DEEP-HybridDataCloud Project overview, achievements

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2/10/2020

Outline

- **DEEP-Hybrid DataCloud overview**

- **Overview of technical activities**

- **Conclusions**

DEEP project in a nutshell

- **D**esigning and **E**nabling **E**-Infrastructures for intensive data **P**rocessing in a **Hybrid DataCloud** (Grant agreement number 777435, Nov 2017 – Apr 2020)
  - 10 Partners, 5 Countries

- **Global objective**: Promote the use of **intensive computing services** by different research communities and areas, and the **support by the corresponding e-Infrastructure** providers and open source projects

  - Focusing on **Machine learning**, **Deep learning**, and **Post processing**
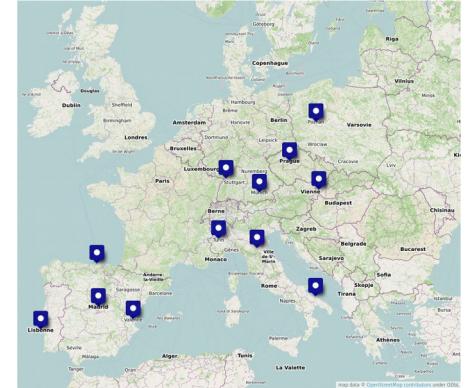
DEEP-HybridDataCloud vision

- Provide **specialized cloud services** to **develop, exploit and share** machine learning and deep learning applications → **Service Oriented Architectures and platforms**

  - Covering the whole application development cycle

  - Focused on all types of users

- **Transparent access** to specialized computing resources (accelerators, high performance computing) → **reduce entry barrier**

- Build the **EOSC machine learning marketplace** as an application exchange → **ease of use, foster collaboration, knowledge dissemination**

- Using different resources (Cloud, HPC, GPU, etc.) → **ease of use**

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DEEP WP Breakdown

- **WP1 (NA)**: Project Management and Exploitation
  - Project oversight, quality management, admin, etc.
- **WP2 (NA)**: Intensive Computing Pilot Applications
  - Definition and understanding of pilot usage scenarios
- **WP3 (SA)**: Testbed and Integration with EOSC service
  - Project service activities: testbeds, tools, integrations
- **WP4 (JRA)**: Accelerated High Performance Computin the Cloud
  - Support for accelerators and HPC resources
- **WP5 (JRA)**: High Level Hybrid Cloud solutions
  - Platform provisioning, delivering the execution platform WP5
- **WP6 (JRA)**: DEEP as a Service
  - Deliver final solution to the users
- **WP7**: Ethics requirements
 - Leader: CSIC
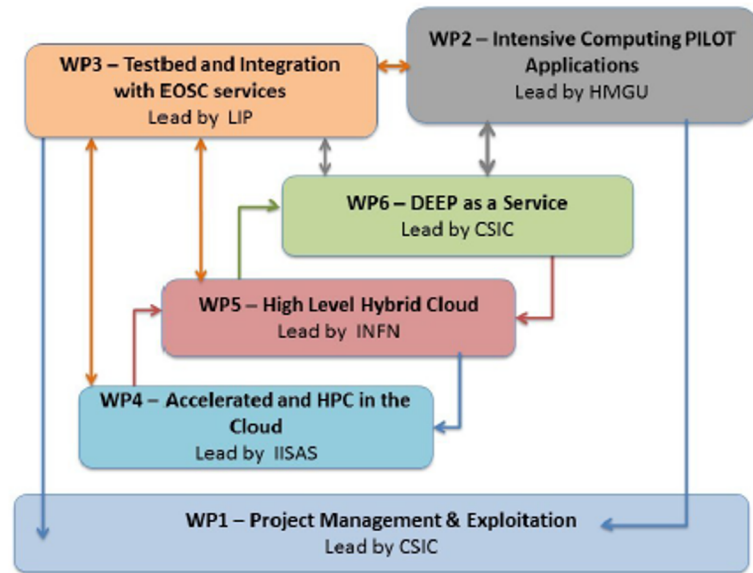
High level architecture
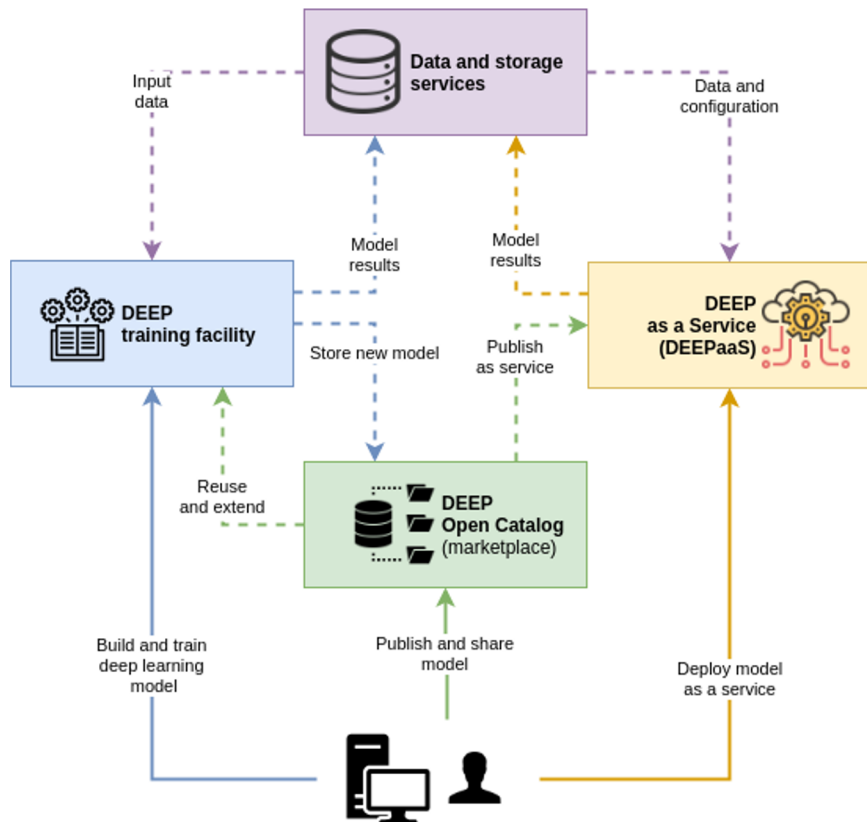
- Position as technology providers to support DL/ML in the EOSC

- Generic building blocks (services) for exploitation through EOSC
  - **DEEP training facility**
  - **DEEP as a Service (DEEPaaS)**
  - **DEEP Open Catalog**

- Integration with storage from external initiatives (eXtreme-DataCloud, EGI Data Hub)

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Machine learning development cycle
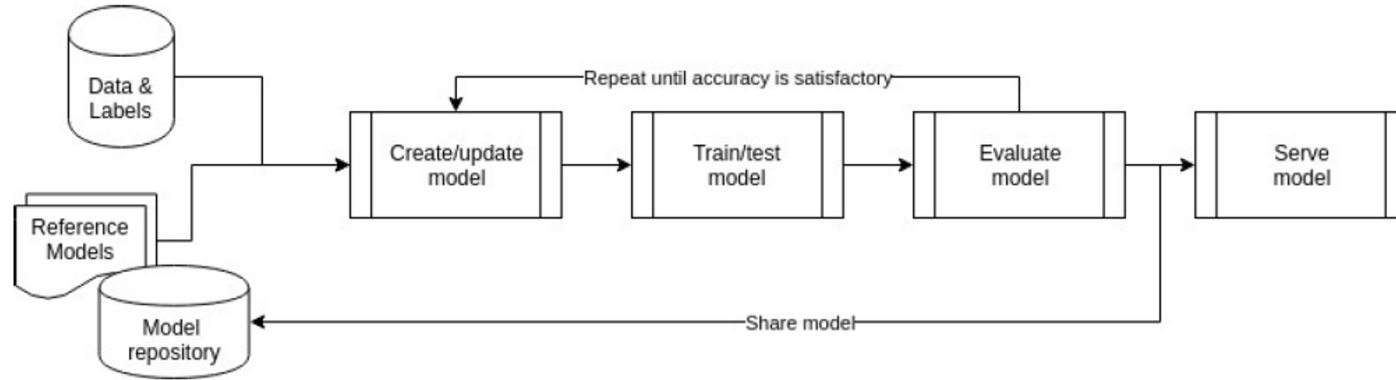

- The project covers all development phases of a machine learning application:

    - Creation, update, improvement of a model (existing or new) → **DEEP Open Catalog and DEEP training facility**

    - Model training, test, evaluation → **DEEP training facility**

    - Model deployment as a service → **DEEP as a Service**

    - Model publication for sharing and reuse → **DEEP Open Catalog**

DEEP Open Catalog

Sharing knowledge between users

https://marketplace.deep-hybrid-datacloud.eu
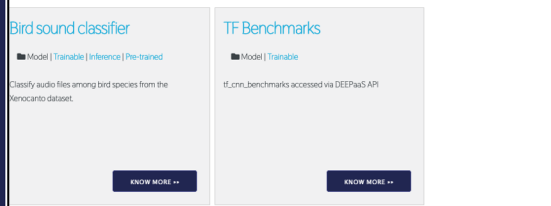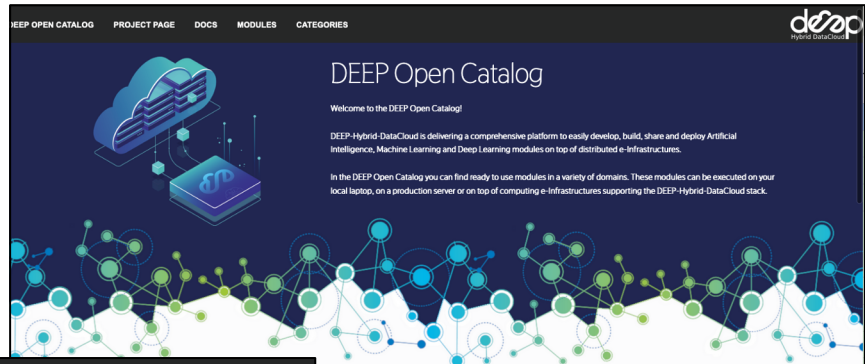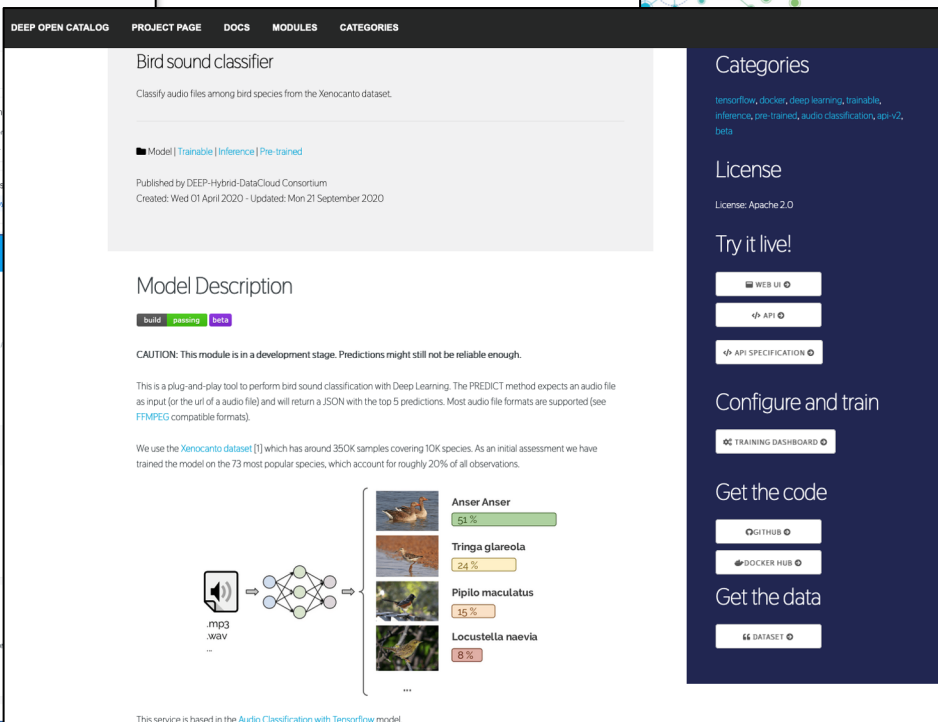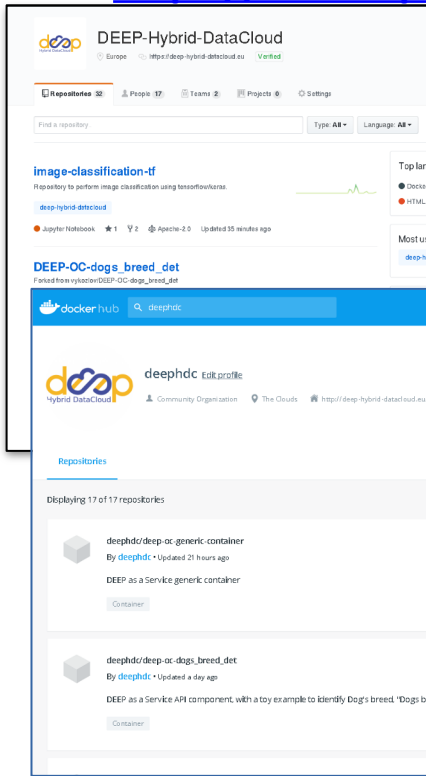
DEEP training facility

Development and training environments

https://train.deep-hybrid-datacloud.eu
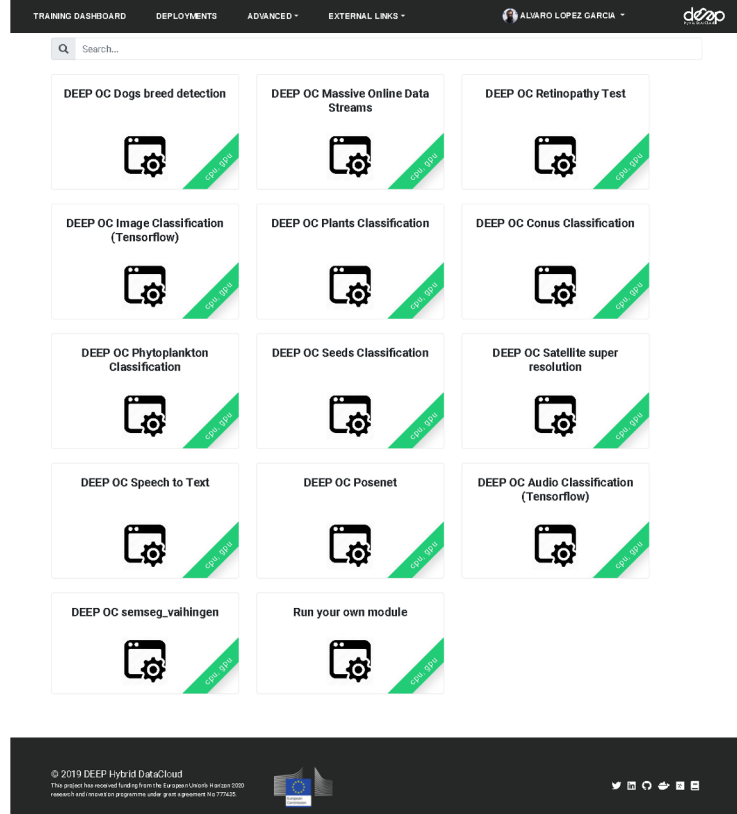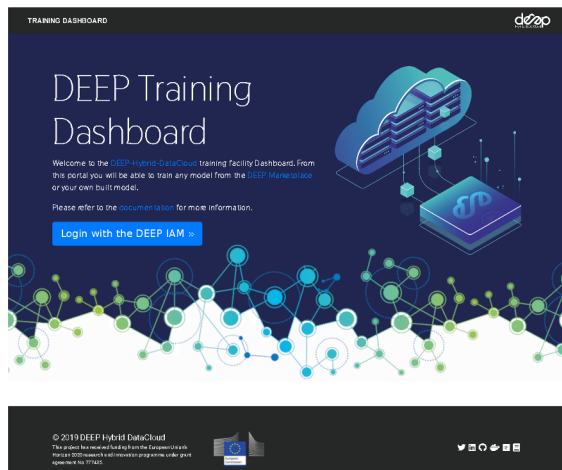
Train, test and evaluate of models through the DEEPaaS API
- Transparent access to infrastructure resources
- Based on **TOSCA templates** submitted via **INDIGO-DataCloud PaaS orchestrator** and **Infrastructure Manager**

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DEEPaaS: DEEP as a Service

Automatic deployment of catalog modules to exploit their functionality

https://deepaas.deep-hybrid-datacloud.eu

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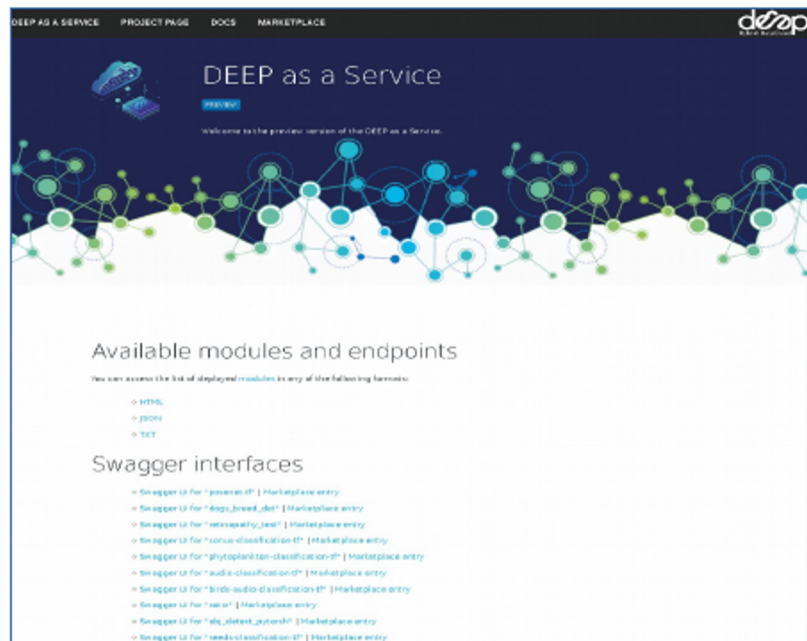
DEEPaaS API: models as services

Exposing models through a common and standard-based API

https://deepaas.readthedocs.io
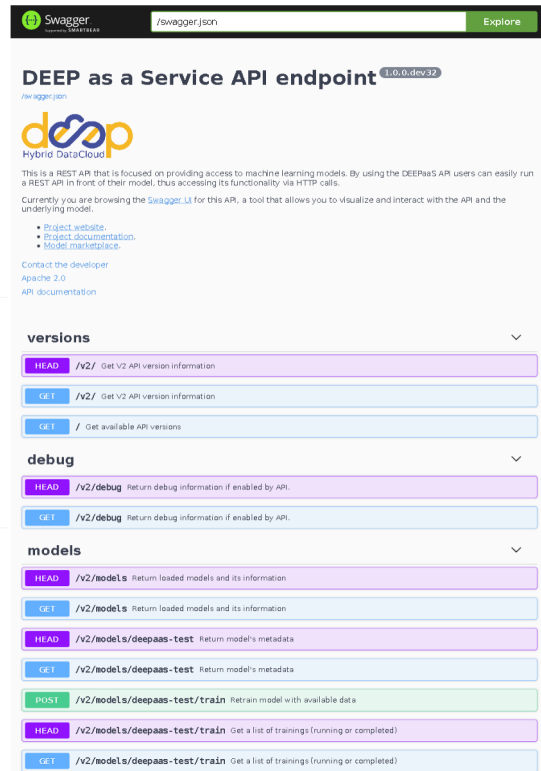
Different users, different needs

- **Category 1**: Deploy a readily trained network for somebody else to use it on his/her data set
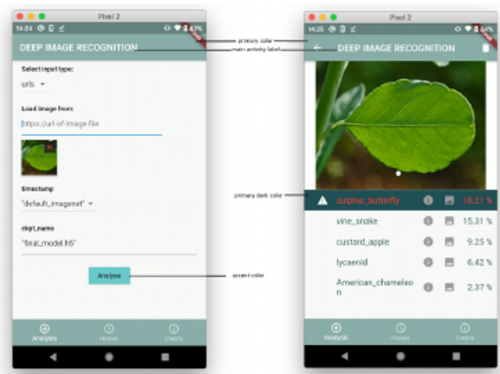 - Domain knowledge

- **Category 2**: Retrain (parts of) a trained network to make use of its inherent knowledge and to solve a new learning task
  - Domain + machine learning knowledge

- **Category 3**: Completely work through the deep learning cycle with data selection, model architecture, training and testing
  - Domain + machine + technological knowledge

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High Level Hybrid PaaS

- Advance TRL of INDIGO-DataCloud PaaS Orchestrator, Infrastructure Manager, Virtual Router and Cloud Info Provider in order to:
    - Scale deployments across private and public clouds with seamless network connections
    - Exploit special hardware resources (namely GPU, Infiniband) from Cloud and HPC environments
    - Ensure flexibility and interoperability through TOSCA and federated authentication (IAM)

- Improved support for hardware resource selection
    - Fine-grained accelerator (GPU) selection
    - Support at information providers modules

- Improved support for hybrid-cloud deployments
    - Leveraging high-level networking solutions

- Improved management of deployment failures
    - Resource selection and error recovery

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Overview of technical activities

CNAF for the DEEP-HDC project

- **3M euros** (Total project Funding)
  - **375K** (BARI, CNAF, TORINO)
    - **110K** Personale (CNAF)
    - **20K** Missioni (Progetto, CNAF_CCR)

- **448 PMs** over 30 months
  - **56** PMs (INFN)
  - **22** PMs (CNAF)

WP	Task	PM complessivi	CNAF (PM)	Reponsabilità
WP3		**12**		
WP3	Task 3.1 – Pilot testbeds and integration with EOSC platform and their services	4	3	
WP3	**Task 3.2 – Software quality assurance, release, maintenance and support**	8	8	**Responsabilità INFN: Cristina Duma**
WP4		**12**		
WP4	Task 4.3 – Interaction with HPC resources with PaaS approach	8	1	
WP5	**INFN WP Leader**	**20**		WP Leader: Giacinto Donvito/Marica Antonacci
WP5	Task 5.1 – PaaS-level Orchestration Supporting Multi-IaaS Hybrid Infrastructures	12	3	Responsabilità INFN: Marica Antonacci
WP5	Task 5.3 – High-level networking orchestration to connect seamlessly to hybrid clouds	3	3	
WP6		**12**		
WP6	Task 6.1 – Application model building	8	3	
WP6	Task 6.2 – DEEP as a Service deployment and exploitation	4	1	
Totale		**56**	**22**	

CNAF: people who reported

Persone	%	WP	Mesi	PM
Salomoni D.	10%	3,5,6	28	2
Duma C.	20%	3,5,6	28	5
Michelotto D.	7%	3	27	2
Ceccanti A.	7%	4,5	28	2
Ronchieri E.	7%	3,6	28	2
Costantini A.	20%	3,4,5,6	21	5
Morganti L.	15%	2,4,5,6	17	3
Falabella A.	7%	5,6	27	2
Vianello E.	20%	3,4	14	2
Caberletti M.	0%	5	0	0

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WP3 - Pilot infrastructures and services

LIP/INCD (Provider)
IM: https://im.ncg.ingrid.pt:8800
Alien4Cloud: https://a4c.ncg.ingrid.pt
OpenStack: https://stratus.ncg.ingrid.pt/

CESNET (Provider)
OpenStack: https://dashboard.cloud.muni.cz/

IFCA/CSIC (Provider)
DEEPaaS: https://deepaas.cloud.ifca.es/api/v1/web/deepaas
Training dashboard: https://train.deep-hybrid-datacloud.eu/
Mesos (GPUs): https://mesos.cloud.ifca.es/mesos/
OpenStack (DEEP-IAM): https://portal.cloud.ifca.es/
Oneprovider (DEEP-IAM): https://oprov.ifca.es
Object store: Swift: https://cephrgw01.ifca.es:8080/swift/v1

PSNC (Provider)
QCG/HPC: ssh ui.eagle.man.poznan.pl
Mesos: https://cereus.man.poznan.pl/mesos
OpenStack: https://cereus.man.poznan.pl/horizon

IISAS (Provider)
Mesos (GPUs): https://mesos.ui.sav.sk/mesos-web/
OpenStack (DEEP-IAM): https://horizon.ui.savba.sk/horizon/
Oneprovider (DEEP-IAM): https://oneprovider.fedcloud.eu

INFN/CNAF (Pilot TB)
DEEP-IAM: https://iam.deep-hybrid-datacloud.eu
PaaS Orchestrator: https://paas.cloud.cnaf.infn.it/orchestrator/
PaaS Orchestrator Dashboard: https://paas.cloud.cnaf.infn.it/
Onezone: https://onezone.cloud.cnaf.infn.it
Oneprovider: http://onedata-mon1.cloud.cnaf.infn.it:5001/
OpenStack: https://horizon.cloud.cnaf.infn.it/dashboard

INFN/Bari (Integration TB)
PaaS Orchestrator dashboard: https://deep-paas-dev.cloud.ba.infn.it/
PaaS Orchestrator: https://deep-paas-dev.cloud.ba.infn.it/orchestrator
IM: https://deep-paas-dev.cloud.ba.infn.it/im
Mesos (With GPUs): https://mesos.recas.ba.infn.it/marathon
Onezone: https://onezone-beta.cloud.ba.infn.it
Oneprovider: https://oneprovider-beta.cloud.ba.infn.it
Vault: https://vault.cloud.ba.infn.it:8200
OpenStack: https://cloud.recas.ba.infn.it
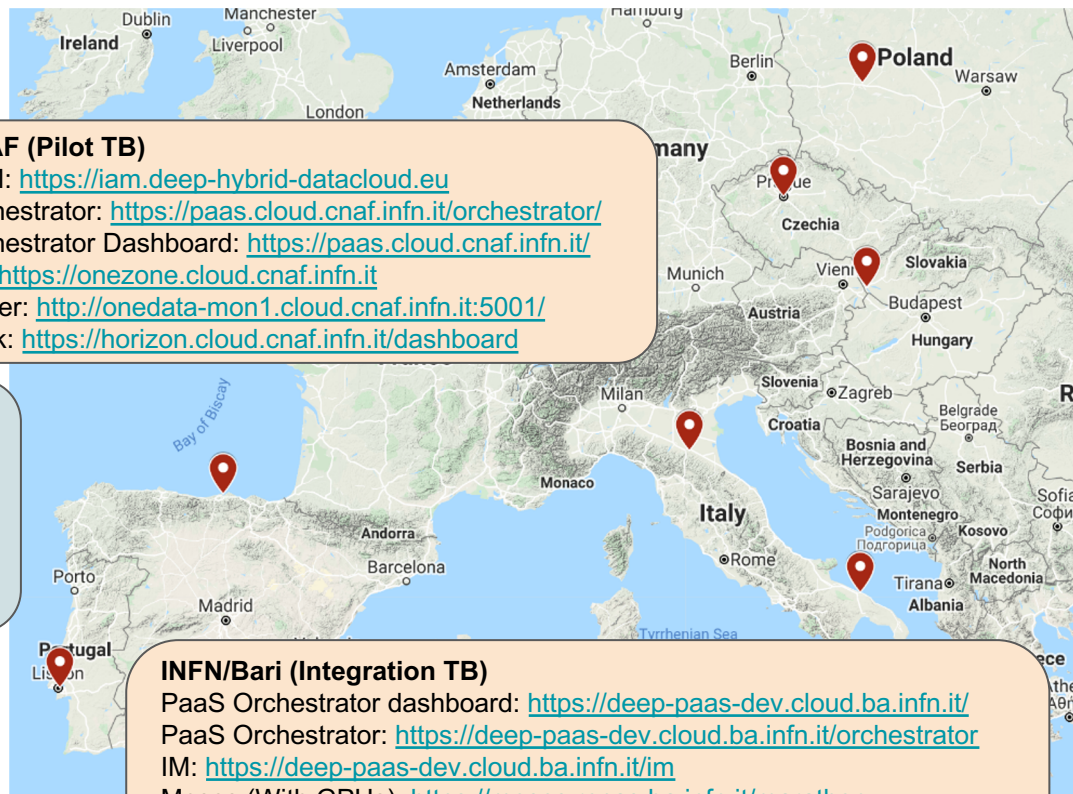
WP3 - Software quality assurance, release, maintenance and support

- Release management
  - Software and platform release and maintenance
  - Project-wide documentation, product documentation, release notes

- Security coordination and external assessment

- Extensive automation in place for relevant processes
  - Software Quality Assurance (SQA), Software release and maintenance
  - State of the art continuous integration infrastructure

- Work with user communities with DevOps approach
  - Collaboration with WP2

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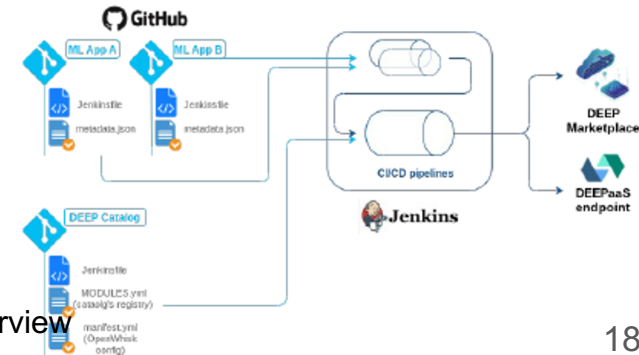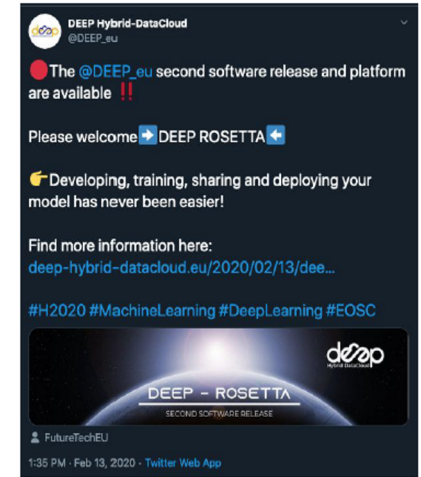
# WP4 - Interaction with HPC resources with PaaS approach

Deployment of a Kubernetes cluster

- Support for GPU in Kubernetes is provided via NVIDIA runtime plugin

- Integration with DEEP IAM using OpenID Connect (OIDC) standard

- Authorization supported via Attribute Based Access Control (ABAC) in Kubernetes

- Support to the deployment of production site with GPUs and OIDC

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WP5 - PaaS-level Hybrid Cloud solutions

5.1 Support to Multi-IaaS Hybrid Infrastructures

- Integration tests with the developed services
- Testing of automatc deployment via TOSCA
- Orchestrator-Dashboard
  - tests and deployments
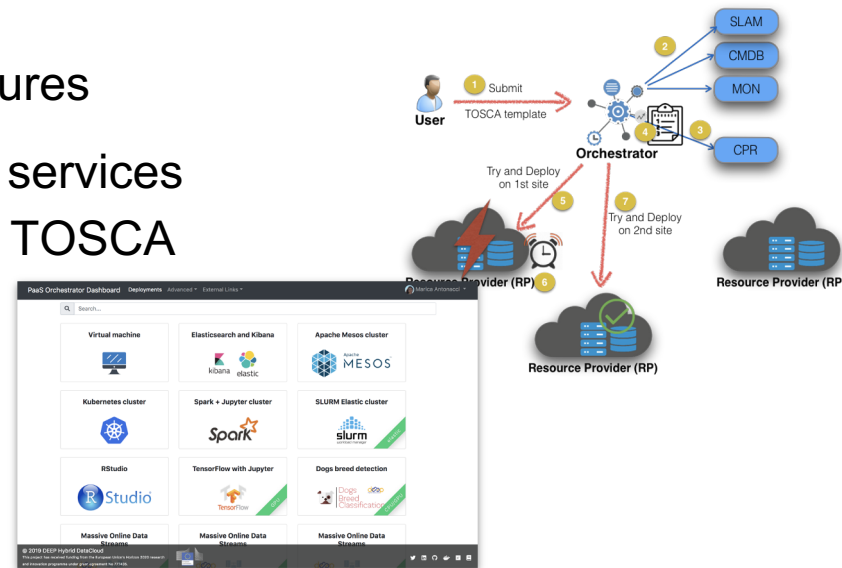
5.3 High-level networking orchestration

- This activity has not been finalised due to people leave

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WP6 - DEEP as a Service

- Alien4Cloud high level user interface as DEEPaaS solution

- Application lifecycle contribution

  - deployment, testing and validation

Alien4Cloud
(Application
Modeler)

```
tosca_definitions_version: tosca_simple_yaml_1_0

imports:
  - indigo_custom_types: https://raw.githubusercontent.com/indigo-dc/tosca-
types/master/custom_types.yaml

topology_template:
  inputs:
    wn_num:
      type: integer
      description: Number of WNs in the cluster
      default: 1
      required: yes
...
  wn_node:
    type: tosca.nodes.indigo.LRMS.WorkerNode.Kubernetes
    properties:
      front_end_ip: { get_attribute: [ lrms_server, private_address, 0 ] }
    requirements:
      - host: lrms_wn
```
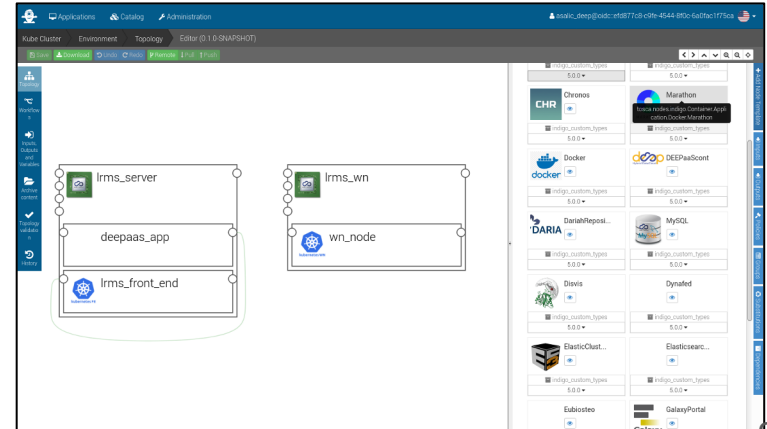
Conclusions

- DEPP-Hybrid DataCloud outcomes and results presented at the final review
  - Held on June 4th 2020, virtually
  - Excellent result in the final evaluation
    - *"Project has delivered exceptional results with significant immediate or potential impact"*
  - CNAF had an important role in WP3 (Release management and Software Quality Control)
  - This central role and the related activities have been recognized by the reviewers
    - *"WP3 [...] it ensured the production of an industrial quality software"*

- CNAF contribution
  - Depending on the effort distribution, CNAF supported all the JRAs by contributing to deployment, testing and validation of the tools and services
    - Used in the current e-infrastructures
    - Available in the EOSC marketplace

- Other contribution
  - Fund fixed-term contracts
  - Strengthen the relation with other players and partners