SKAO on software optimisation

Byte by Byte, Watt by Watt
IRIS Collaboration Meeting

Ugur Yilmaz

02 July 2025

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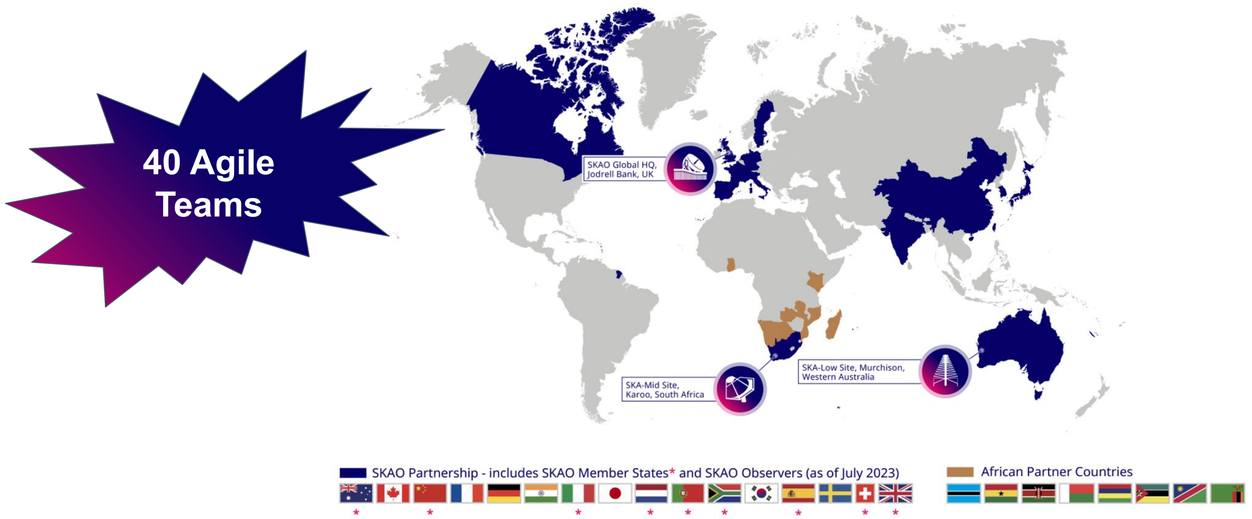
Agenda

- Background
- STFC Clusters (CI/CD & Integration/Staging)
- SRCNet
- DP HPC Cluster (AWS)

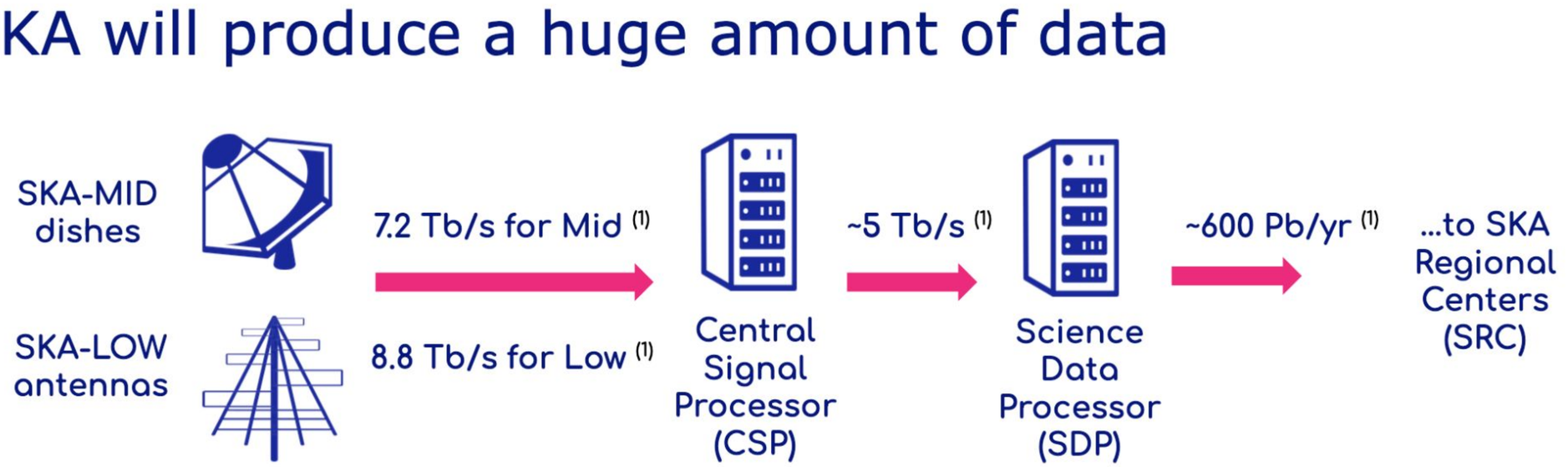
SKAO Construction - Software

- We are a highly distributed and diverse project - different:
  - Time zones
  - Cultures
  - Developer experiences
  - Subject domains
  - Delivery timeframes
  - Large and varied codebase
  - Small central team driving this (supported by a team of 10)



"How do we make sense of this so that we can deliver to a consistent level of quality, and efficiently use resources available, on time, and on budget"

SKA Data Needs



- At this scale every 1 % saving = 120k£(2) per year.

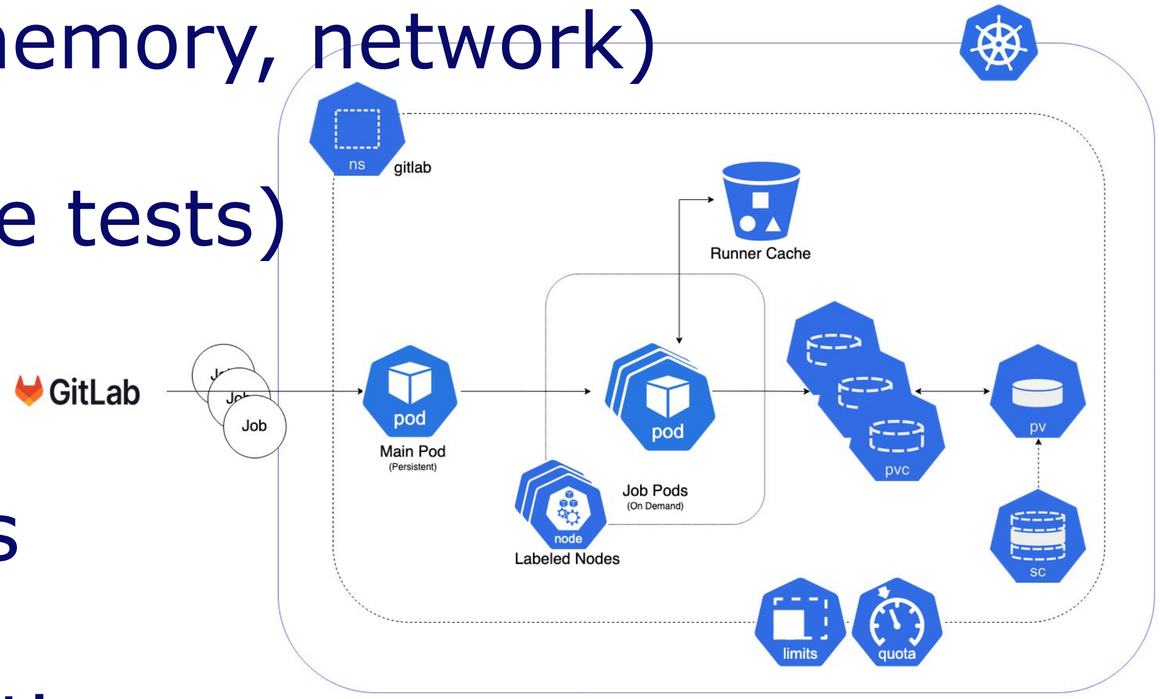
(1) Data for SKA1 implementation
(2) Napkin math based on very rough estimates

STFC - CI/CD

Cluster: 2k vCPU, 8TB RAM, 1 TB Storage

*Daily Average

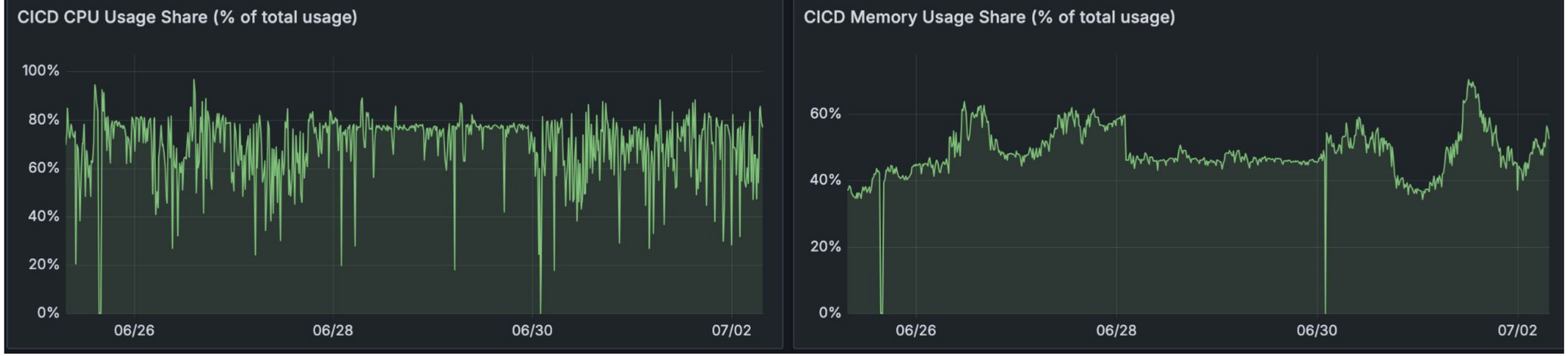
- Main Workload
- Dynamic Job Processing
- **Story:**
  - We set some defaults (cpu, memory, network)
    - They looked good
  - They were bad defaults (broke tests)
  - They didn’t work at all!
    - *Realised many devs do not optimise*
    - *if they think they have the resources*
- Right-sizing containers & pods
- Node heterogeneity
  - Choosing right flavor at right time



Observability

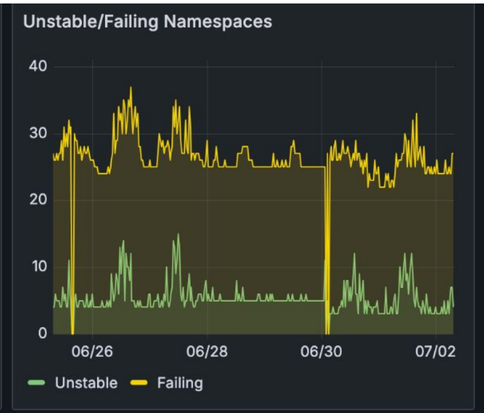
You cannot optimise what you cannot measure

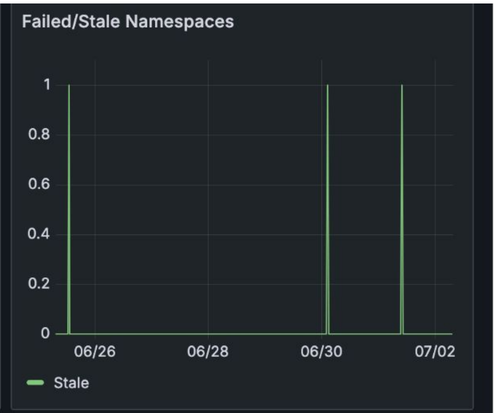
- PromStack to understand, identify and optimise usage
- Enabler for teams to self-optimise
  - *Incentives*
    - Shows progress
    - Recognition
  - *Deterrants*
    - Nudge them in optimising/profiling their workloads
      - *SRE giveth, SRE taketh away*
    - Do not allow usage, eviction policies etc.
- Special Cases
  - One-shot experiments:
    - TMC/CSP requiring 1K vCPU, 5TB Ram for AA2.0 Scale testing

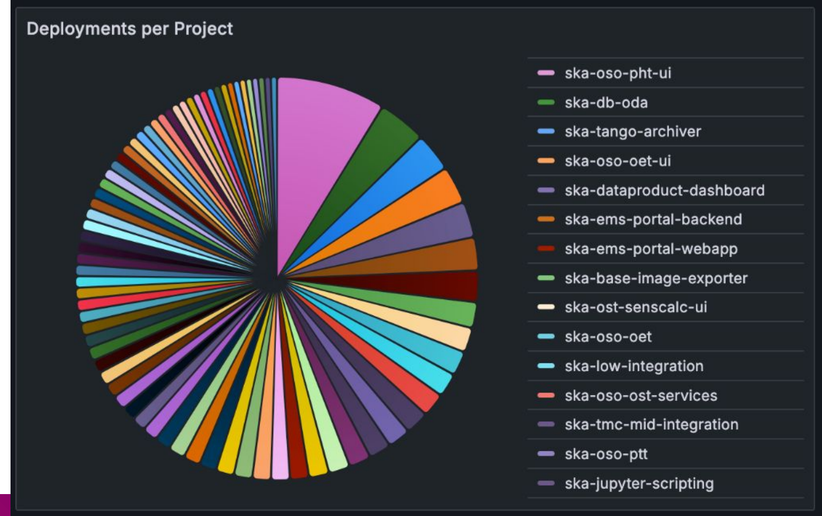

CICD CPU Usage Share (% of total usage)
100%
80%
60%
40%
20%
0%
06/26
06/28
06/30
07/02

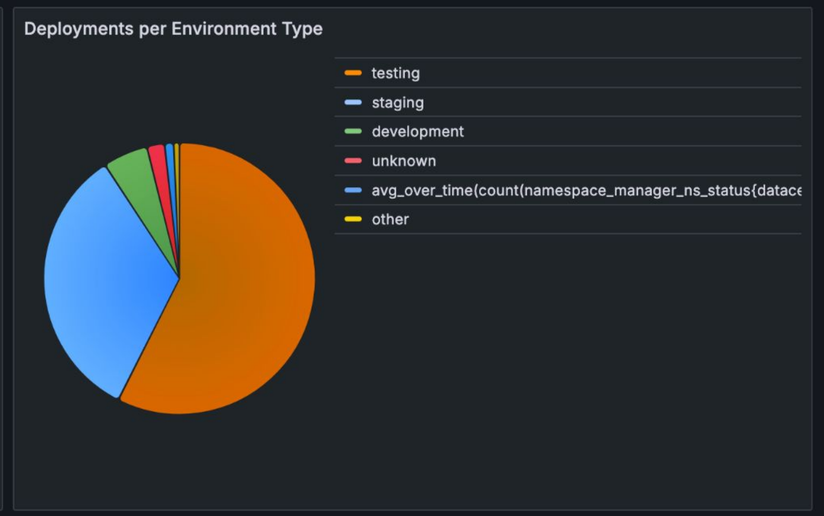
CICD Memory Usage Share (% of total usage)
60%
40%
20%
0%
06/26
06/28
06/30
07/02

Healthy Namespaces
160
140
120
100
80
60
40
20
0
06/26
06/28
06/30
07/02

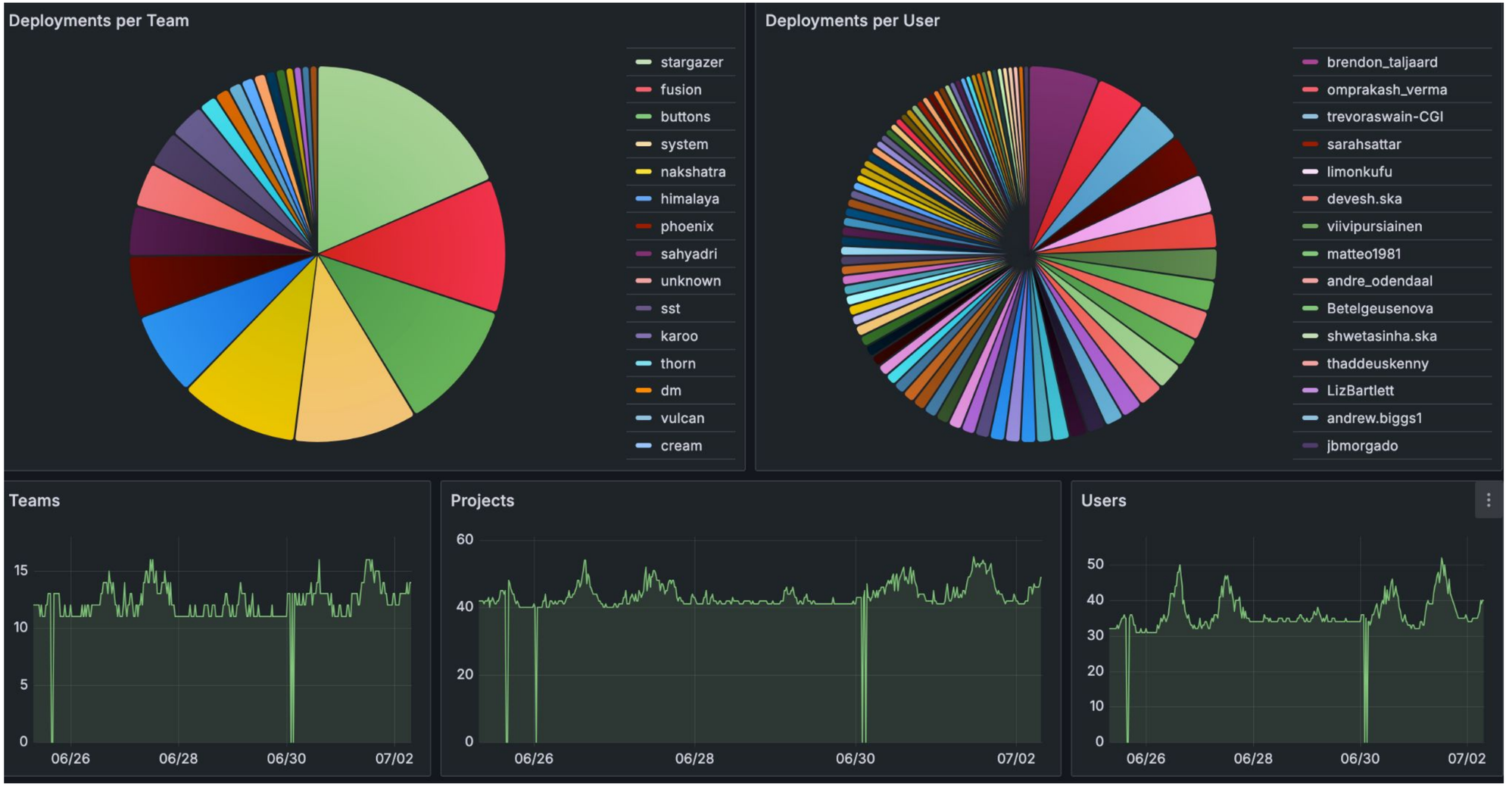

Unstable/Failing Namespaces
40
30
20
10
0
06/26
06/28
06/30
07/02
Unstable
Failing


Failed/Stale Namespaces
1
0.8
0.6
0.4
0.2
0
06/26
06/28
06/30
07/02
Stale


Deployments per Project
ska-oso-pht-ui
ska-db-oda
ska-tango-archiver
ska-oso-oet-ui
ska-dataproduct-dashboard
ska-ems-portal-backend
ska-ems-portal-webapp
ska-base-image-exporter
ska-ost-senscalc-ui
ska-oso-oet
ska-low-integration
ska-oso-ost-services
ska-tmc-mid-integration
ska-oso-ptt
ska-jupyter-scripting


Deployments per Environment Type
testing
staging
development
unknown
avg_over_time(count(namespace_manager_ns_status{datace
other

Observability



STFC - Platform

- Usage of CAPI
  - We scale up&down based on historical data, expected usage
  - Future Work: Autoscaling
- Storage: Future Work
  - *Investigate Performance of different types (next month)*
  - *No plans for tiered storage usage in near future*
- Network
  - Preventing unnecessary traffic with network policies, node affinitions on Calico/Cilium
  - Future: Topology Awareness, QoS Policies
    - Topology Awareness (or simulating it) will allow us to deploy/redeploy and rotate more efficiently

Some funny(funny now!) stories

- Unexpected Cluster Rollouts while learning/using CAPI
  - Cost a lot of time to rotate everything
- Switching to AWS for STFC downtimes/maintenance
  - We have a small AWS CI/CD cluster as backup
  - First time we switched it showed being cloud agnostic, IaC is hard!
    - Hardcoded/Uncoded config values, LB and Network Issues
    - User Migration
- Backlog of CI jobs or deployments/workloads that takes ages for unnecessary usage: *Clean up Policies*
  - unstable deployments get deleted after 2 days
  - All testing/ci deployments gets deleted after 1 day

SRCNet - Services utilising IRIS Resources

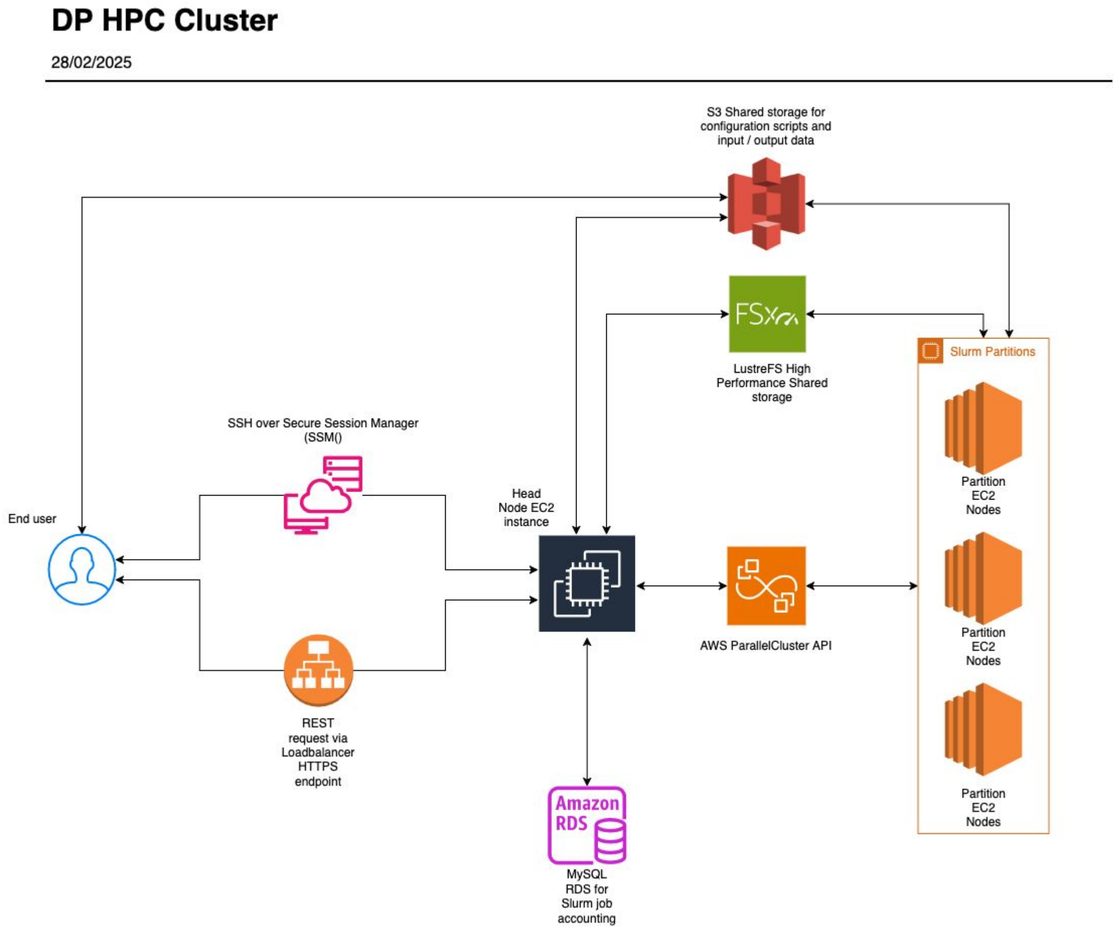
Cluster Resources: 400 CPU, 1.6TB RAM, 40TB

- CAPI management cluster controls workload clusters
- Global services supporting SRCNet running in STFC Cloud
  - Rucio data management system + core API services
  - Metadata management services
  - Indigo IAM + API interface services
- Local ‘SKAOSRC’ test environment
  - StoRM-WebDAV Rucio Storage Element
  - ‘CANFAR’ container-based science platform
  - Data access services

DP HPC Cluster

Started as pilot project
Usage: 3k vCPU peak, (350 average), 229 TB RAM peak (194 avg),30TB Lustre

- Provides a scalable on-demand HPC solution
- Utilises AWS ParallelCluster
- Reduces cost compared to always-on configuration by 80-90%
- Accessible via CLI (users) and REST API (applications)
- Built and operated in house by SKAO to allow rapid / agile configuration changes and reduce 3rd party costs



DP HPC Resource Optimisations

- **Provisioning:** Nodes in a HPC partition are shut down when not in use or needed - only head node stays active
- **Location:** Resides in AWS Stockholm region which is 10% cheaper than London region, while offering more HPC capacity
- **Usage:** Multiple node sizes available to suit use cases
- **Price:** Spot priced nodes have a higher default priority than on-demand. Users are encouraged to use spot nodes wherever possible
- Default partition is spot priced with suitable node type
- Input / output working data stored in S3

WSClean Scaling/Optimisations

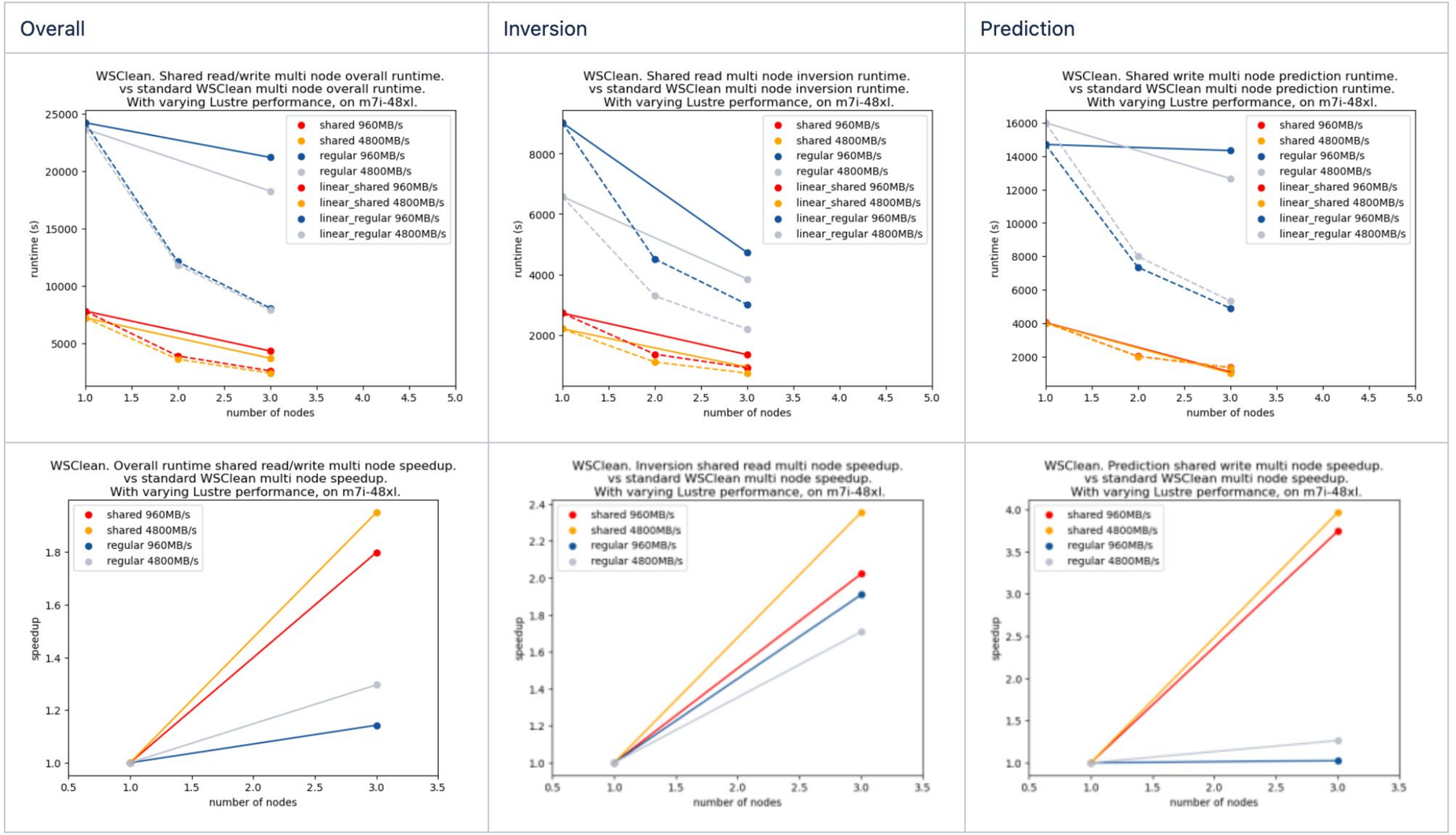
Science Data Processing Workflows

User-wise:

- *From scaled back parameters to full performance scale*
- *Base performance*
  - *New bottlenecks*
- *Feeds back to how actual pipelines should look like*

Infra-wise:

- Allows us to see the end goal and create a roadmap (at a cost) for our own HPC
  - Machines Configs..
  - Storage..
  - Use-cases..



Thank you!

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We recognise and acknowledge the Indigenous peoples and cultures that have traditionally lived on the lands on which our facilities are located.

SKAO

www.skao.int