



User Group Meeting 2017

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Provisioning Flexible and High Available iRODS-based Data Services at Euro-Mediterranean Center on Climate Change

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cmcc
Centro Euro-Mediterraneo
sui Cambiamenti Climatici

Outline

- Motivations & Objectives
- iRODS-based Data Portal Application
- Data Service Components for netCDF files: iRODS, Solr, Thredds
- CLIMA Architecture for provisioning Data Services
- Future works

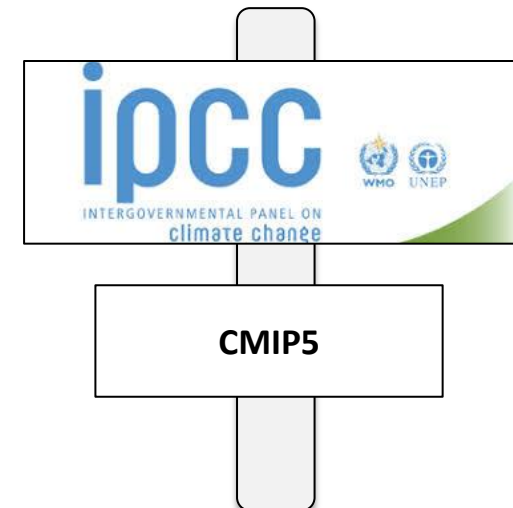
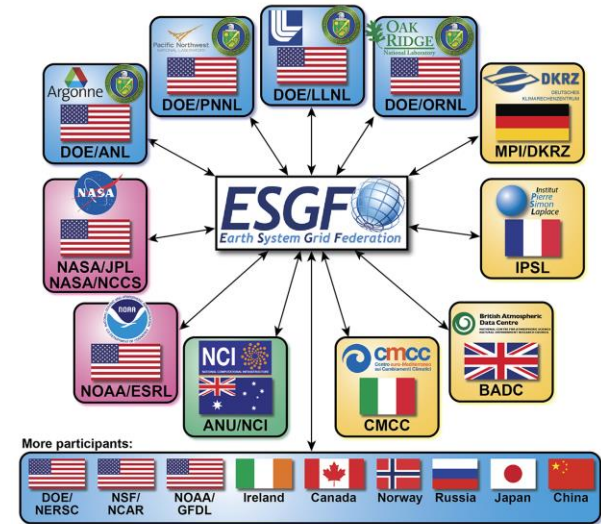
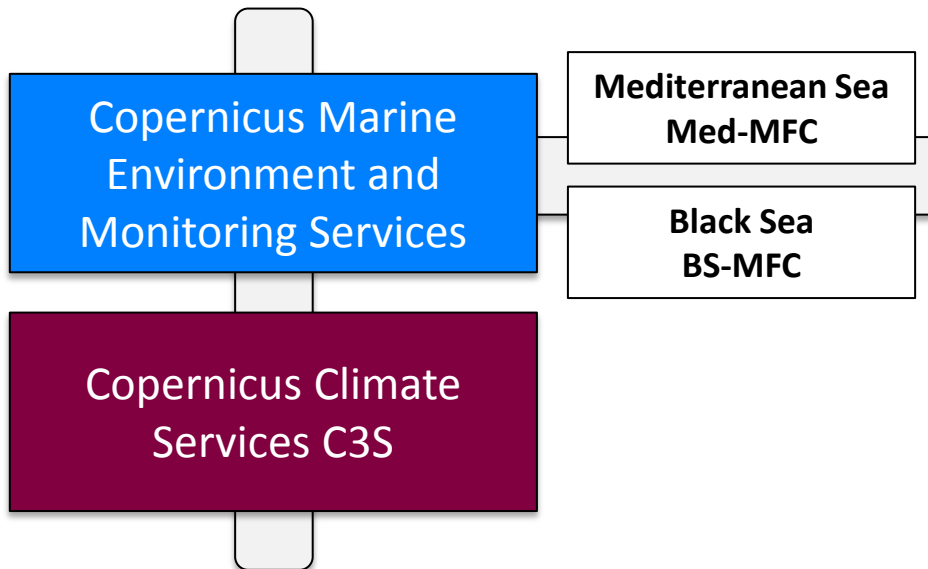


Motivations

- CMCC scientific datasets: **multidisciplinary** data related to climate change scenarios and impacts: climate, ocean, agriculture, hydrology, atmosphere, socio-economic, forest, ecosystems, climate indicators, risk assessment
- Some scientific datasets can be **critical**, used by different divisions and **accessed in different (spatial/temporal) ways**
- CMCC operational data services can have **different needs and requirements**:
 - *data formats* (such as **netCDF**, csv, grib,...)
 - *schemas*
 - *data policies*
 - *storage characteristics*
 - *software components* (Thredds Data Servers (OpenDAP, WMS, NCSS), OGC-WPS, FTP, Science Gateway, Custom Operational Chains, ...)



Examples of Operational Data Services @ CMCC



Objectives

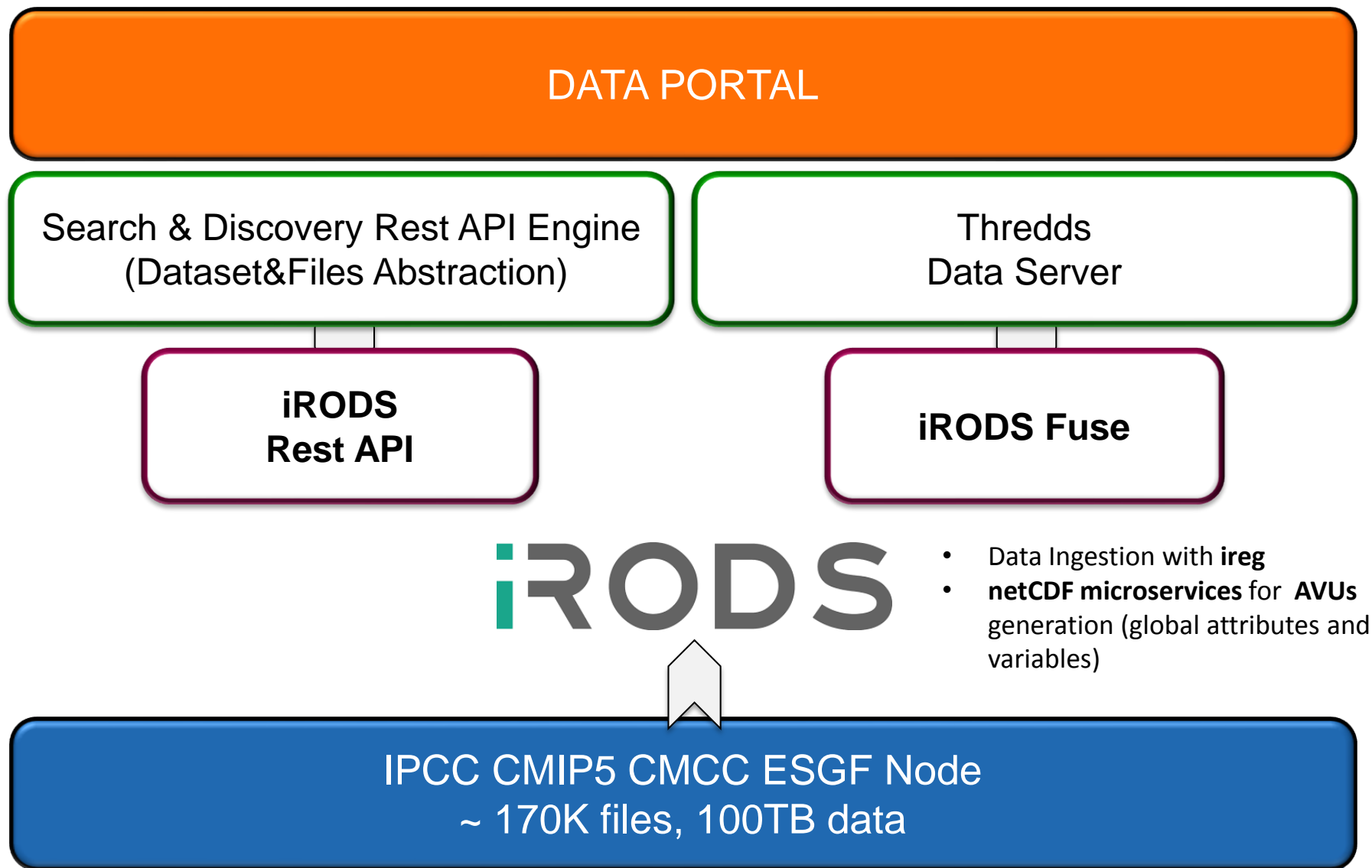
- Providing users with a **unique global namespace** for their scientific datasets to ease the management of scientific datasets (**retrieve&archiving**)
- **Optimal storage usage** from admin perspectives
- **Ease the implementation of operational chains** (netCDF post-processing - adding global attributes, schema compliant verification (CF), file naming rules, validation, product quality)
- **Improve collaboration productivity** between internal and external users by sharing CMCC scientific datasets
- Development of a **data portal for CMCC products** (datasets publishing, search&discovery, data subsetting,, ...)
- **Flexible setup of operational data services**



iRODS



iRODS-based Data Portal for netCDF Files



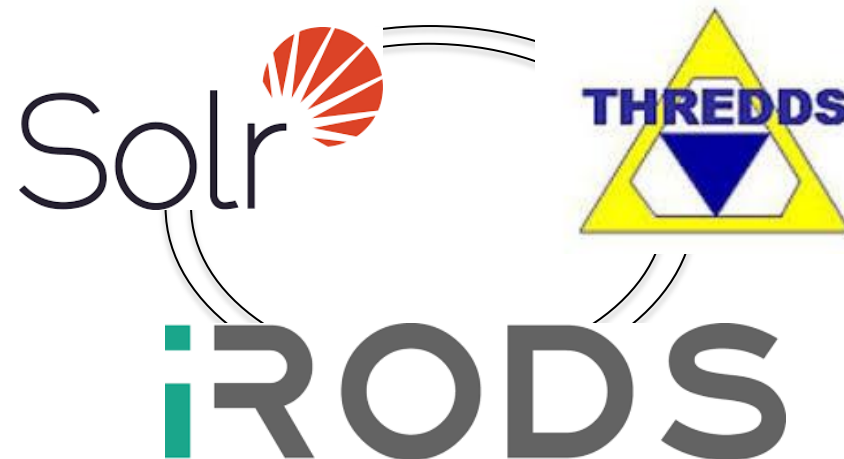
Issues

- iRODS Query Engine performance
- iRODS Query Engine expressivity limitations (i.e., spatial and time queries, faceting, ...)
- Performance and cache issues of iRODS fuse with Thredds
- One iRODS Zone is not a feasible solution for CMCC needs:
 - a unique metadata DB for any CMCC file/operational service difficult to define and maintain
 - possible side effects for the ingestion rules of different operational services datasets
 - admin operations needed for updating rules



How to solve issues?

- **Tight integration of iRODS with Thredds**
- **Solr search platform** for indexing netCDF header
- **Multiple iRODS Zones**: one for each “**data service**”



How to integrate iRODS with Thredds?

- Parrot Virtual Filesystem (<http://ccl.cse.nd.edu/software/parrot>)
- NFSRods (<https://github.com/modcs/NFSRODS>)
- Thredds servers configured for iRODS POSIX-compliant resource
 - Issue for compound resources: the file is in the archive and not in the cache
- Leveraging Jargon library (<https://github.com/DICE-UNC/jargon>) for
 - Thredds Dataset Source Plugin
(<http://www.unidata.ucar.edu/software/thredds/current/tds/reference/DatasetSource.html>)
 - provide Thredds *ucar.unidata.io.RandomAccessFile*
(<https://www.unidata.ucar.edu/support/help/MailArchives/netcdf/msg09388.html>)

iRODS



Thredds Dataset Source Plugin for iRODS

```
public class IrodsDataSource implements thredds.servlet.DataSource {  
  
    public boolean isMine( HttpServletRequest req) {  
        ...  
    }  
  
    public NetcdfFile getNetcdfFile (HttpServletRequest req,  
    HttpServletResponse res) throws IOException {  
        ...  
    }  
}
```

Dataset Source class into `${tomcat_home}/webapps/thredds/WEB-INF/lib` or `classes` directory

Add a line to `${tomcat_home}/content/thredds/threddsConfig.xml` file

```
<datasetSource>clima.thredds.IrodsDataSource</datasetSource>
```



Automated Solr Indexing of netCDF files

- Rules for `acPostProcForPut/acPostProcForDelete/acPostProcForObjRename`
- `msiExecCmd microservice` to execute a ruby script for indexing netCDF header (*query the Thredds NCML (netCDF Markup Language) Service and transform the xml doc for Solr*)



- Solr document id = iRODS data_object id
- A single value field for iRODS data object
- A single value field for each global attribute
- A multi-value field for variable/dataset names
- Spatial and time coverage fields

iRODS



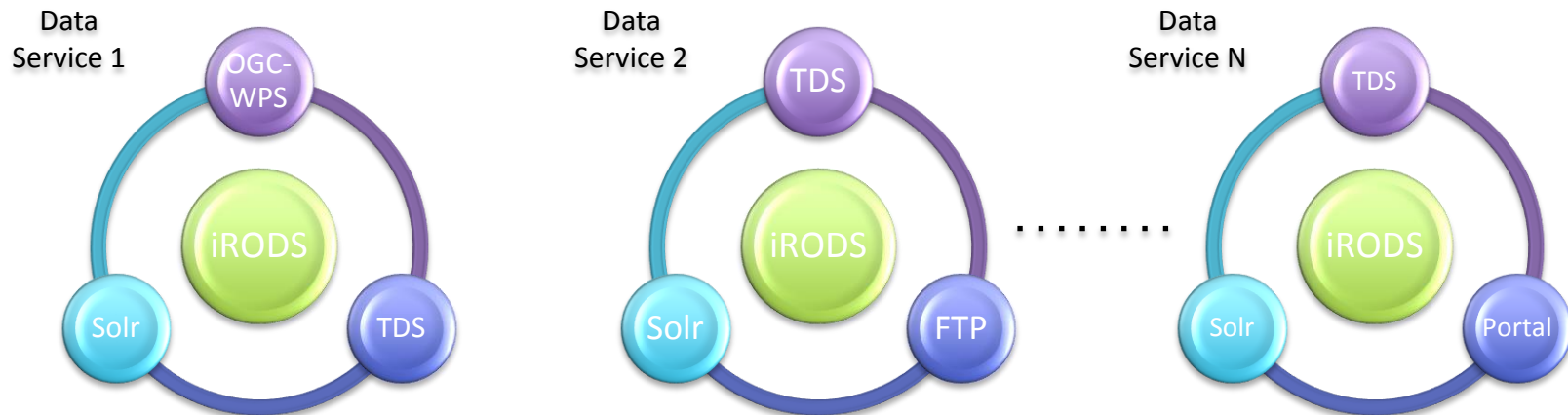
Solr



CLIMA Architecture (Vision)

APPS LAYER

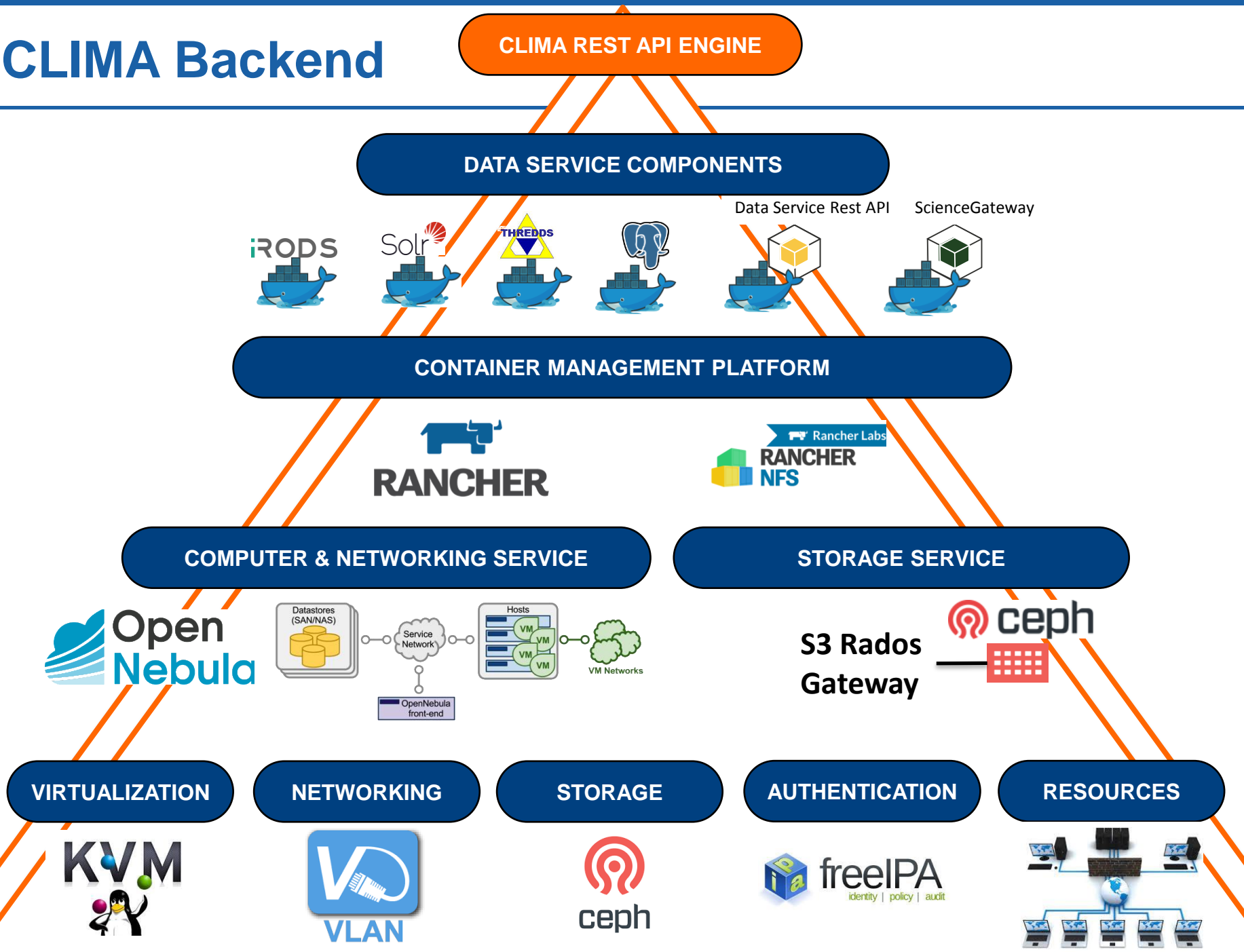
DATA SERVICE INFORMATION ACCESS LAYER



**CLOUD-BASED BACKEND FOR LIFECYCLE MANAGEMENT OF
CONTAINERIZED DATA SERVICES**



CLIMA Backend





VIRTUALIZATION



LIGHT & SIMPLE

Lightweight and easy to install, maintain, operate, upgrade and use

FLEXIBLE

Fully open-source and customizable to fit into any data center and policies

ROBUST

Production-ready, highly-scalable, reliable and supported

POWERFUL

Innovative functionality for private/hybrid clouds and DC virtualization

ORCHESTRATION

Cloud Management

- VDC multi-tenancy
- Simple cloud GUI and interfaces
- Service elasticity/provisioning
- Federation/hybrid

OpenNebula

Virtual Infra Management

- Capacity management
- Multi-VM management
- Resource optimization
- HA and business continuity

OpenNebulavCenterKVMXenVMware



A complete container management platform that makes it easy to...

Production ready

- ✓ 20 million+ downloads
- ✓ Open platform for innovating
- ✓ Easy to use interface
- ✓ Multi-tenant
- ✓ Role based access
- ✓ 24X7 support
- ✓ And more....

RUN CONTAINERS

with the most complete set of container and infrastructure management capabilities



MANAGE APPLICATIONS

by simplifying day to day application lifecycle management



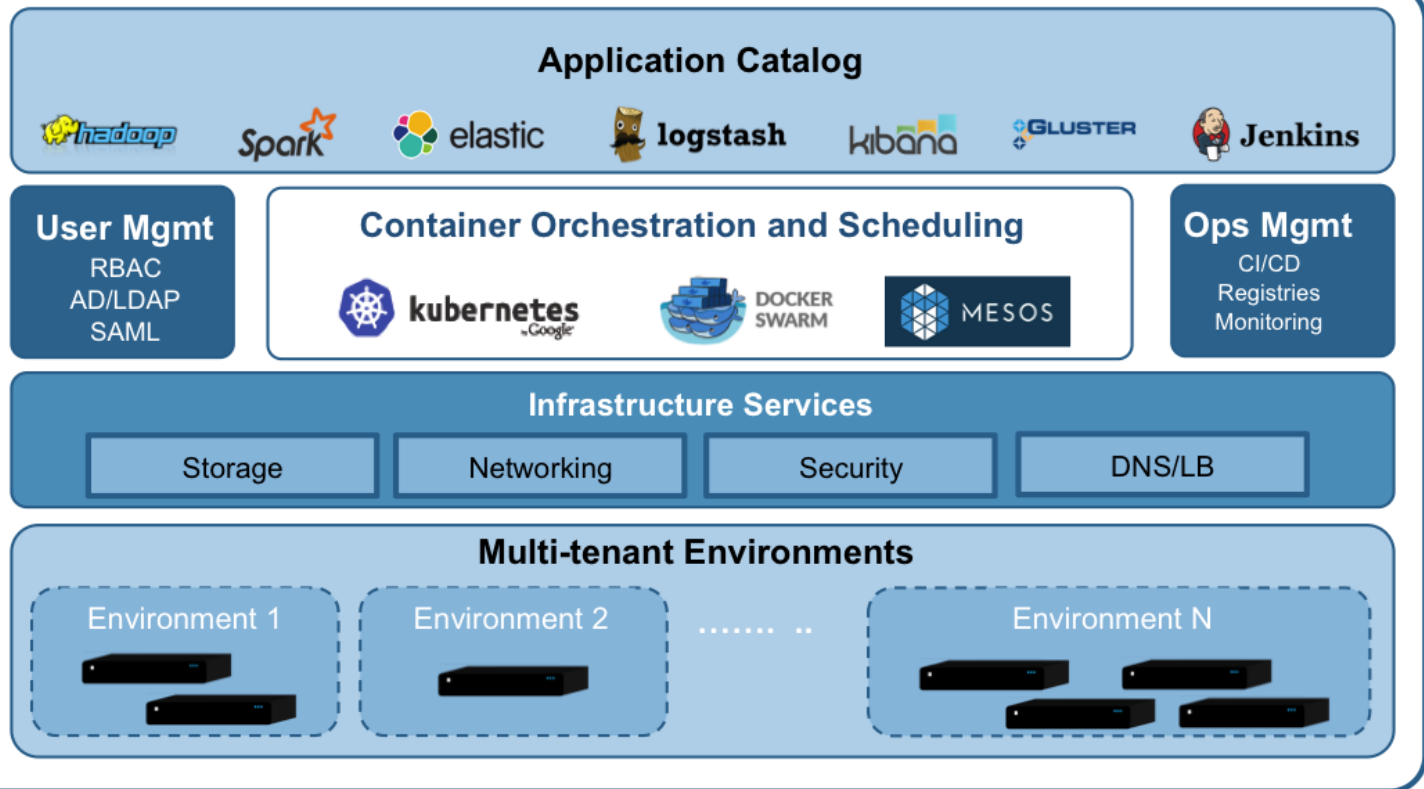
INNOVATE WITH CONTAINERS

without compromising flexibility by empowering developers with fast access to the latest tools





Complete Container Management Platform





OpenNebula and Rancher Integration





- **OpenNebula docker-machine plugin**
<http://github.com/OpenNebula/docker-machine-opennebula>
- PR #315 to the **Rancher community catalog**
(<https://github.com/rancher/community-catalog/pull/315>)



CLIMA Catalog in Rancher

 demods ▾ STACKS ▾ CATALOG ▾ INFRASTRUCTURE ▾ ADMIN ▾ ! API ▾  ▾


Catalog: CLIMA Category: All ▾ 



iRODS iCAT

(Experimental) iRODS iCAT Server


[View Details](#)



iRODS Resource server

(Experimental) iRODS Resource Server


[View Details](#)



iRODS Rest API Server

(Experimental) iRODS Rest API Server


[View Details](#)



MariaDB Galera Cluster

(Experimental) Synchronous multi-master cluster for MariaDB


[View Details](#)



PostgreSQL

PostgreSQL — an object-relational database (ORDBMS)


[View Details](#)



Solr

Solr Server for netCDF

[View Details](#)



Thredds

(Experimental) Thredds Data Server with iRODS Dataset Source Plugin

[View Details](#)



Catalog: iRODS iCAT ▾

iRODS

Add iRODS iCAT Stack

iRODS iCAT Server

Catalog: CLIMA
Category: Data Management
Support: Maintained by community members

Configuration Options

iRODS Zone Name*

Name of the iRODS Zone

iRODS Port*

Port of the iRODS ICAT Server

iRODS Control-Plane Port*

iRODS ICAT control plane port

iRODS Zone Key*

iRODS Zone Key

iRODS Negotiation Key*

iRODS Negotiation Key

iRODS Control Plane Key*

iRODS Control Plane Key

iRODS Administrator Username*

iRODS Administrator Username

iRODS Administrator Password*

Generate

iRODS Administrator Password

iRODS Default Resource Name*

iRODS Default Resource Name

Postgres Database Service*

postgres

▴ ▾

irods database service

☒ Start services after creating

CLIMA Data Service deployment with Rancher

- Rancher Environment -> CLIMA Data Service -> iRODS Zone
- External DNS for DNS Update (RFC2136) -> FQDN of iRODS iCAT and Resource Servers
- Rancher NFS as a storage service for container volumes
- Rancher Load Balancer and Health Checking for iRODS iCAT High Availability
- Rancher metadata service to share iRODS setup information such as Zone name, Zone key, iCAT db , ...
- Rancher sidekick services to setup volumes and read metadata information



Ongoing & Future Works

- Federation of Data Services with Hybrid cloud setup (OpenNebula + AWS)
- Indexing netCDF Files (... Looking forward for QueryArrow Database plugin and GQv2)
- iRODS & Thredds Integration
- iRODS & netCDF integration (iRODS-based netCDF library?)
- CLIMA Data Service Integration with Ophidia (CMCC Big Data Analytics Platform - <http://ophidia.cmcc.it>)
- Automated Scaling of CLIMA Data services with Rancher webhooks and Prometheus



Thanks! Questions?