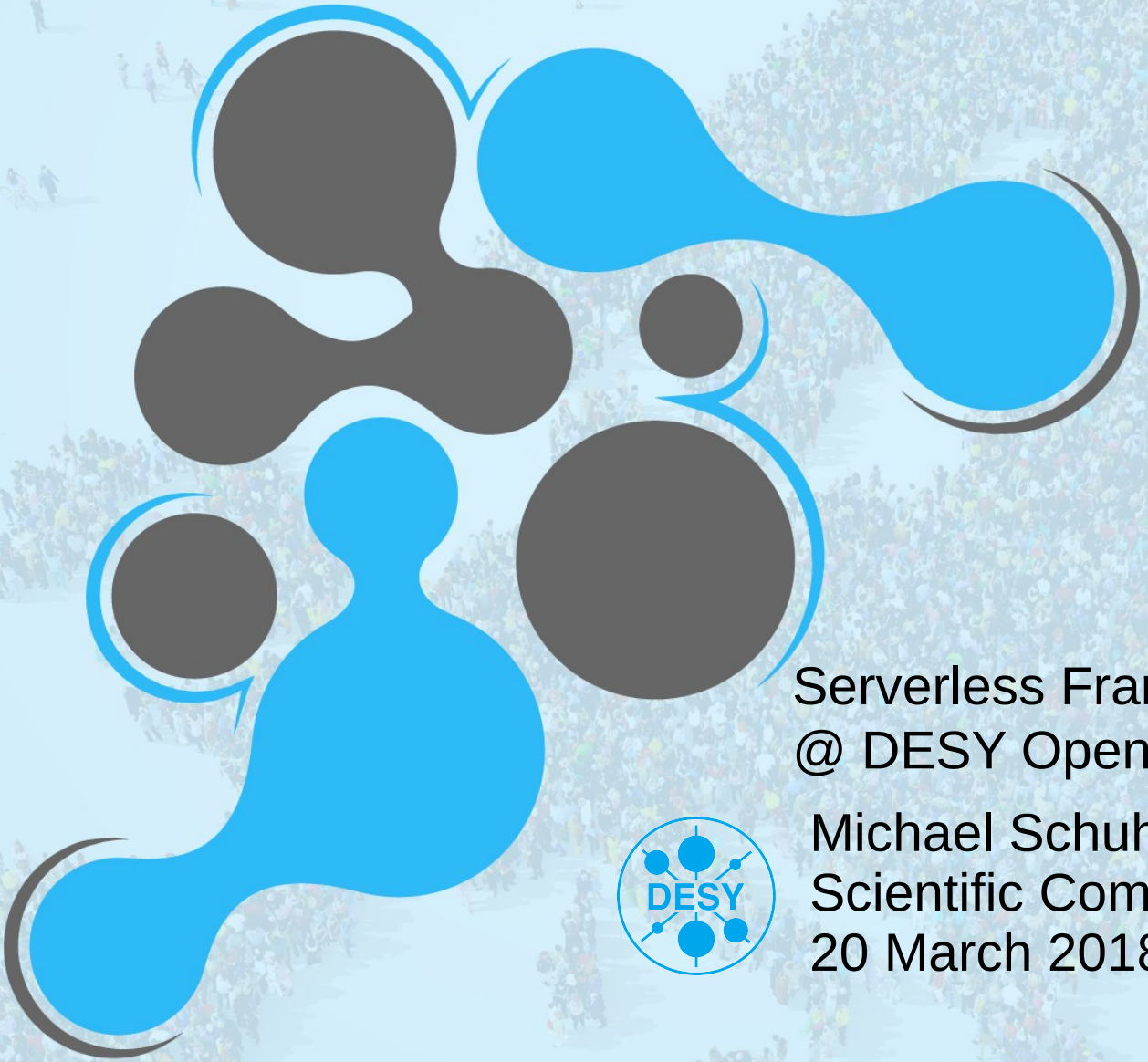


Serverless Frameworks @ DESY OpenStack Cloud

Michael Schuh
Scientific Computing
20 March 2018

EOSCpilot
The European Open Science Cloud for Research Pilot Project
www.eoscpilot.eu

Raising Cloud Computing in a HPC production environment

- Use the Cloud to virtualize GRID/HPC architectures to run established workflows and/or migrate workflows from HPC to Cloud?
- Workflows already under construction, turning towards container orchestration engines. Atomic design: Do one thing and do it good.
- Growing demand for scalable visualisation, graphical interaction and dynamic resource management
- Data simply too big: Bring the computing to the data, not vice versa

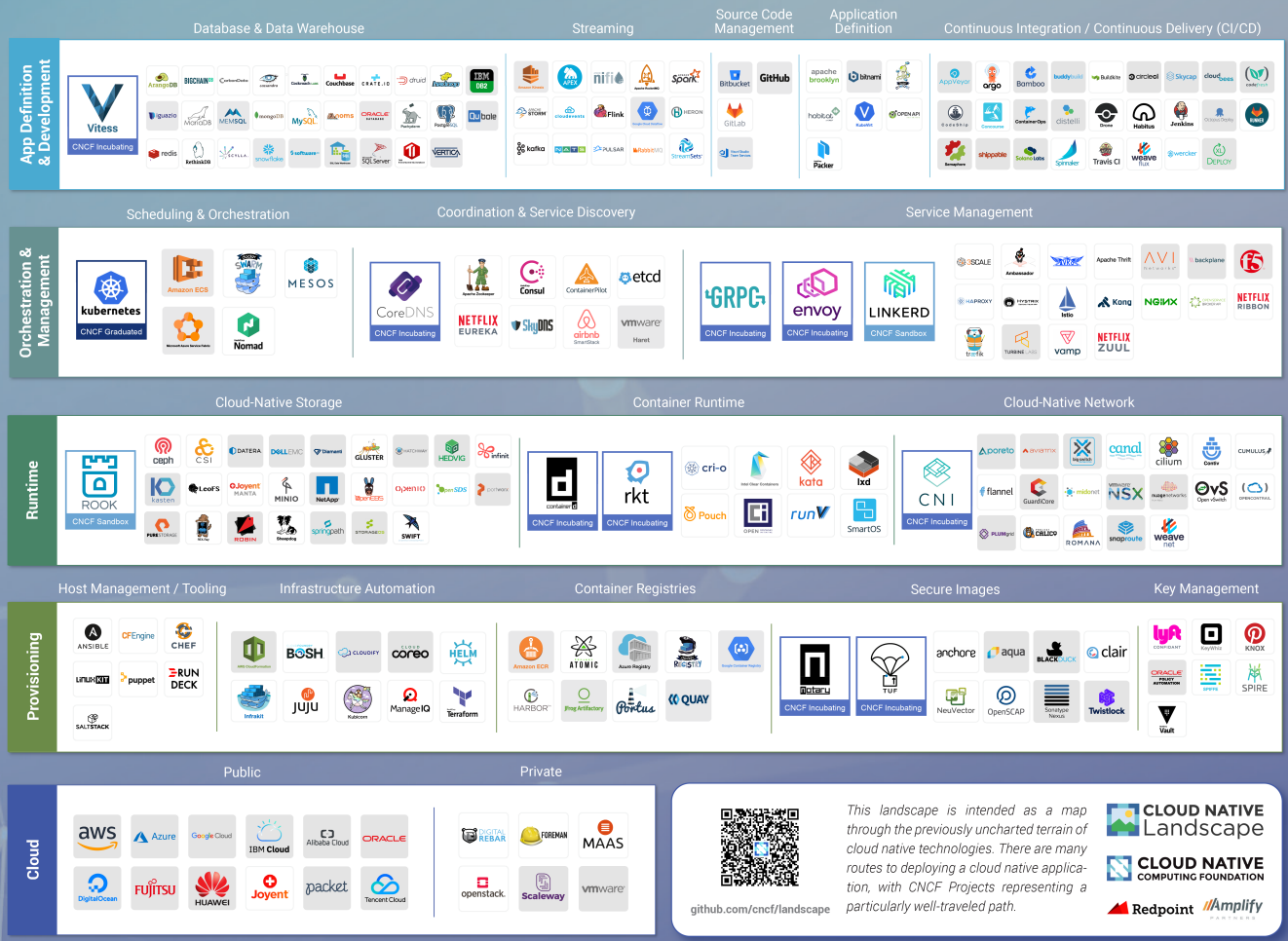
The European Open Science Cloud for Research pilot project is funded by the European Commission, DG Research & Innovation under contract no. 739563

Cloud Native Landscape

v2.0

See the interactive landscape at landscape.cncf.io

Greyed logos are not open source



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Serverless Cloud Native Landscape
v2.0

See the serverless interactive landscape at **s.cncf.io**

Greyed logos are not open source

Libraries
python-λ

Tools
.arc Architect, Dashbird, IO|pipe, LambCI, Node Lambda, STACKERY, Stackvana, THUNDRA

Frameworks
APEX serverless architecture, aws Chalice, BUSTLE, Claudia.js, Dawson, Gordon, gun.io, kappaIO, MITOC GROUP, SAM Local, serverless, SPARTA, Spring Cloud Function

Platforms

	Hybrid	Kubernetes-Native
OpenWhisk, AWS Lambda, Azure Functions, Clay, Google Cloud Functions, HYPER.SH, IBM Cloud, Iron.io, NANO-LAMBDA, OVERCLOCK, OVH, PubNub FUNCTIONS, spotinst, stdlib, syncano, twilio, WEBLAB, webtask, ZEIT	BINARIS, cloudboost, fn, fx, GALACTIC FOG, LunchBadger, nuclio	fission, Funktion, Kubeless, OPENFAAS, OpenLambda, Oracle Application Container Cloud, PubNub

Security
PURESEC, snyk

github.com/cncf/landscape

Serverless computing refers to a new model of cloud native computing, enabled by architectures that do not require server management to build and run applications. This landscape illustrates a finer-grained deployment model where applications, bundled as one or more functions, are uploaded to a platform and then executed, scaled, and billed in response to the exact demand needed at the moment.

CLOUD NATIVE Landscape
CLOUD NATIVE COMPUTING FOUNDATION
Redpoint

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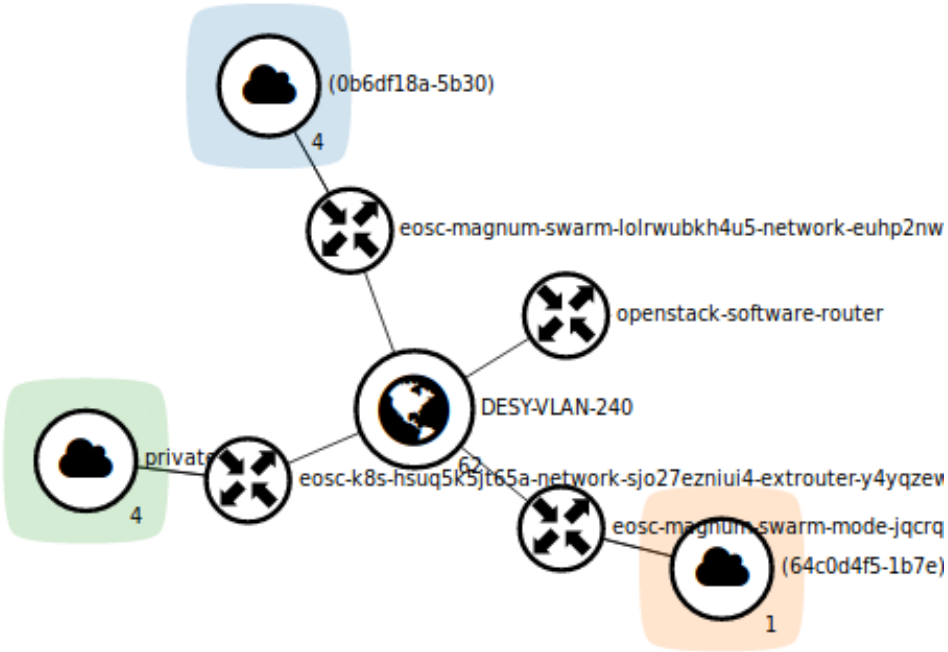
Magnum clusters on OpenStack

- Per project networking based on native OpenStack Objects: Neutron networks, software router, LbaaS, DNS
- Bare Metal Clusters and Infiniband supported. Overhead HPC O(1%) [1]



- Small clusters ready in less than 5 minutes
- Magnum does NOT run containers. Container management through native COE client: kubectl, docker swarm
- Performance and efficiency of native code execution with the abstraction, security and immutability of virtualization

[1] https://www.openstack.org/assets/science/OpenStack-CloudandHPC6x9Booklet-v4-online.pdf

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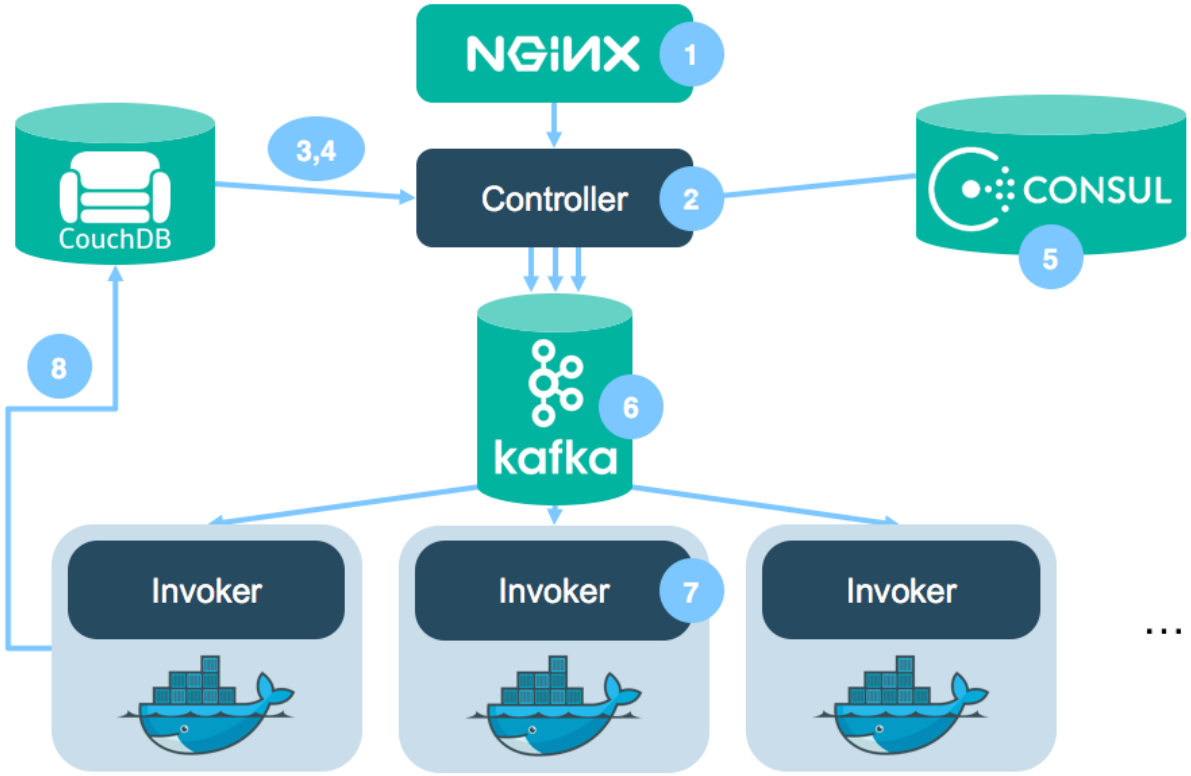
OpenWhisk: Cloud functions as a Service



1. User Api Gateway
2. LoadBalancing, URL dispatcher
3. Authentication
4. Authorization
5. Discovery
6. Message buffer
7. Invoke Client Code
8. Obtain JSON result

…

FROM base-action
RUN install more tools
~~RUN mount filesystem~~
ADD more stuff
~~USER bind-to-UID~~
ENV runtime=args

```
% wsk action create my-workflow --docker my-action
% wsk action create my-workflow my-start-script.zip --docker my-action
% wsk action create my-workflow my-start-script.zip --native
```

APACHE OpenWhisk

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OpenWhisk: Container as a function

```
[root@d089f8c162ce /]# ls
action          bin  home   media  proc  sbin  tmp
actionProxy     dev  lib    mnt    root  srv   usr
anaconda-post.log  etc  lib64  opt    run   sys   var
[root@d089f8c162ce /]#
```

```
FROM centos:latest
RUN yum -y install python-pip && pip install flask
ADD actionProxy/actionproxy.py #runtime
ADD exec action/exec #executable, start-script
```

- Native CentOS Linux for Client Code deployment
- action/exec anything callable from start script to large binary
- actionProxy/actionproxy.py for serverless service integration
- JSON arguments in
- JSON arguments out

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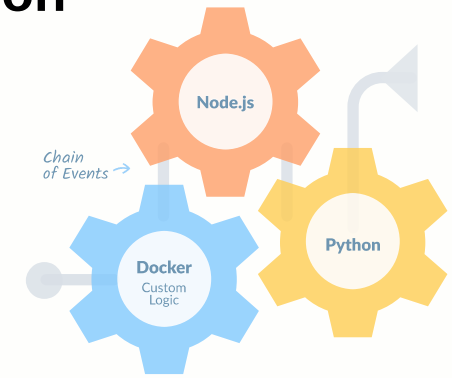
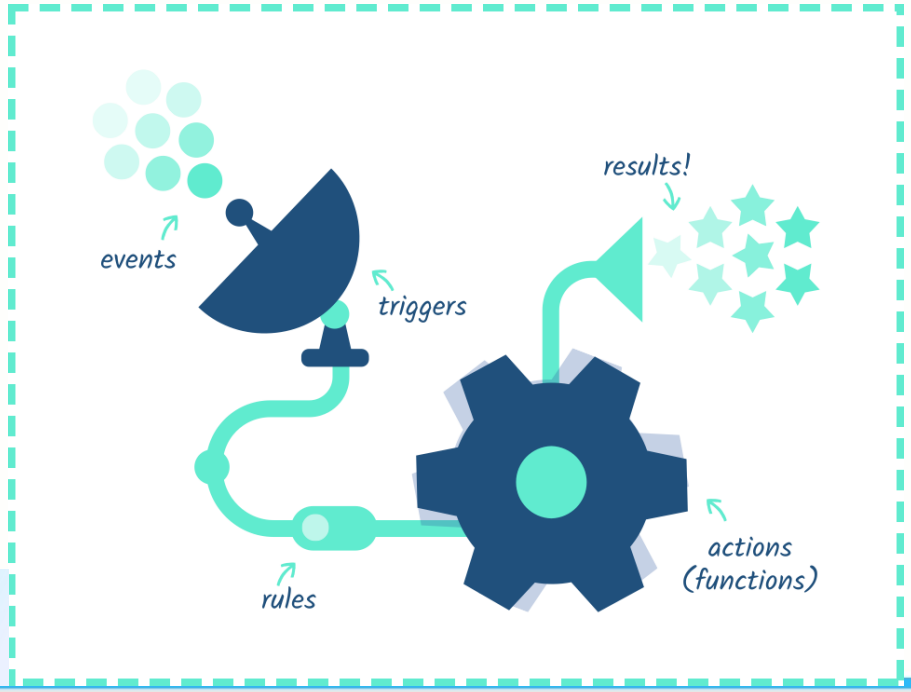
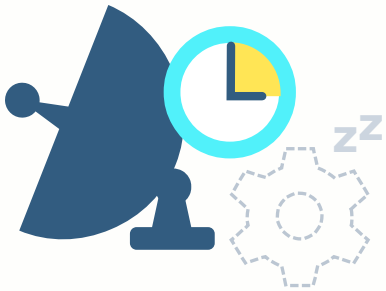
Packaging functions for event driven computation

- Execute code in response to events
- Elastic auto scaling of swarms and clusters
- Suited for data, API, Experiment Computing
- Efficient resource sharing
- Per usage billing







APACHE OpenWhisk

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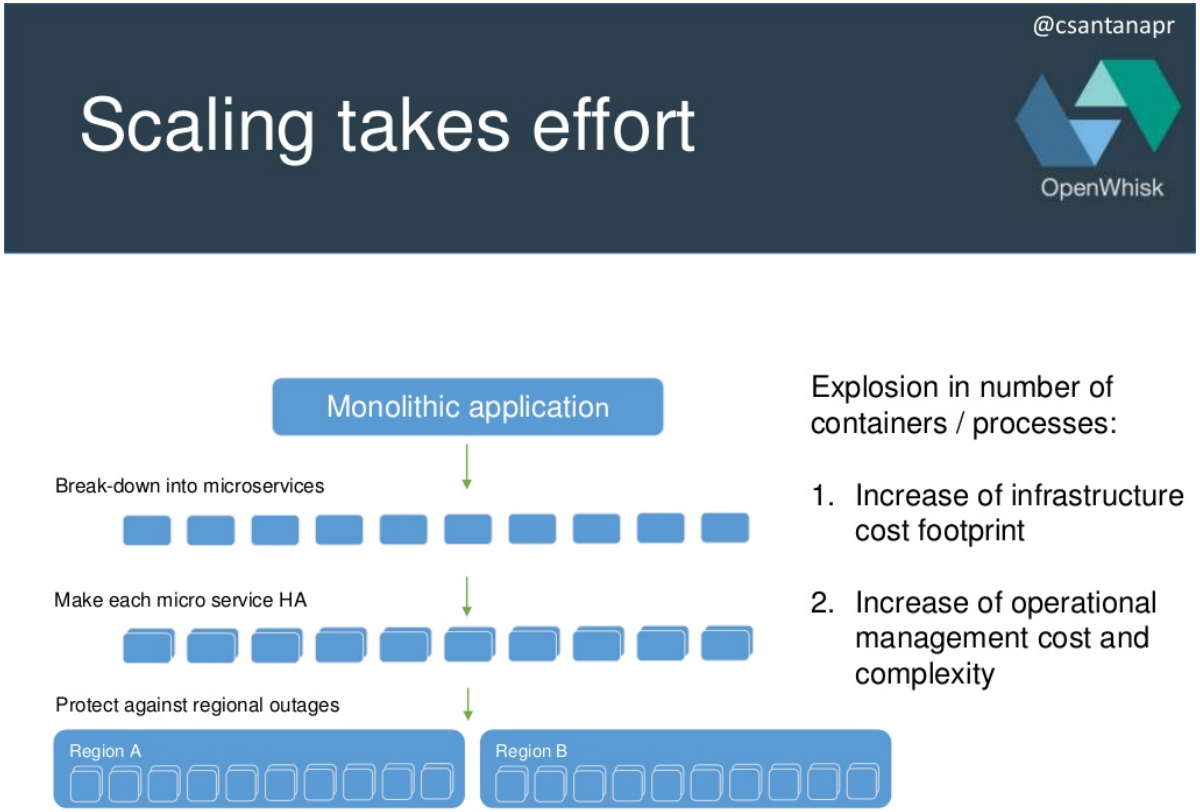
Science DevOps challenges

- Software
  - Deploy codes as microservices, stateless units
  - Licences to include new use cases and distribution channels
  - Non-public Container registries not freely-redistributable codes
- Skills and training:
  - Science DevOps
  - Science User
- On-premise/hybrid cloud
  - Infrastructure DevOps
  - Platform DevOps



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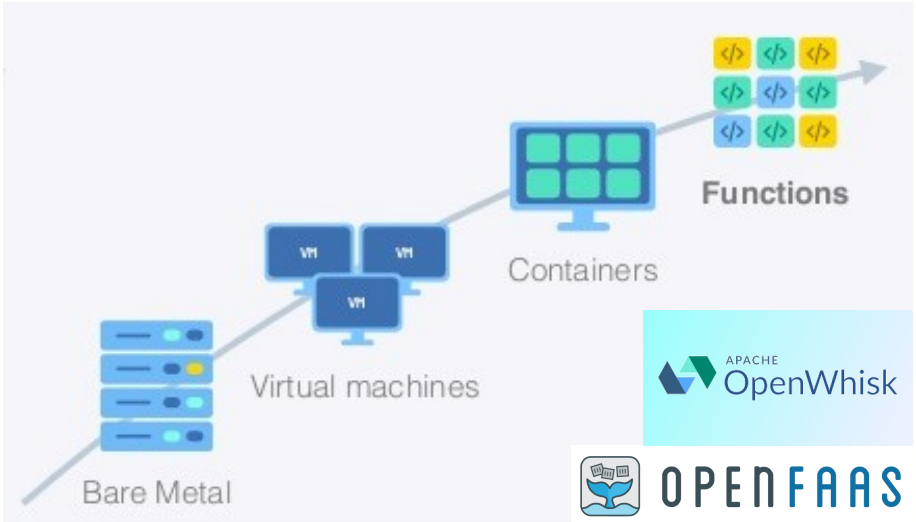
Science user perspective

- EOSCpilot Photon & Neutron Science Demonstrator: Process and index CrystFEL diffraction images
- High portability and reproducibility for large-scale distributed scientific workflows
- User-facing RESTful HTTP API
- Asyncronous and synchronous modes, periodic
- Efficient software distribution over CVMFS (file-based transfer using CernVM-FS graphdriver plugin for Docker)
- Function repository through docker registries
- Co-development, distributed teams
- Function-as-a-Service



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Science user perspective

- Users interact with Jupyter Notebook spawned in individual container
  - Develop functions iteratively, tests locally
  - Export and share executable functions using FaaS
- Users can download docker container with pre-configured software and run locally, co-develop, inherit, derive
  - Distribute again on the docker registry
  - Implement on a function server
- Easily cherry pick micro services from other project namespaces
- Deploy same functions for event driven computational pipelines

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Images borrowed from:

- https://github.com/apache/incubator-openwhisk
- https://github.com/apache/incubator-openwhisk-devtools
- https://github.com/openfaas/faas
- https://github.com/openstack
- https://github.com/cncf/landscape

Thank you!

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