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STFC Cloud Developments

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HEPiX Spring, Madison, WI
17 May 2018

Contents

- Background & History
- Current design considerations
- New Use cases
- (Some of) What this allows us to do
  - IRIS (UKT0)

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Background

- OpenNebula cloud now running for several years on a stable, but pre-production basis.
  - Has served very well.
- Rise of more complex use cases – in particular supporting external user communities –> deploying OpenStack
- In final stages of deploying
  - decommissioning OpenNebula
  - migrating remaining users in coming months

Hardware

- OpenNebula: reducing from ~700 to ~300 cores
- OpenStack: ~500 cores, growing to ~3500 end May and ~5000 by end 2018.
- Adding
  - Hypervisors: 108 Dell 6420 sleds (27 x 4-up 2U 6400 chassis) - **Testing complete, about enter production**
    - 16 physical cores each, 6GB RAM/core, 25G NIC
  - Cloud Storage: 12 Dell R730xd (12 bay 2U) - **Testing complete, about enter production**
    - 12 x 4TB each, total 576TB, 25G NICs
    - Replicated CEPH (3x), VM image storage
  - Data Storage: 21 x (Dell R630 + 2 x MD1400) sets **- Just finished testing**
    - Added to ECHO for UKT0 project
    - 4PB raw /~2.9TB configured
  - Network:
    - 7 x Mellanox SN2100 16x100Gb port

OpenStack implementation

- Flexible
  - Within reason want a design that can accomodate whatever comes along – within reason
- Multi tenancy
  - Separating different user communities
- Highly Available
  - Services should be as highly available as possible – OpenStack services behind HAProxy
- Ceph
  - A replicated Ceph cluster called SIRIUS provides block storage for VMs and Volumes
  - 3x Replication
  - Optimised for lower latency

Ceph RBD

- A replicated Ceph cluster called SIRIUS provides block storage for VMs and Volumes
- 3x Replication
- Optimised for lower latency
- Helps speed up launch of VMs
- Are considering use cases that would benefit from local VM storage
- Currently being rebuilt – fresh installation in new machine room location.

Multi Tenancy

- Projects (Tenants) need to be isolated
  - From each other
  - From STFC site network
- Security Groups
- VXLAN private project networks
  - Brings its own problems

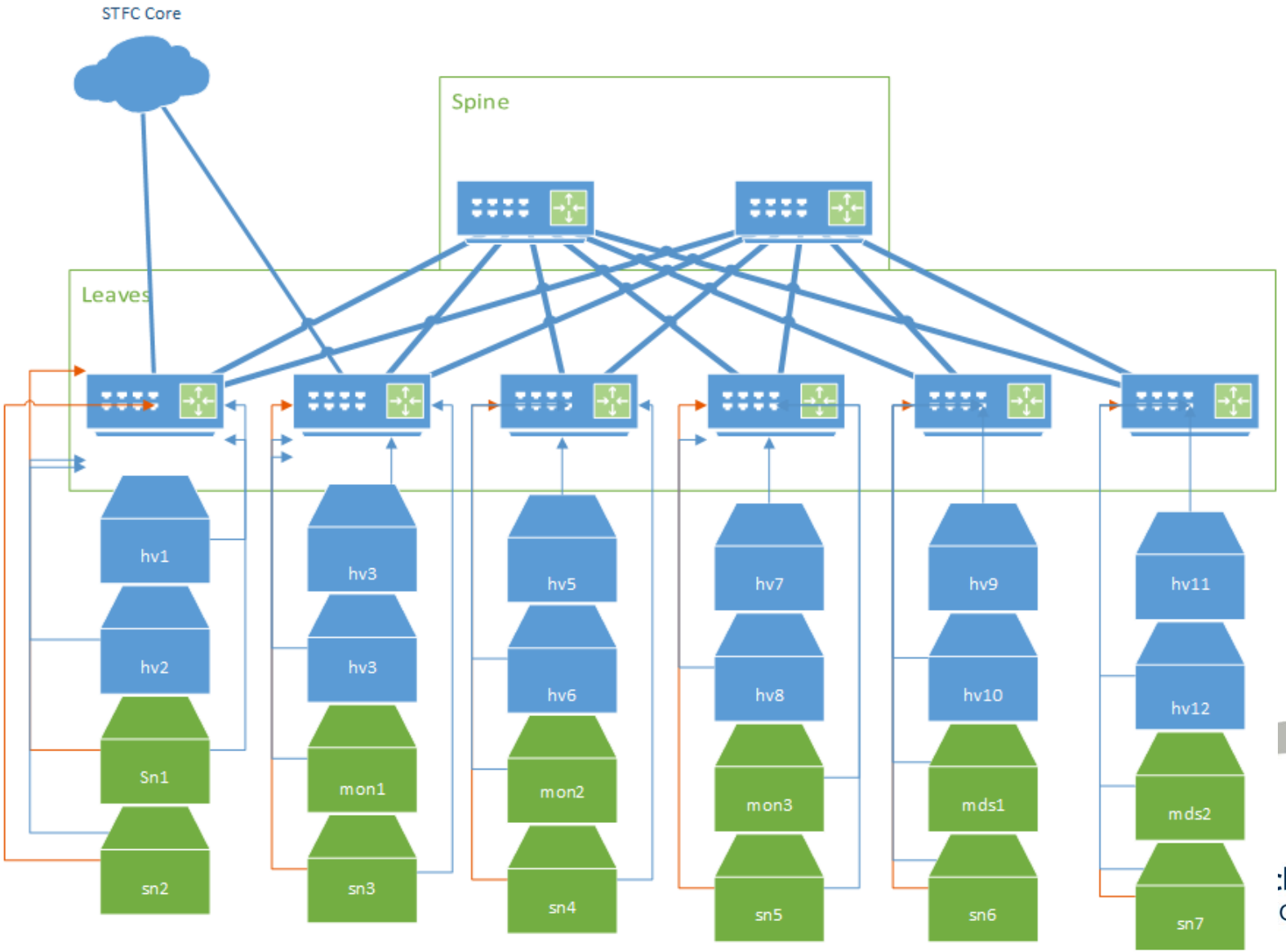
Private Networks

- Virtual machines connect to a private network
  - VXLAN is used to tunnel these networks across hypervisors
- Ingress and Egress is via a virtual router with NAT
  - Distributed Virtual Routing is used to minimise this bottleneck – every hypervisor runs a limited version of the virtual router agent.

VXLAN

- VXLAN by default showed significant overheads
  - VXLAN performance was ~10% of line rate
- Tuning memory pages, CPU allocation, mainline kernel
  - Performance is ~40% of line rate
- Hardware offload
  - VXLAN offload to NIC gives ~80% of line rate
- High Performance Routed network + EVPN
  - 99+% of line rate

Cloud Network



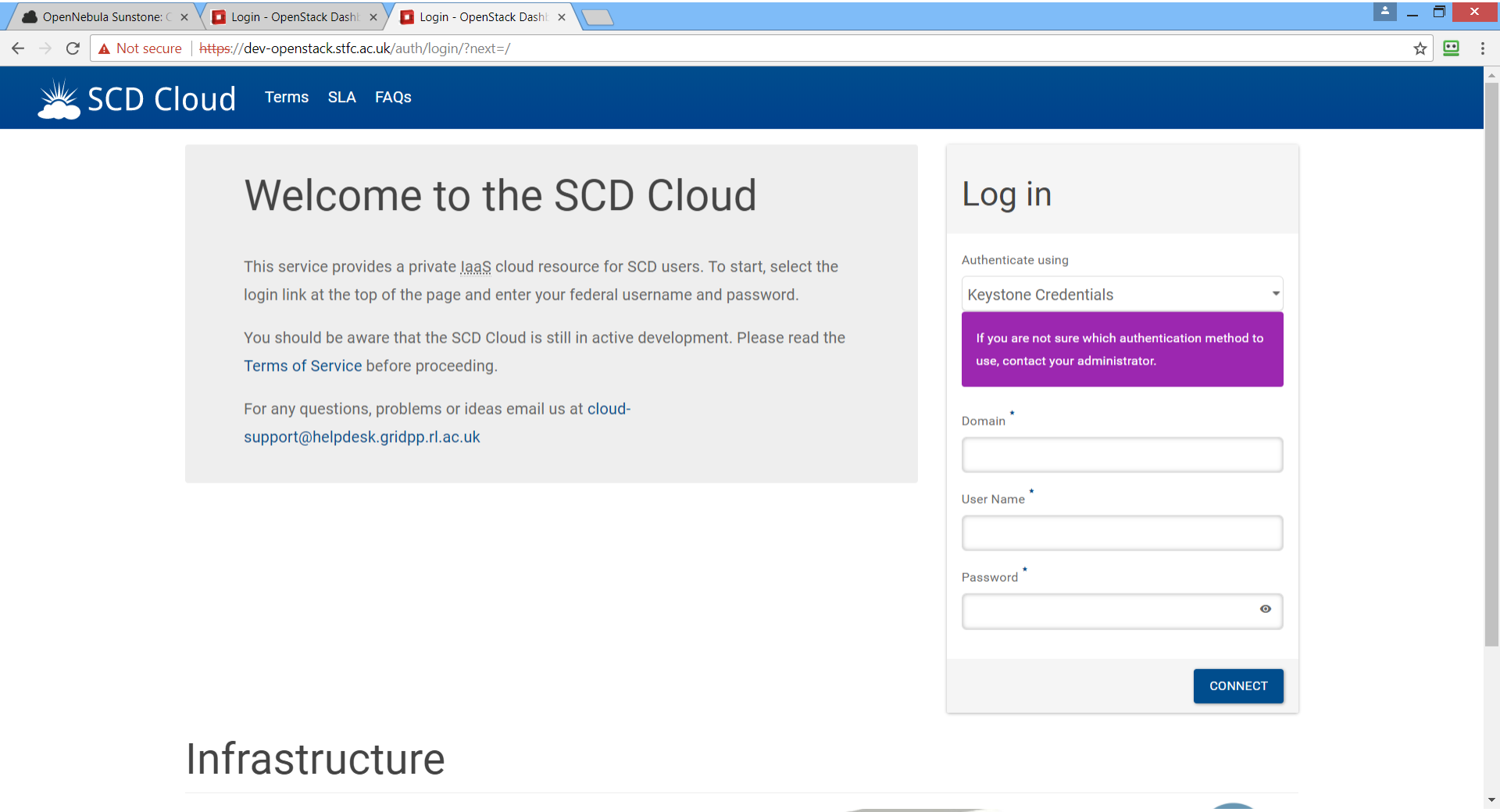
Flexible

- Availability Zones across site
  - 1st will be in ISIS soon
  - In discussion with other departments
- GPU support
- AAI
- APIs
  - Nova, EC2, OCCI
- Design decisions should, so far as possible, preclude anything
- ‘Pet’ VMs as well as ‘cattle’

Current User Communities

- STFC Scientific Computing Department “internal”
  - Self service VMs
  - Some programmatic use
- Tier1
  - Bursting the batch farm
- ISIS Neutron Source
  - Data-Analysis-as-a-Service
- Jenkins Build Service for othere groups in SCD
- Central Laser Facility – OCTOPUS project
- Diamond Lightsource - Xchem
  - Cloud bursting Diamond GridEngine
  - Xchem data processing using OpenShift
- WLCG Datalake project
- Quattor Nightlies
- Range of H2020 & similar projects

AAI – EGI CheckIn - Horizon



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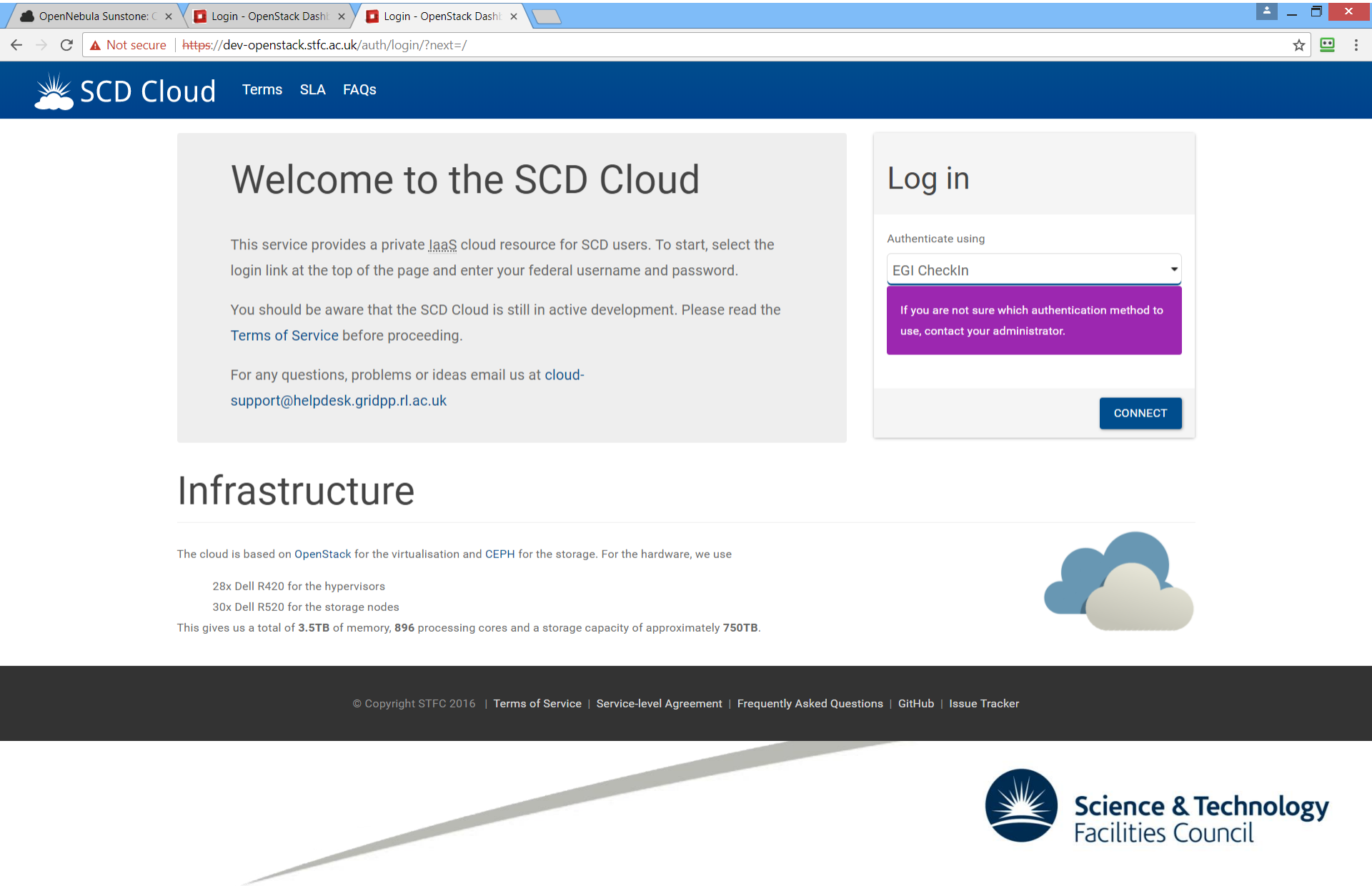
AAI – EGI CheckIn – Horizon 2



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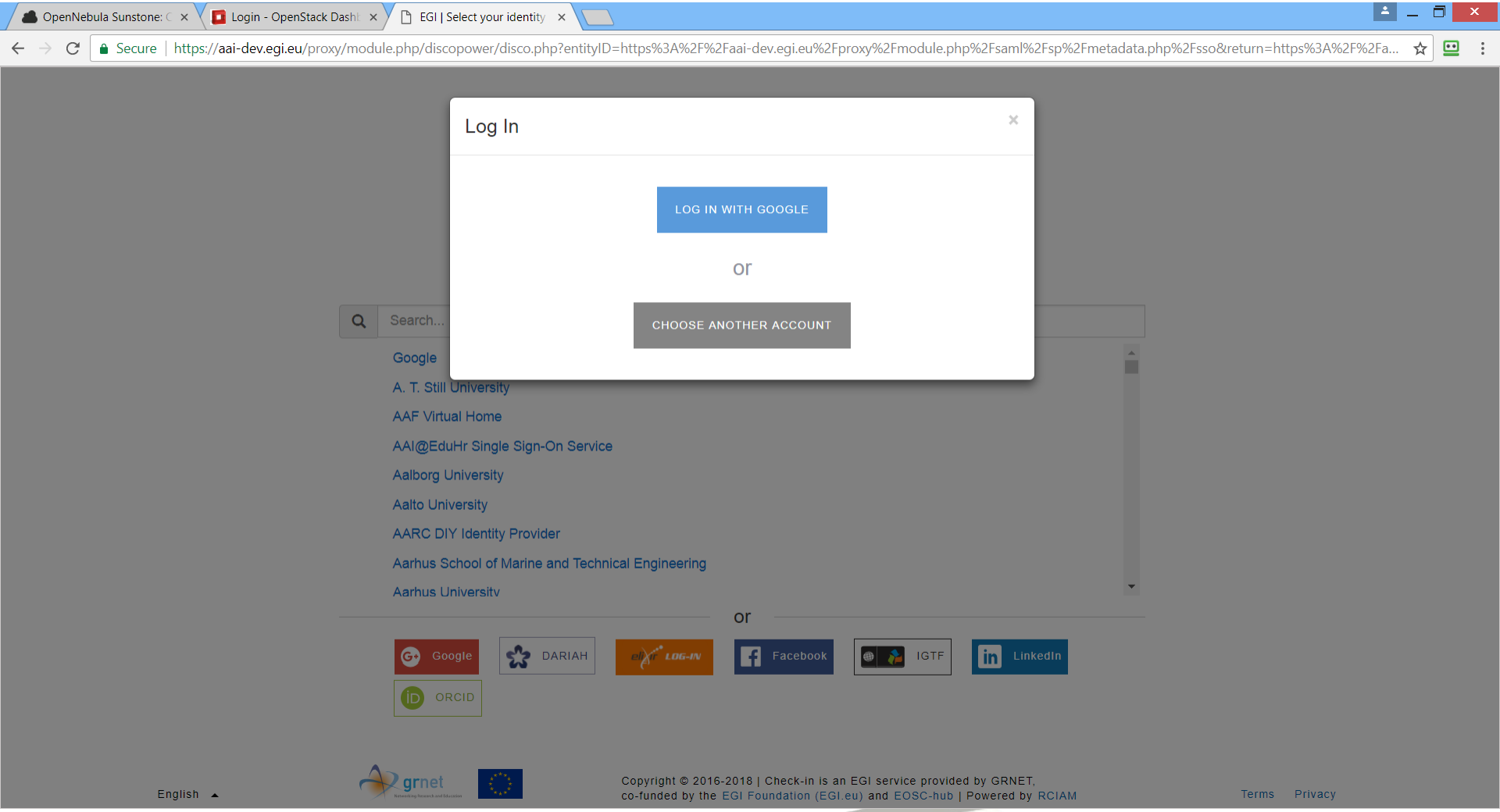
AAI – EGI CheckIn



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AAI – Google Login

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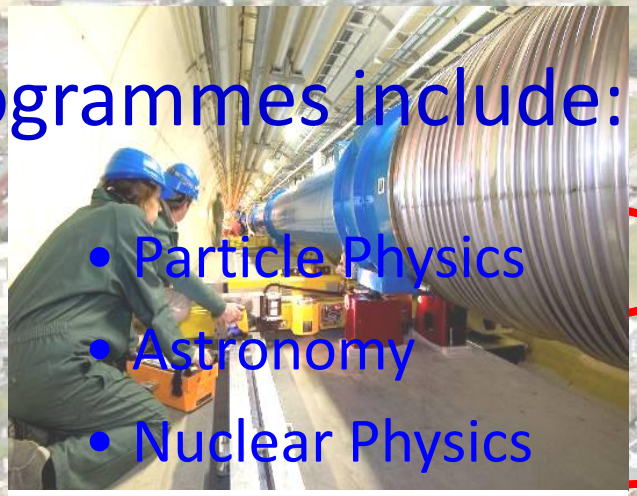
What do we do?

Programmes include:



- Particle Physics
- Astronomy
- Nuclear Physics

Large Hadron Collider

25

International include:

- CERN
- ESO
- SKA
- ESS
- ESRF
- ILL

Square Kilometre Array

National Laboratories include:

- Neutron and Muon Source
- Synchrotron Radiation Source
- High Power Lasers
- Scientific Computing/Hartree Centre
- Space Science
- Electronics, Cryogenics

Daresbury Laboratory

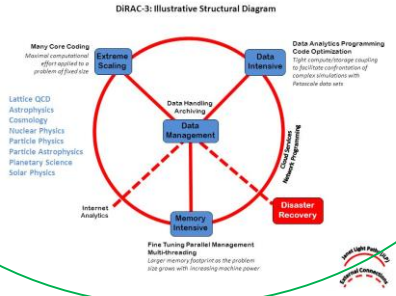
ESRF & ILL, Grenoble

GridPP: HTC for the LHC

Scientific Computing Department

Hartree Centre: Industry

DiRAC: HPC for Theory & Cosmology



HTC and data storage for Astronomy, Nuclear, Astroparticle

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Wider UK landscape

- Effort running for several years now under ‘UKT0’ banner
- Bringing together different communities
  - HTC and HPC for ‘STFC’ science
- Linking together diverse resources into coherent and complementary support for existing & emerging communities
- “UKT0” (now IRIS) is an umbrella project which
  - represents users
  - ‘contracts’ to resource providers
  - eventually should provide effort for cross-cutting activities

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IRIS – eInfrastructure for STFC Science

- Initiative to bring STFC computing interests together
- Formed bottom up by the science communities and compute providers
- Association of peer interests (PPAN + National Facilities + Friends)
  - Particle Physics: LHC + other PP experiments (GridPP)
  - DiRAC (UK HPC for theroretical physics)
  - National Facilities: Diamond Light Source, ISIS
  - Astro: LOFAR, LSST, EUCLID, SKA, ...
  - Astro-particle: LZ, Advanced-LIGO
  - STFC Scientific Computing Dept (SCD)
  - CCFE (Culham Fusion)
- Not a project seeking users - users wanting and ready to work together

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Evolution – UKT0 -> IRIS

- 2015-2017 Loose association
- ➔ Community Meeting Autumn 2015
- 2017/2018 first funding £1.5M to be spent by 31 March'18
  - ➔ interim-PMB (to manage short term completion)
  - ➔ Grant delivered resources into machine rooms
    - ➔ Cambridge, Edinburgh, Manchester, RAL,
  - ➔ First (proto) Collaboration Meeting – March 2018
  - ➔ Project was successful and on time (spent money/wrote software)
- 2018 Approved BEIS "keep lights on funding" of £4M p.a. for 4 years for UKT0/ALC.
  - Now finalising Organisational structures and delivery planning

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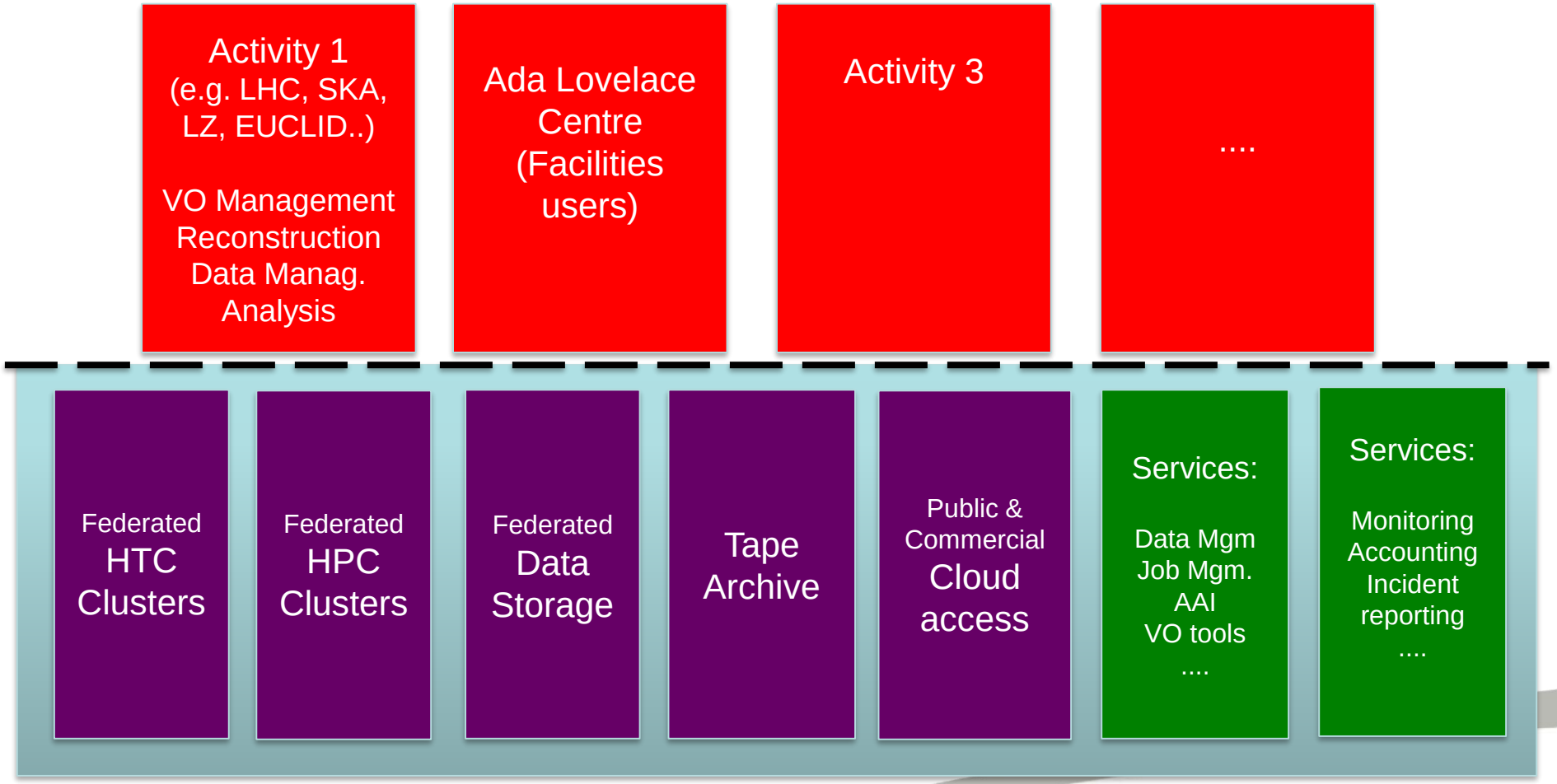
UKT0 'idea'



Share where it makes sense to do so

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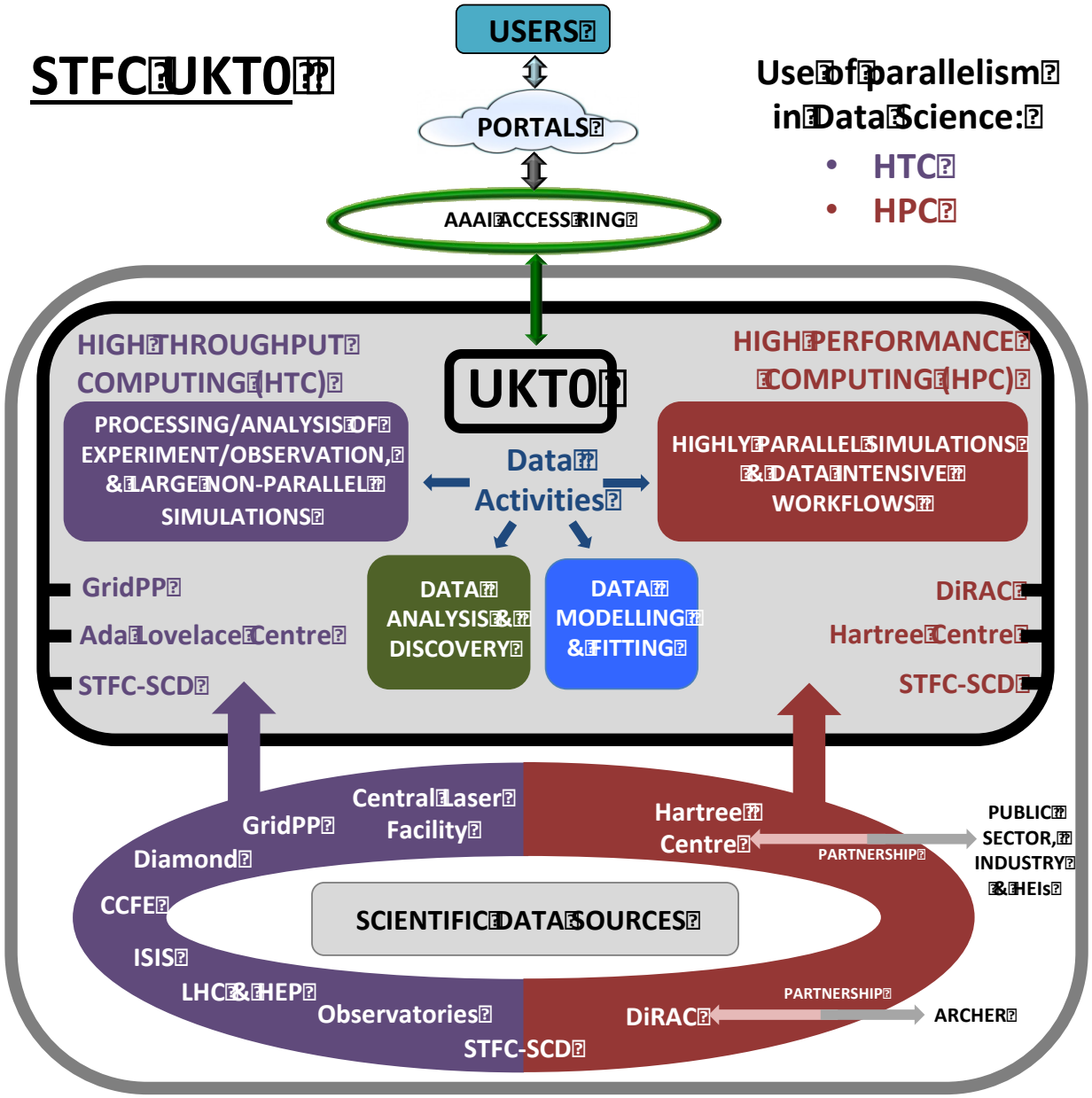
Long Term Aspiration

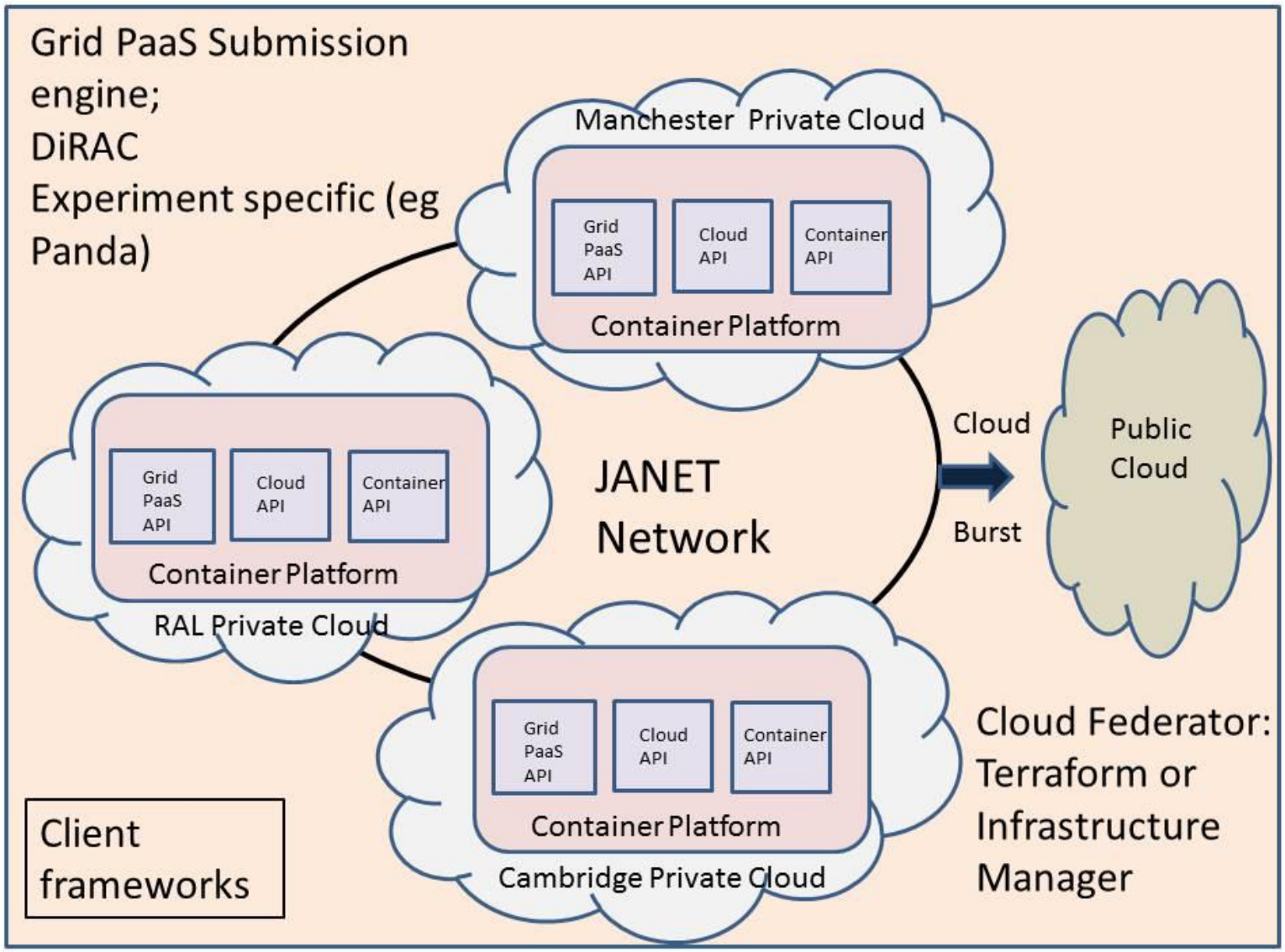
STFC UKT0

Use of parallelism in Data Science:

- HTC
- HPC



Initial Architecture



nology

Investment – next 4 years

- Bulk is from Department of Business, Energy & Industrial Strategy (BEIS)

- £10.5M eInfrastructure compute and storage assets
- £5.5M for eInfrastructure Digital assets

- Minimal resource ☹
  - £250K from BEIS in years 3+4
  - £250K resource from STFC in years 1+2

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Questions?

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