Welcome to WP4’s Virtualized Resources

WP4.1 Computing Virtualisation
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WP4.2 Storage Virtualisation
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WP4.3 Network Virtualisation
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Content

- High level objectives of INDIGO WP4.
- High level overview.
- Details on selected highlights.
- Usage and contribution to standards in WP4.
- Summary.
High level WP4 Objective

- In WP4 we develop components needed to guarantee that INDIGO solutions can be non-disruptively integrated into the major existing e-infrastructures (Grid, HPC and Cloud).

- In the context of the INDIGO software stack, WP4 components are the building blocks, the PaaS level is build upon.
IaaS in the INDIGO Context

User Portals
Mobile Apps
Scientific Workflow

PaaS Orchestrator
Onedata, FTS

Infrastructure Mgr

TOSCA
HOT
OCCI
CDMI

Non-INDIGO IaaS

OpenStack
dCache

OpenNebula
CEPH

Network Orchestration
High level overview
High Level Overview

- Providing Support for Containers in addition to the already existing VM support at the IaaS layer
  - Support for selected Cloud Management Frameworks.
  - Using open-standard interfaces.
  - With automatic repository synchronization.

- Improving on-demand compute capabilities at the local datacenters
  - Improving cloud scheduling, a mandatory requirement for production systems.
  - Facilitating container execution in HPC and HTC systems.
  - Providing site-level orchestration.
High Level Overview (cont.)

- Providing “Network Isolation” resp. “Multi Tenancy” for Virtual Machines.
  - Protecting user VMs from world access.
  - Protecting the world against maliciously acting virtual machines.
  - However, making VMs within a “Tenant” visible and discoverable.
  - Evaluating vendor support for SDN, as reported in INDIGO Deliverable D4.4.

- Providing a common framework to orchestrate Quality of Service in Storage across various Open Source and industry based storage technologies.
  - Including GPFS, CEPH, dCache, HPSS and StoRM
  - Setting up a European-wide Testbed with different types of storage endpoints.

- Consolidating AAI across the entire IaaS layer.
  - Integration of OpenID Connect when possible.
  - Using Token Translation when necessary.
High Level Overview (cont.)

Supporting Standards

- OCCI support in Compute and Networking for the supported CMFs
- Agreeing on a common vocabulary for QoS in storage across various science communities via RDA.
- CDMI Extension with SNIA to supporting Storage Quality of Service
- TOSCA language as the orchestration standard.
- OpenID Connect for common authentication, allowing Single Sign On.
- Standardized Usage Records, defined by the Open Grid Forum (OGF), for accounting.
Details on highlights

In INDIGO-1 release.

Development in progress, but not in release yet.

INDIGO teams actively involved in standardization process.
Container Support

- **Container support in Cloud Management Frameworks**
  - OpenStack (nova-docker)
    - Maintenance and packaging of nova-docker -> bug-fixes and improvement
  - OpenNebula (ONEDocker).
    - New driver development from scratch plus maintenance and packaging

- **Container repository (DockerHub) synchronization**
  - Generic WebService, responding to events from the central DockerHub service, by automatically synchronizing containers to local repositories.
  - New product developed: java-reposync

- **Batch system container support**
  - uDocker
    - Running Docker containers in user-space, without Docker at all.
  - BDocker
    - Manager for executing containers in batch-systems.
    - Under development, not yet released.
Improved Scheduling

- **Synergy**
  - General purpose manager for OpenStack, implementing FairShare scheduling, based on user, group and ‘past usage’ information.
  - SLURM “Multifactor Algorithm”
  - External product interacting with OpenStack Compute.

- **OpenNebula FairShare Scheduler**
  - Under development.
  - Will be accepted as an OpenNebula plug-in.

- **Partition Director**
  - Switches physical compute resources between a Batch System and a Cloud Infrastructure.
  - Reassigning shares and quotas.
  - Released in INDIGO-1 for the LSF batch system.
  - Next step is to provided the PD for other batch systems, e.g. HTCondor.
Improved Scheduling (cont.)

- OPIE: OpenStack *pre-emptible* Instances Extension
  - Pre-emptible instance model: interruptible by higher priority VMs.
  - Technical prerequisite to support spot instance markets.
  - Currently shuts-down VMs, but different actions can be chosen, e.g. suspending and resuming VMs.
  - Implementation as a pluggable scheduler + API extensions.
  - Working on upstream integration.
IaaS Design in Computing

- DockerHub INDIGO
- INDIGO-IAM
- OpenID Connect
- Advanced Scheduling
- Local Repository
- Java-reposync
- TOSCA Parser
- HEAT Translator
- OCCI
- TOSCA
- OpenStack
- Heat / IM (Orchestration)
- OpenNebula
- Cloud UR
- GLUE
- JSON
- Cloud-info-provider
- Information system
- SSM (Accounting)
- Docker Container
- Virtual Machines
- Local Repository
- INDIGO-IAM
Network Orchestration

- Networking functions and orchestration for OpenNebula
  - Currently in alpha version.
  - Network Orchestrator Wrapper
    - Standalone component to orchestrate VXLAN-based networks in OpenNebula.
  - rOCCI-server backend for NOW to enable network management over OCCI.
  - Provides preliminary consistency checks before translating and forwarding the OCCI request to the local network infrastructure.
OCCI Layout for the network

- Custom client app.
  - Native Ruby application
    - rOCCI-api
    - rOCCI-core
  - Native Java application
    - jOCCI-api
    - jOCCI-core

Application or script using command-line executables

- Custom client app.
  - rOCCI-api
  - rOCCI-core

Shell script

- # Shell script
  - rOCCI-cli
  - rOCCI-api
  - rOCCI-core

- Other independent OCCI compliant client

- Indigo IM

Clients

http occi

- OpenStack
- Synnefo
- OpenNebula
- MS Azure
- Indigo IM

Servers

http occi

- NOW
- Amazon Web Services

NOW Clients

http occi

Servers

http occi

Indigo IM
OCCI Layout for the network

DEMOs yesterday

EGI Integration and Disvis & Powerfit
Authentication and Identity Management

- Authentication based on OpenID Connect..
  - OpenID connected matches the INDIGO design requirements to a large extend and provides an industry standard.
  - OIDC is in line with the AARC blueprint architecture.
  - In consequence, INDIGO components, designed to work with the INDIGO IAM system, like the Token Translation service, can authenticate with other, similar, IAM systems, like EGI and Google.
  - OIDC Plug-Fest in preparation.

Demo yesterday
Authentication and Identity Management

- **OpenID Connect support (Cont.)**
  - Direct *OpenID Connect* support:
    - OpenStack support through its native KeyStone tool.
      - Refactored Command Line Interface merged and released upstream.
    - CDMI Framework System.
    - dCache storage technology.
  - Support through the *Token Translation Service, TTS*
    - *OpenNebula* : OIDC to Username/Password
    - *Grid Systems* : OIDC to X509 Proxies via an Online CA.
Cloud Info Provider

- Publishes resource provider information and capabilities.
- Augmented to implement a JSON rendering.
- Changes being merged into EGI’s upstream info provider.
- The goal is to provide a single product for both types of rendering.
  - The traditional *LDIF* for Grid and
  - *JSON* for cloud systems.
Cloud Storage Virtualisation

- Implementation of CDMI extensions
  - Information system to provide details about storage quality
    - Initial attributes supported:
      - **Access latency** (estimated time to first byte), **Location** of data (on a country-level granularity for legal purposes), **Number of copies** of data
      - List of available storage qualities into which a migration is available
  - Storage systems supported via plugins
    - TSM/StoRM, dCache, CEPH, HPSS
  - Modify storage quality
    - “Bring online” by moving between the available storage classes
  - Established a *European Testbed* with heterogeneous technologies.
Pluggable CDMI Framework

CDMI Framework Server

Plug-in System

SRM

RESTful

RESTful

Direct API

Storage Endpoints

GRID System

StoRM

dCache

GPFS Lustre, CEPH
Pluggable CDMI Framework

CDMI Framework Server

Plug-in System

SRM
X509

RESTful
Trusted

RESTful
OIDC

Direct API
Set UID

Storage Endpoints

GRID System

StoRM

dCache

GPFS Lustre, CEPH

Online CA

Token Translation Service

Identity Harm.

OpenID Connect

IAM

Online CA

Token Translation Service

Identity Harm.
## CDMI Media Capabilities

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<th>Object</th>
<th>Value</th>
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<tr>
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<tr>
<td>Children</td>
<td>DISK</td>
</tr>
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<td></td>
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<table>
<thead>
<tr>
<th>Key</th>
<th>Value</th>
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<tbody>
<tr>
<td>Data_redundancy</td>
<td>1 Copies</td>
</tr>
<tr>
<td>Geographical Placement</td>
<td>“DE”</td>
</tr>
<tr>
<td>Latency</td>
<td>600000</td>
</tr>
</tbody>
</table>

- Data_redundancy: 1 Copies
- Geographical Placement: “DE”
- Latency: 600000
Cloud Storage Virtualisation

- Implementation of CDMI extensions
  - (Including workflows, Staging)
  - Webservice at KIT continuously verifies 5 evaluation endpoints:
    - http://seemon.data.kit.edu
      - KIT (GPFS, HPSS)
      - BARI (GPFS, Ask Giacinto)
      - CNAF (GPFS, StoRM)
      - POZNAN (CEPH)
      - DESY (dCache)
Support of standards

- **OCCI** : IaaS management standard and interface.
  - “ooi” : include OpenStack networking changes.
  - Both rOCCI (ONE) and “ooi” support containers transparently.
    - Currently in Production at EGI Sites.
  - Networking functions in OpenStack OCCI Interface.
  - INDIGO involved in OCCI network definition OGF Working Group:
    - IP address reservation
    - Security Group Controls
Support of standards (cont.)

- **TOSCA: The Orchestration Standard.**
  - "tosca-parser" and "heat-translator": fixes for supporting custom types. This work has been contributed upstream.
  - TOSCA support in ONE through the *Infrastructure Manager (IM)*.
  - TOSCA support in OpenStack through the "heat-translator".
  - Currently in preparation by IBM: "HEAT Translator as a Service"
Support of standards (cont.)

- Survey available SDN options to enable spanning inter-site networks.
  - Recommendations and possible approaches for federated environments such as EGI Federated Cloud
  - INDIGO Deliverable D4.4 evaluates options and possible standards.
- Agreement on a common vocabulary for storage QoS across sciences under the umbrella of the Research Data Alliance.
  - INDIGO created a QoS in storage working group.
- Agreement on an extension of the CDMI protocol with the Storage Network Industry Association.
  - Member of the SNIA CDMI extension working group.
Support of standards (cont.)

- OGF Usage Record for accounting.
  - Accounting based on the OGF standard *Usage Record* (UR) resp. the *Cloud Accounting Usage Record*.

- Consistent usage of OpenID Connect authentication.
  - OpenStack via KeyStone.
  - OpenNebula via the INDIGO Token Translation Service.
  - CDMI Framework and dCache: direct OIDC
Contribution merged upstream

Essential in the context of sustainability and acceptance.

- **OpenStack**
  - NovaDocker
  - Heat Translator (On the client side)
  - OOI (OCCI for OpenStack)
  - Cloud info provider has been merged into EGI upstream code.
  - Pre-emptible Instance (in progress)

- **OpenNebula**
  - OneDock
  - rOCCI

- **OpenID Connect**
  - OpenID Connect via KeyStone (in the client side, via browser)
    - Lib Cloud authentication.
    - Erlang library
    - Java implementation for dCache.
Summary

- WP4, presenting the IaaS endpoints, is composed of a large variety of heterogeneous sites across Europe, representing a large set of scientific communities.

- In order to provide easy integration into the European infrastructures, WP4 is using standard technologies and protocols wherever possible and contributes to standardization efforts when necessary.

- WP4 puts significant efforts into contributing components to their official upstream repositories:
  - Increases acceptance by local site administrators.
  - Makes those components sustainable beyond INDIGO.
The End