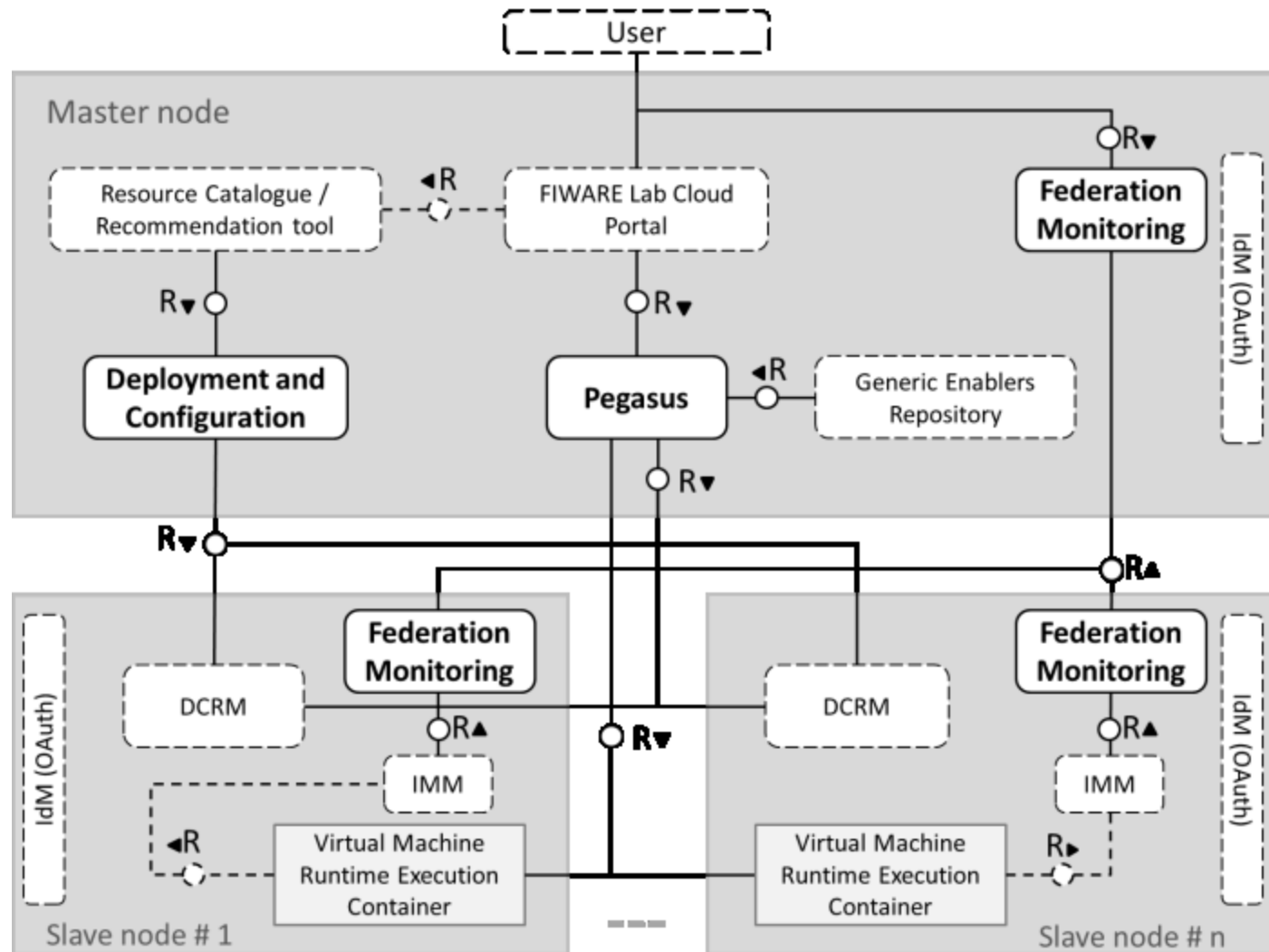- Deploy GEs
- Federated Monitoring

Distributed Resources
- Access GEs
- Access VMs
- Monitoring data
- IdM & AC
- Network configuration

# FIWARE Lab cloud federation management from App developers' viewpoint

▪ Focusing on **innovative components** that, working in an **orchestrated manner**, perform core operations dealing **with the management of resources and services from an application developer viewpoint**, in particular:

i. the ability to deploy multi-tier applications across the federation

   a. Due to regulatory or security reasons each tier may need to be deployed in different infrastructure

   b. Select among a set of configuration tools helping developers to minimize chronophage operations

ii. the provisioning of real-time information about the services (GEis) available in the federation through standardized RESTfull API

iii. a centralized mechanism to handle large-scale monitoring data gathered through the federated underlying resources, by establishing a well-defined and standardized API for storing, aggregating and publishing such data

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Simplified architecture: cloud federation management from App developers' viewpoint

IdM: Identity Management
IMM: Infrastructure Monitoring Middleware
DCRM: Data Center Resource Management (OpenStack-Based)

Platform-as-a-Services (Pegasus)

- Enables a user to deploy easily any kind of application (single VM, single GEi or multiple GEis)

- Offers the opportunity to deploy multi-tier applications, where each tier can be accommodated by a different infrastructure of the federation

- No restriction of the platform technology
  - The developer is free to select his own platform
  - Products that will be supported: J2EE, Apache, DB: MySQL, PostgreSQL, PHP, …

- Automate how you build, deploy, and manage your infrastructure using Chef or Puppet (Sagitta)
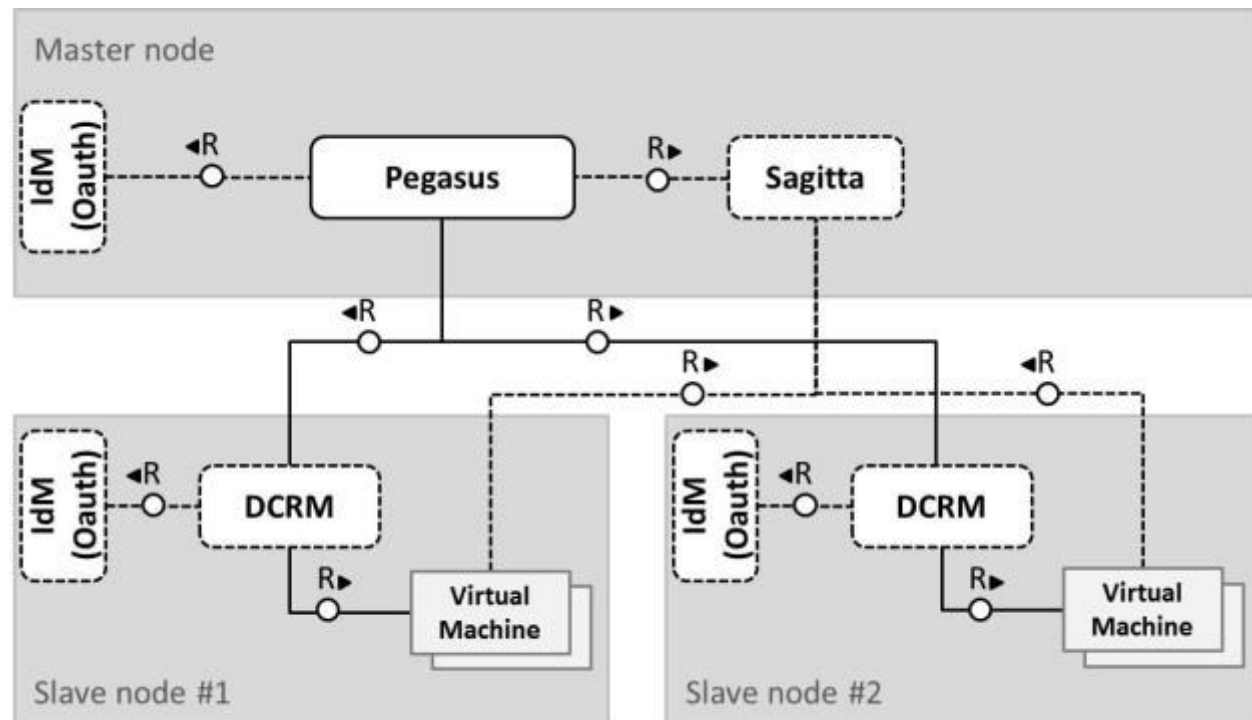
Platform-as-a-Services (Pegasus)

- **Deployment design**: concrete number of machines, VM structure: products, application components, load balancers, final network structure

- **Deployment execution**: orchestration of different steps: configuration of the cloud services, configuration of IaaS/NaaS, creation of the VMs with the software inside, configuration of the monitoring system, etc.

- **Infrastructure control layer**: creation and configuration of VMs+software, interaction with IaaS/NaaS providers, deployment and execution of VMs

- **Monitoring:** configuration of the monitoring probes in order to recover the data from the VMs, network and or process

- **Adaptation and scalability** of the applications (multi-tenancy)

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Deployment and Configuration Adapter (DCA)

- DCA caters for the persistency of all pertinent information related to the whole lifecycle of services (GEis)

- DCA exposes a RESTful API that can be used by interested users to collect all needed information regarding GE instances available in the cloud federation either as SaaS or PaaS offerings

- DCA is a flexible component that accommodates different accessing policies, following infrastructure owners' requirements
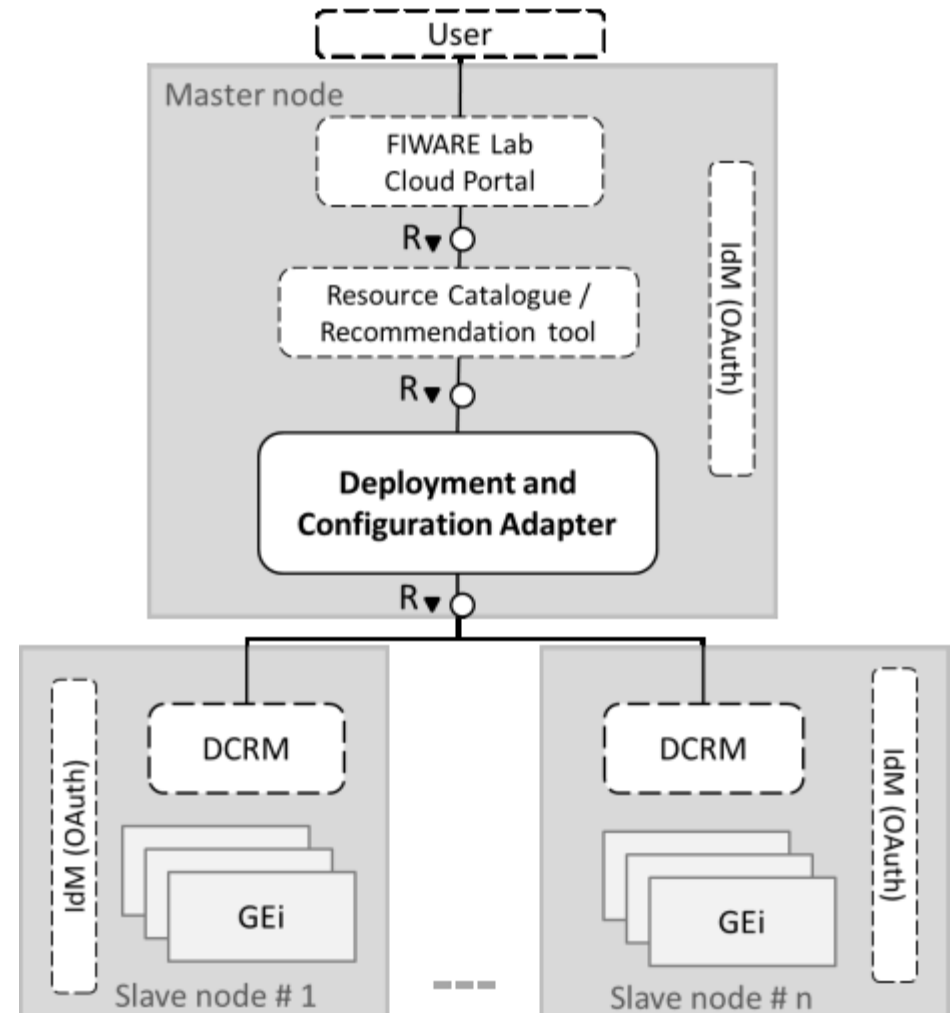
# Deployment and Configuration Adapter (DCA)

- **Challenges**:

  i. Respecting potential stringent access policies applied by the infrastructure owners (Slave Nodes) not willing to provide administrative privileges to external parties

  ii. Unambiguous identification of the deployment of a specific GEi in several infrastructures

- **Solutions:**

  i. **Software component** (Python script), which is able to collect respective information through the OpenStack Nova and Glance components, **is used by the infrastructure administrator** to **edit and customize the parameters** of the Python script before installing it on the controller of the infrastructure (DCRM)

  ii. The information is made available to the DCA through a **particular configuration** done by the **Pegasus during GEi deployment through the use of the metadata service** offered by the OpenStack

    › inserting a specific value (called NID) in the Glance metadata that uniquely and unambiguously allows for GEi identification across the cloud federation

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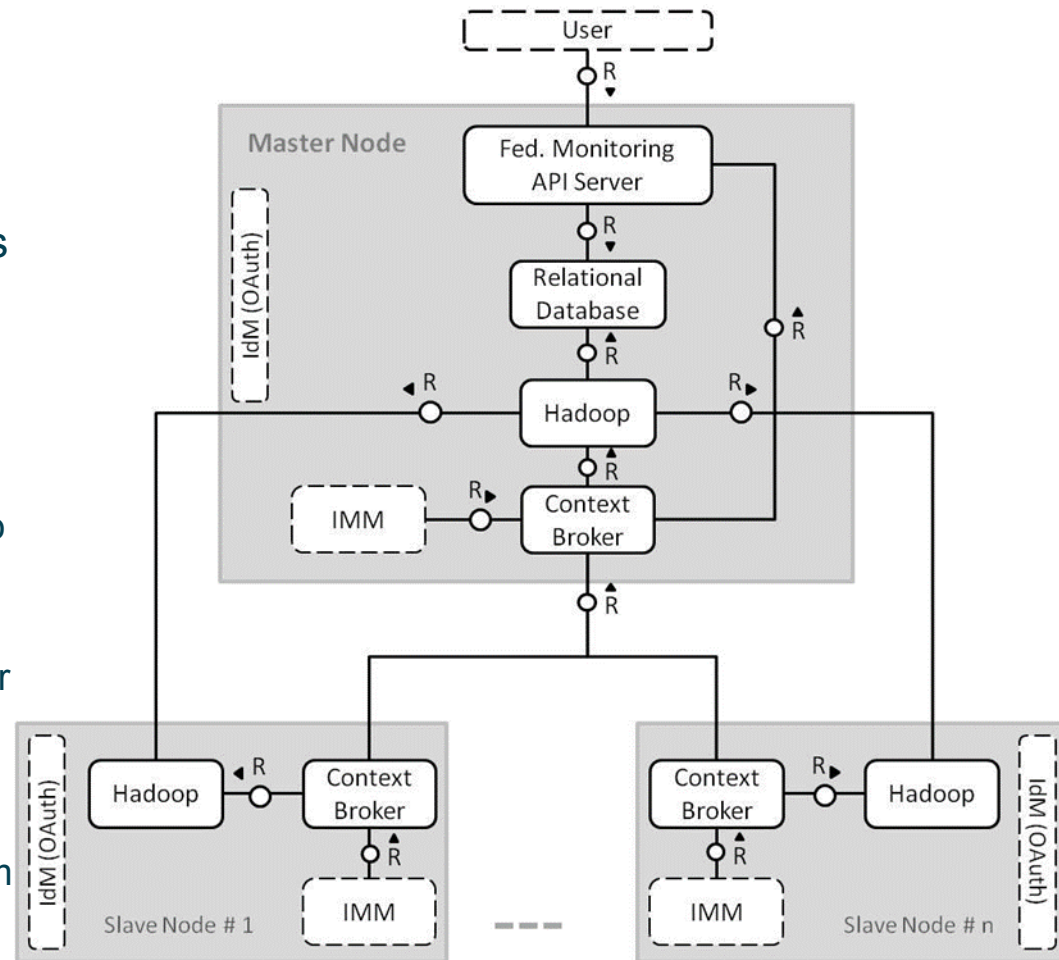
Federation Monitoring

- Attached to the local monitoring system(s), a cross-domain adaptation mechanism, denoted as Infrastructure Monitoring Middleware (IMM), unifies the format of and the accessibility to the collected data

- The Federation Monitoring fulfilling the next operational layer is in charge of storing and publishing the unified data-set by defining a Fed. Monitoring API

  - This layer is able to elaborate the data by leveraging on Big Data analysis techniques and providing aggregation features
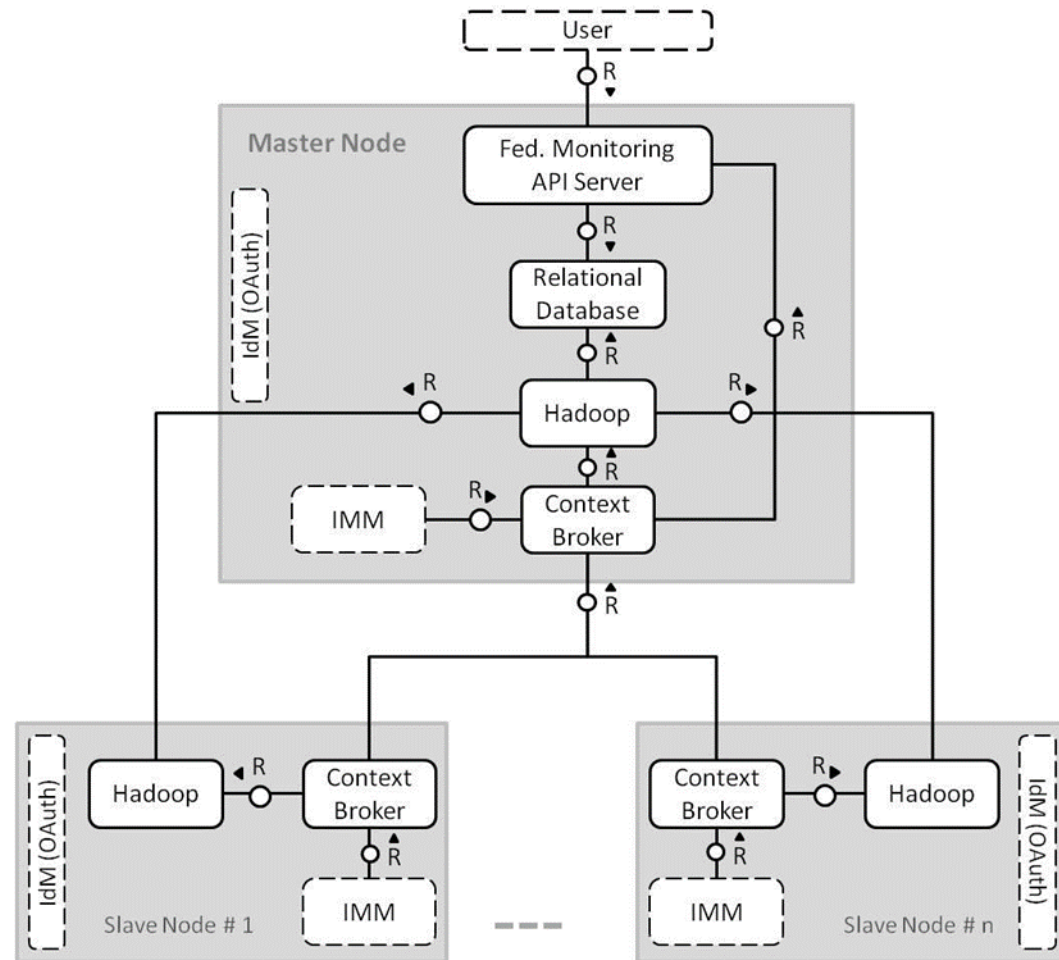
Federation Monitoring

- Fed. Monitoring components:
  - **Context Broker**: the IMM notify the monitoring data as NGSI context format into the CB that handles the datasets and updates the metrics into Hadoop
  - **Apache Hadoop**: provides scalable, reliable and distributed data processing and storage
    - › perform aggregating operations to the data coming from the subscription with the CB
    - › all Hadoops are federated in order to maintain the service in high availability
    - › only the Hadoop deployed in the Master Node is allowed to perform operations with the relational database

Federation Monitoring

- **Relational database**: required to store the elaborated data

- **Fed. Monitoring API Server**: API for users to access the processed monitoring data stored in the relational database, and real-time data from the federation

- Only master node hosts specific federation-aware functionalities
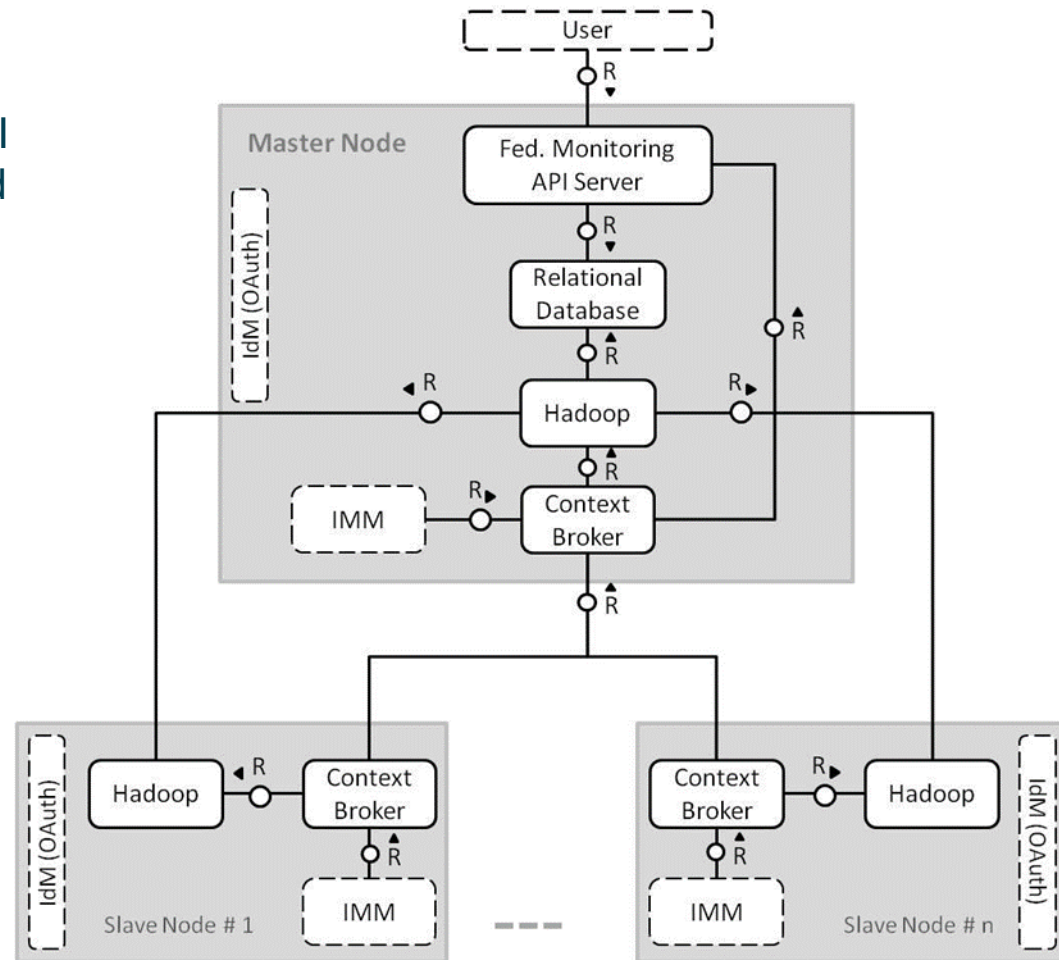
Managing resources in multi-tier application: a real case scenario

- An application developer willing to offer a weather service
  - by allowing subscribed users to **check**, via a website, weather conditions or be **automatically informed of sudden** weather changes
  - Weather information are collected through a network including several sensors

- S/he selects:
  - the Orion Context Broker GEi: to publish the data collected by the sensor
  - the Complex Event Processing GEi: to process the information from sensors and to create events through customized threshold
  - the WireCloud GEi: to properly display this information in a webpage,

- Due to regulatory reason, Pegasus deploys them in two clouds (two-infrastructure application)

- DCA allows a user to query its API providing all VMs created by him

- Monitoring API is used to get monitoring infos using a unique ID of the VM

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Conclusion

- Addressed FIWARE Lab solutions
  - for seamless deployment of services across the federation and ability of services to span across different members of the federation
  - For monitoring of the resources and data which can be aggregated with a common structure
  - be offered as an open ecosystem for innovation at the developers' disposal

- These solutions are implemented and deployed in FIWARE Lab that includes a running federation of 17 infrastructures distributed across Europe

- Developers can get an account by registering through the Cloud Portal and enjoy the offerings

- How to use/interact/start working is presented in the upcoming Webinar "XIFI for developers" on Wednesday, February 25, 2015.

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