Exploiting private and commercial clouds to generate on-demand CMS computing facilities with DODAS

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Outline

• Introduction to DODAS
  – Architectural Pillars & High Level Overview
• Opportunistic computing with DODAS in CMS
  – Public and Private clouds
• Data processing: Caching mechanism
• Machine Learning as a Service : a new use case
• Conclusions
**Dynamic On Demand Analysis Service: DODAS**

- Platform as a Service tool which aim is to guarantee deployment of complex and intricate setup on “any cloud provider” with almost zero effort.
- Allows to instantiate on-demand container based cluster to execute software applications.

**DODAS in a nutshell**

- **Opportunistic computing:** Temporarily available for a specific task, user or group.
- **Extension of existing Facility**
  - Manage peaks of usage
- **Multi cloud cluster deployment**
  - Harvest dispersed resources (PaaS level federation)
- **Exploitation of Machine Learning as a Service**
- **Batch System as a Service**
  - HTCondor batch System

**DODAS is a Thematic Service under EOSC-hub Horizon 2020 EU project.**

- Initially developed as an INDIGO-DataCloud use cases based on CMS workflow.
The pillars

Resources Abstraction

TOSCA to describe software applications and dependencies
Infrastructure Manager as connector with underlying IaaSes

Automation

Ansible for software and application setup
Mesos/Marathon to manage resource and orchestrate
Clues to automate horizontal scalability

Multi-cloud support

INDIGO-PaaS Orchestrator to deal with multiple heterogeneous Cloud infrastructures

Federated authentication

INDIGO-Identity Access Management to manage JWT, OpenID Connect, SAML2.0, LDAP, Local (Username/Passwd); Identity harmonization etc

See talk: Beyond X.509: Token-based Authentication and Authorization for HEP
Putting everything together

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PaaS Orchestrator

Home IdP

IAM

AuthN

Submit TOSCA

DODAS

User

PaaS

Private Cloud

Marathon

Master

Slave

Executor

Software Application

Software Application

Public Cloud

Marathon

Master

Slave

Executor

Software Application

Software Application

Data Analysts

Software Application

Software Application

Software Application

Software Application
And how all of this integrates with CMS HTCondor Global pool

- Completely transparent to CMS physicists
- Seamlessly integrating the global infrastructure
DODAS within top 6 CMS Tier2s for 10 days

CMS users analysis: hh—>2b2tau
→ Skimming minAOD (Data & MC) to produce flat-ntuple

- Francesco Brivio INFN
- Chiara Amendola LLR
- Elasticity and self-healing
- Handling “special requirements” high memory jobs
- Stability over days/weeks (120k jobs)

→ Work done in conjunction with

Thanks to Andrea Chierici
Data Ingestion: Caching Strategy

- Deployment of a cache layer between Worker Nodes and remote Grid Storage Elements.
- Cache layer implemented with XRootD Data Cache (XCache)
  - Seamlessly integrating the CMS runtime environment
- Supporting an On-Demand Caching deployment model
  - TOSCA (plus Ansible)

→ Development done in the context of eXtreme DataCloud

See Talk: Advancements in data management services for distributed e-infrastructures: the eXtreme-DataCloud project
DODAS on OpenStack @ICL: cloud.grid.hep.ph.ic.ac.uk

- Use Cases
  - Producing CMS nanoAOD format for IC SMP Analyses
  - Producing Gen-Sim from CMS grid packs
  - Producing CMS grid packs

DODAS adopted to run workflows with specific Memory requests (up to 32GB)
Analysis of “Data Cache” related metadata flow

- To improve caching layer management: **Smart Cache**

1. Collection of raw data
   - Workload management
   - Data management
2. Data enrichment and reduction with Spark jobs
   - Storing of output data in HDFS
3. Analysis of structured data
4. Prototyping of a model

**End Users**

**DODAS ephemeral site**

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DODAS seamless integrated into existing HTCondor Global Pool of CMS
  - Several use cases based both on HTCondor and BigData

Successfully tested on many Public and Private clouds

DODAS is a Thematic Service under the EOSC-hub Project, as such it is supposed to be adopted also outside CMS
  ▪ AMS Experiment is already testing/evaluating DODAS

DODAS experts are available for consultancy and training interested communities.
  - Contact spiga@infn.it
  - Additional info: https://dodas.gitbook.io/dynamic-on-demand-analysis-service/