# An Update from the SLATE Project

## slateci.io

Shawn McKee for the **SLATE Project**

HEPiX Fall 2023 Meeting - Taipei

https://indico.cern.ch/event/1222948/contributions/5321045/

March 28, 2023


# The SLATE Project

**SLATE**: **S**ervices **L**ayer **A**t **T**he **E**dge

(Funded by NSF Aug 2017, Award #1724821)

- An NSF DIBBs award, "SLATE and the Mobility of Capability"
- Equips the SciDMZ with a service orchestration platform, federated to create scalable, multi-campus science platforms
- Underlayment-as-a-service for platform builders & science gateway developers

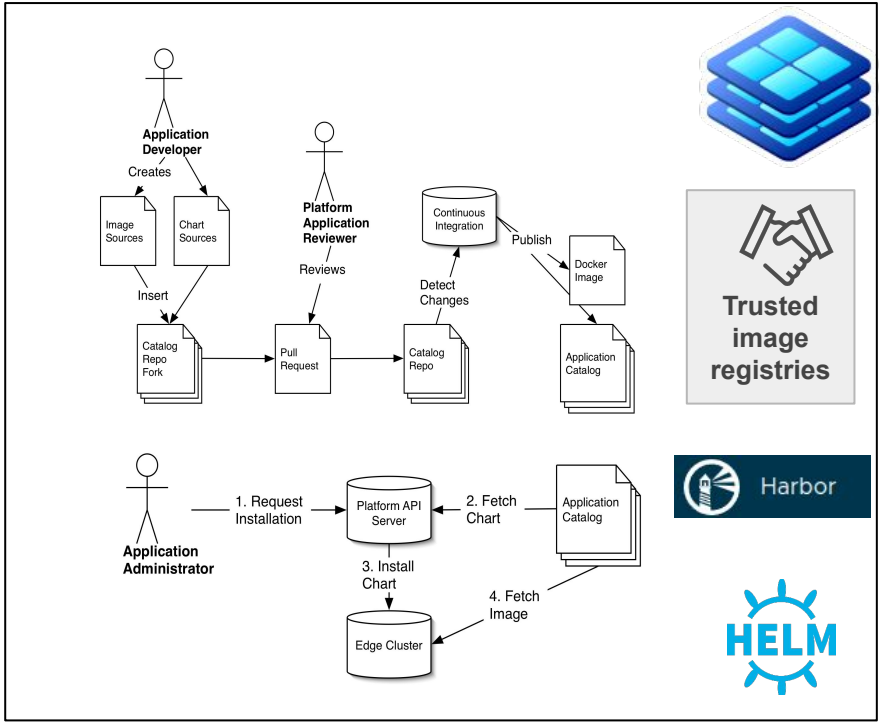
This talk will provide a review of **SLATE** as well as new updates since the spring 2019 talk:
https://indico.cern.ch/event/765497/contributions/3351206/

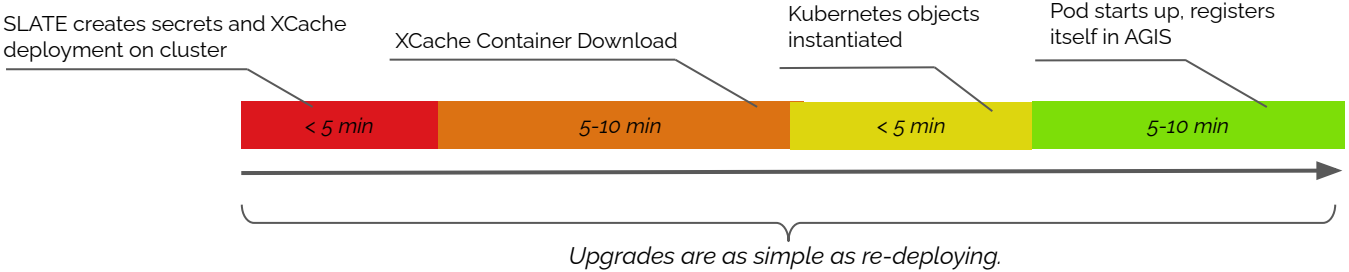
# Introduction to SLATE

- **Service delivery** via **container orchestration** in edge networks
- The **challenges** are many
  - security and trust of container images
  - adoption of a new operations model
- The benefits are:
  - **ease ops burden on site admins**
  - **more quickly deploy updates and new services**

# SLATE in a Slide

- SLATE - a value added K8s distribution
  - Support for CVMFS, ingress controller (multi-tenant, scoped privileges), Prometheus monitoring, **curated application catalog w/ Github Actions**
- Site security & policy conscious
  - SLATE works as an unprivileged user
  - Single entrypoint via **institutional identity**
  - Site owner controls group whitelists & service apps; **retains full control**
- With OSG, WLCG, trustedci.org & others working to establish a "CISO compliant" security posture and **new trust delegation model**



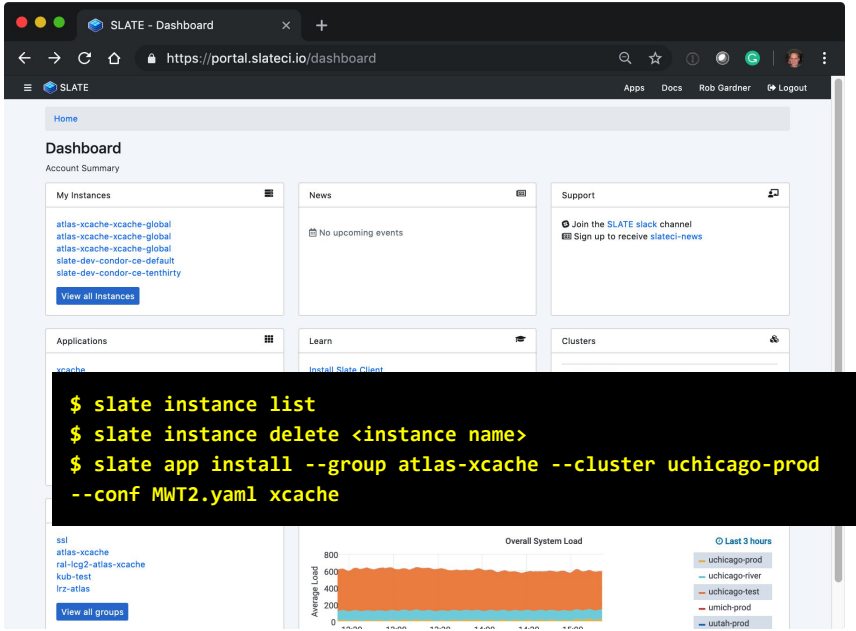

**A data caching network deployed in less than 20 minutes.**

# Towards a NoOps Model with SLATE

**NoOps** - *the concept that an IT environment can become so automated and abstracted from the underlying infrastructure that there is no need for a dedicated team to manage **software** in-house.*

- Remotely manage edge services at sites by **expert teams** from **trusted organizations**
- Deploy updates more quickly & introduce new services more easily
- Save time and effort for local site admins via **NoOps**
- Edge federation via lightweight server/client overlay using **Kubernetes**, the industry leading container orchestration platform

- Software catalog, with push button deploy using vetted **Helm charts** (*Curated Config-knobs for Admins*)



# Main Motivation: The HL-LHC Era Challenge

HSF-CWP-2017-01
December 15, 2017



## A Roadmap for HEP Software and Computing R&D for the 2020s

HEP Software Foundation[1]

Abstract: Particle physics has an ambitious and broad experimental programme for the coming decades. This programme requires large investments in detector hardware, either to build new facilities and experiments, or to upgrade existing ones. Similarly, it requires commensurate investment in the R&D of software to acquire, manage, process, and analyse the shear amounts of data to be recorded. In planning for the HL-LHC in particular, it is critical that all of the collaborating stakeholders agree on the software goals and priorities, and that the efforts complement each other. In this spirit, this white paper describes the R&D activities required to prepare for this software upgrade.

*"**Evolutionary change towards HL-LHC is required**, as the experiments will continue to use the current system. Mapping out a path for migration then requires a fuller understanding of the costs and benefits of the proposed changes. A model is needed in which the benefits of such changes can be evaluated, taking into account hardware and human costs, as well as the impact on software and workload performance that in turn leads to physics impact."*

https://arxiv.org/abs/1712.06982

# Our infrastructure needs to evolve and it seems clear it'll be in an open ecosystem - but HOW?


## Alessandra Forti @ NYU, June 2019

MANCHESTER 1824

GridPP UK Computing for Particle Physics

### Not our software anymore

- EDG/EGEE/EGI/OSG/WLCG/....
  - HEP dictated the middleware development direction
  - Grid is a HEP product
- Containers eco-system is not our sw/infrastructure anymore
  - More people use it, fix bugs etc
  - Easier to integrate with other infrastructures
  - Development not in our control, need to be part of the open source community
- Example of a successful collaboration CERN/Openstack

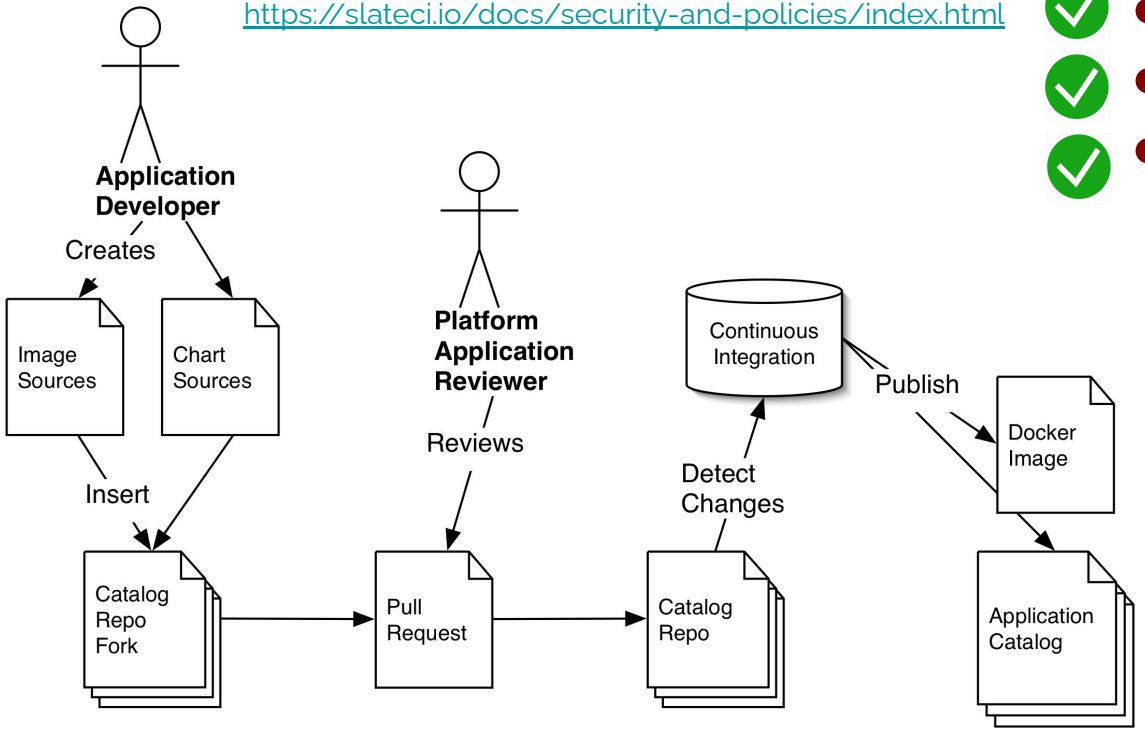
# We will need to evolve our facilities like we evolve our software- SLATE has a role to play


A fundamental **redesign** of our Tier–2 complex is needed to provide **flexibility** to innovate services (CI/CD pipelines), **reproducibility** to ensure reliability, and **security** to sustain new operations models

# SLATE Requires a New Trust Model

## … to gain adoption, site incentives are needed

https://slateci.io/docs/security-and-policies/index.html




- TrustedCI.org engagement
- OSG container security
- **WLCG SLATE security working group formed (see David Crook's presentation)**

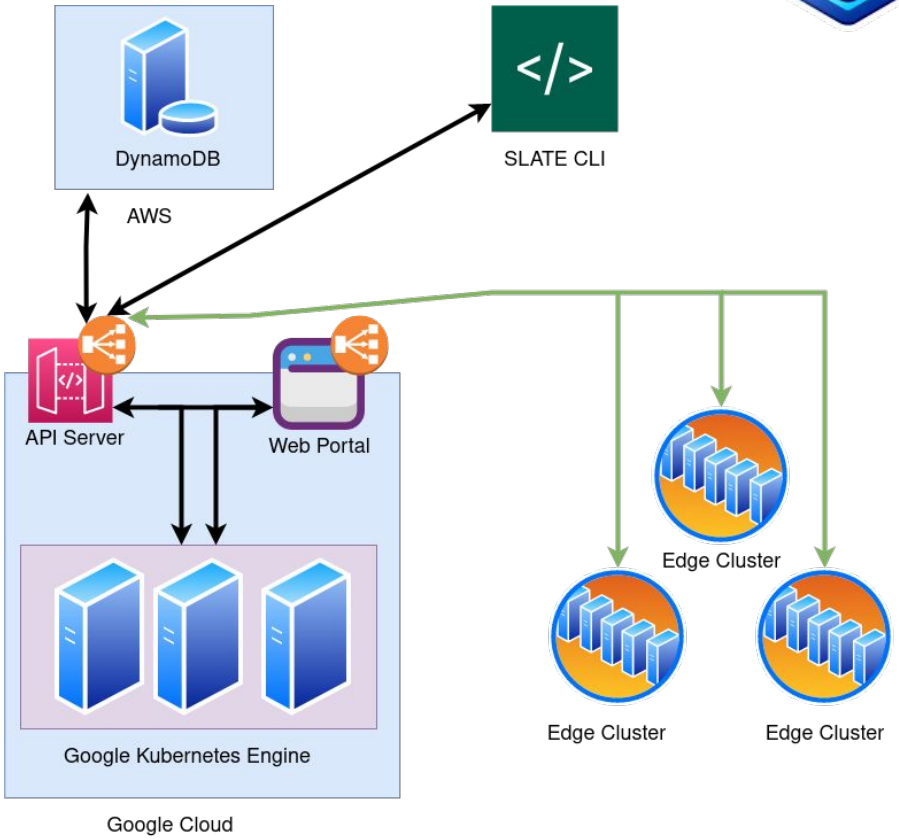
# The SLATE Architecture

- Lightweight federation and application catalog layer on top of **Kubernetes**
  - Security-conscious, site autonomous
  - Sites retain administrative control
- Single entrypoint using institutional identity
- Simple UNIX-like permissions model (Users + Groups)
- **Application catalog** provides natural boundary between configuration knobs users actually want to change and complex Kubernetes configurations
- SLATE is an infrastructure **and software**

Create & manage your own federation over independently managed Kubernetes clusters

# The SLATE Architecture (cont.)

- SLATE uses Kubernetes at the heart of its own infrastructure.
- The Google Kubernetes Engine (**GKE**) serves both the API Server and Web Portal.
- Google Cloud Load Balancing is applied against all inbound traffic to the GKE.
- The persistent data is hosted on **AWS** DynamoDB.
- The SLATE CLI is available as a downloadable GitHub Release.



# General SLATE News

- New applications added to the stable catalog
  - perfSONAR Testpoint
  - XCache
  - Varnish (multithreaded squid replacement)
  - Faucet SDN controller
- **Globus Connect v5 close to being ready**
- Other applications, improvements here: https://portal.slateci.io (have a look!)

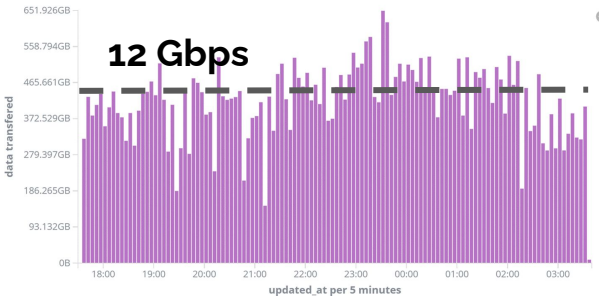
# Vulnerability patching via SLATE

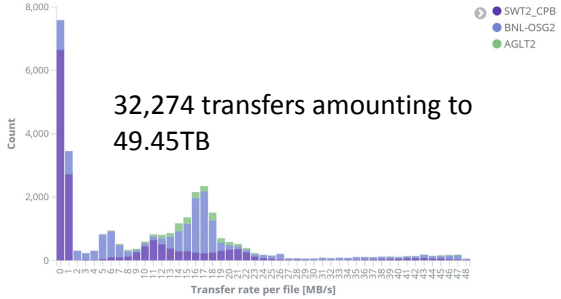
- Previously OSG announced a vulnerability in Frontier Squid which was quickly fixed on SLATE
- New vulnerabilities continually arise…
- **SLATE advantage**: instances can all be simply updated by running:

```
for i in $(slate instance list | grep squid | awk '{print $4}'); do
   slate instance restart $i
done
```

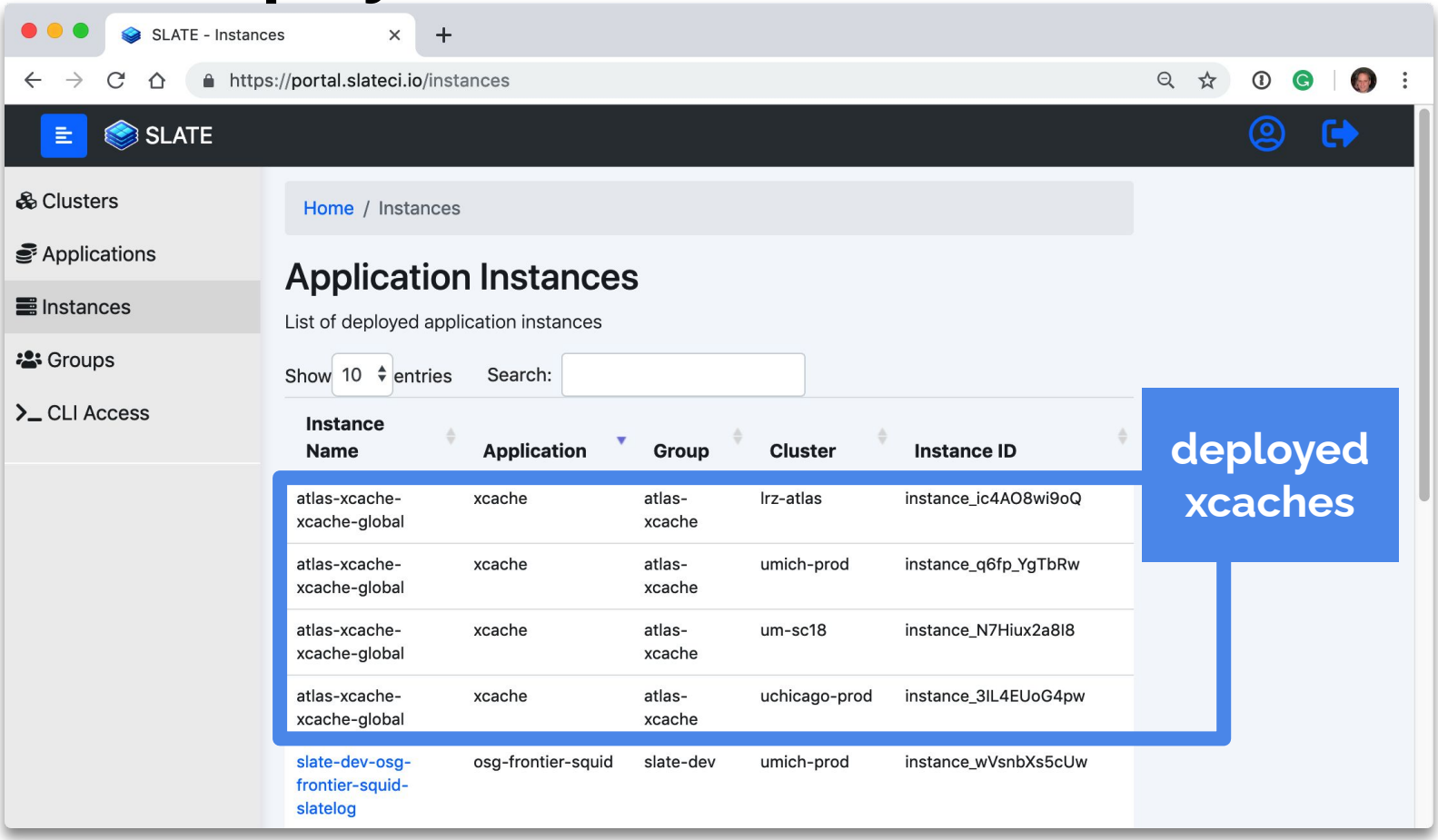
# SLATE and XCache

- **ATLAS** is using **SLATE** to deploy an XCache-based (XRootD caching) cache network at sites
- Have been working with **ESNet** to deploy XCache *in* the network fabric, one cache up & running in production
- **Cache deployment done entirely by XCache team** - Operators in **ESNet** needed only set up the host and firewall rules for us.



# SLATE Deploy XCaches



# XCache updates

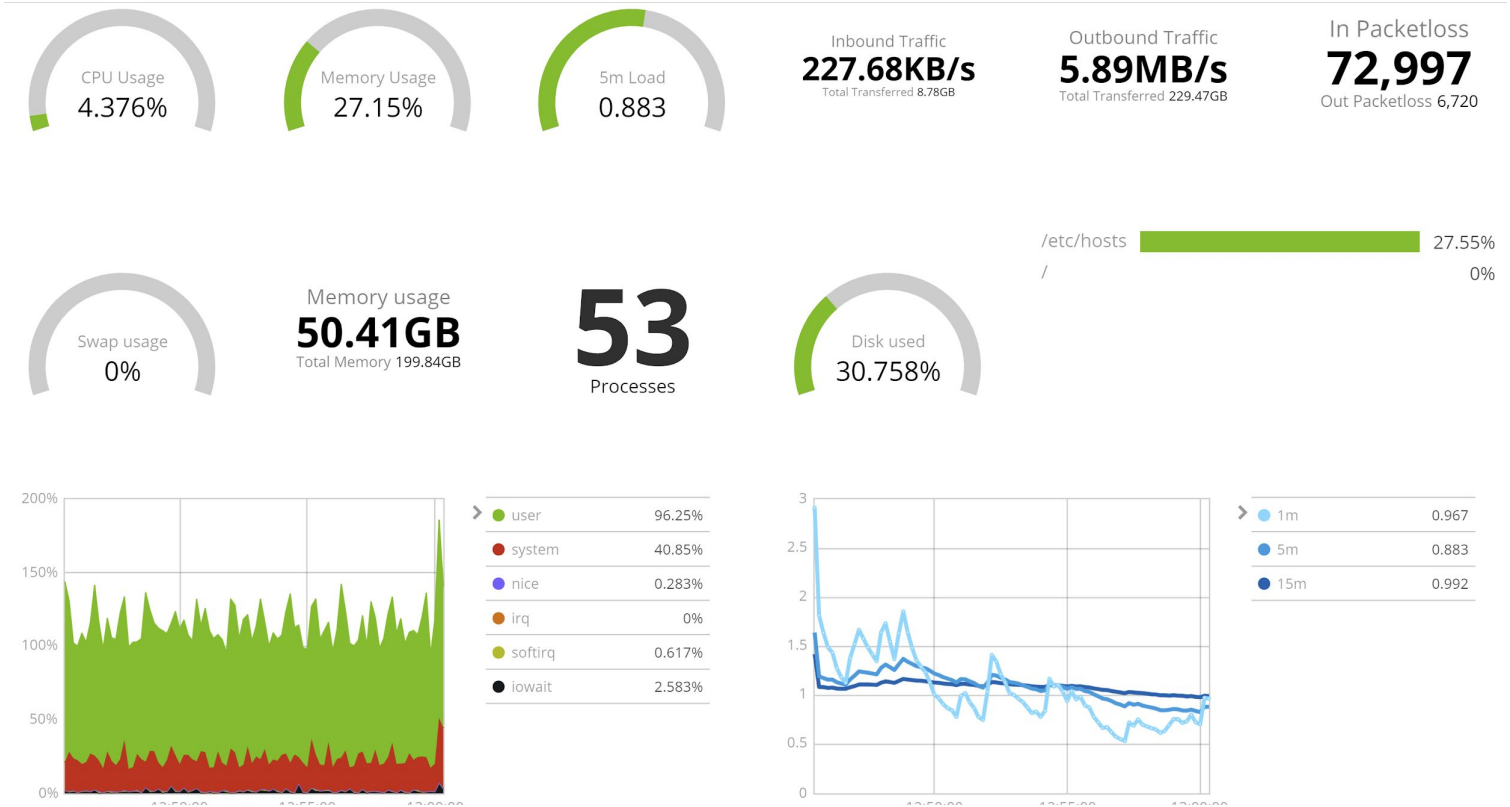
- Even simpler
- Completely transparent to site admin.

```
$ slate instance list
$ slate instance delete <instance name>
$ slate app install --group atlas-xcache --cluster uchicago-prod --conf MWT2.yaml xcache
```

Additional benefits:

- Automatic core dump collection (part of XCache)
- Containerized environment makes it easier to debug

# SLATE Monitoring - ES & Kibana



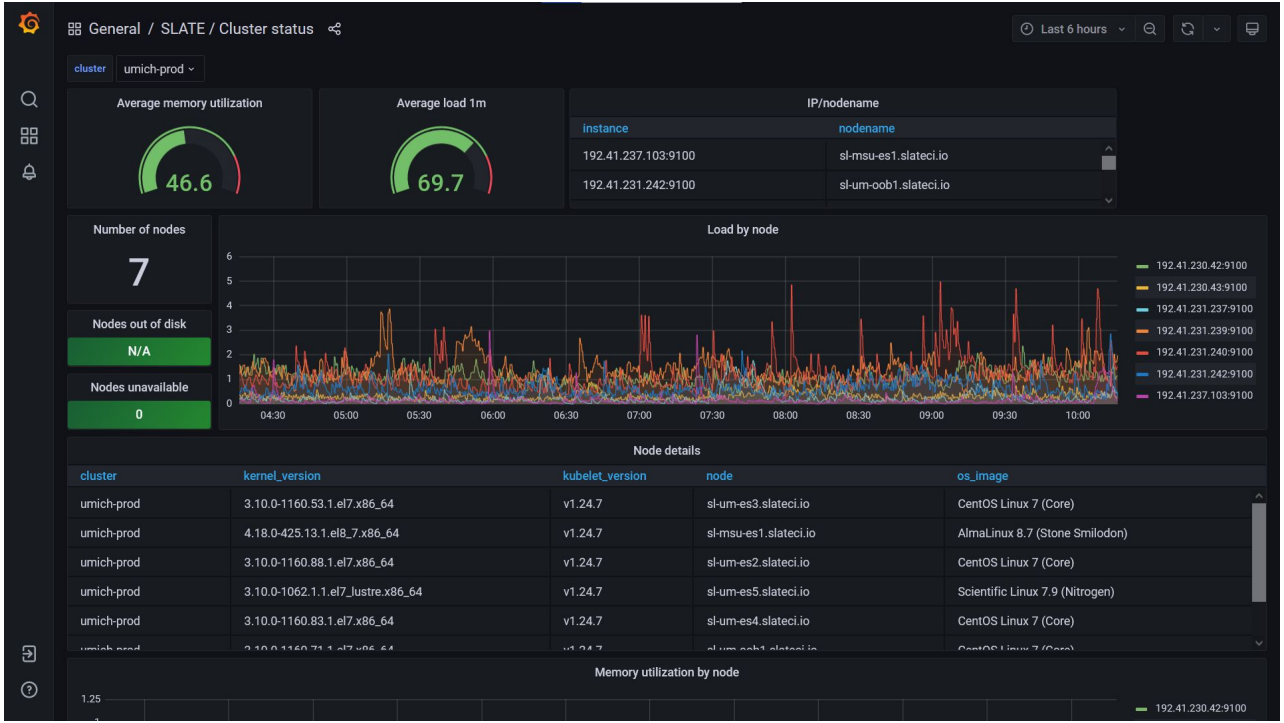
# SLATE Grafana Dashboards - Beta Version

We have set up our SLATE clusters to report metrics for display by Grafana

We are collaborating with the OSiRIS project, hosting monitoring data in OSiRIS S3 buckets

Live dashboard link ->

http://monitoring.umich-prod.slateci.net/d/3T3FQKnZk/slate-cluster-status?orgId=1&var-cluster=All

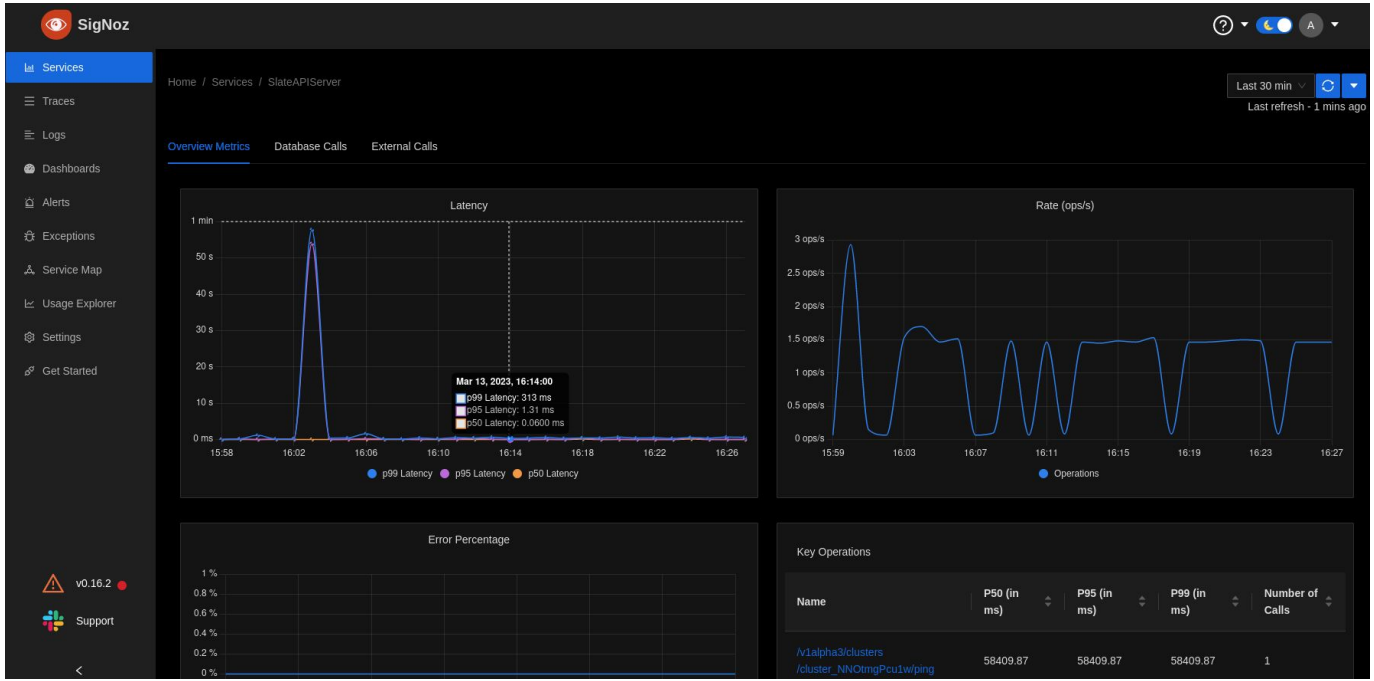


# SLATE SigNoz Dashboards - Beta Version

We have set up our SLATE infrastructure to report metrics for display by SigNoz.

**SigNoz** tracks timing information and success/failure of calls to the API.

It allows for **monitoring** and **alerting** based on error rates or increased latency in the SLATE infrastructure.



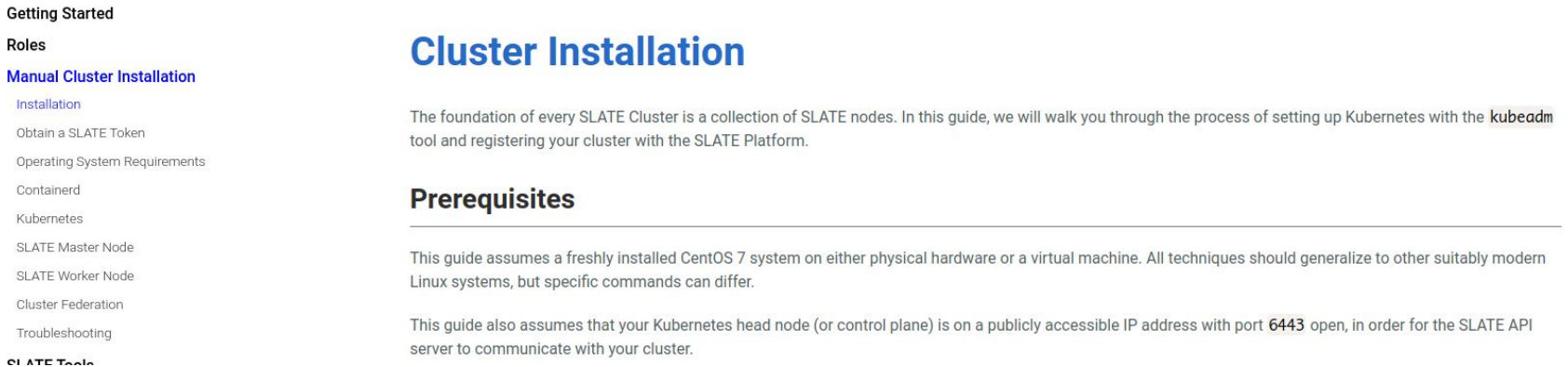
# Faucet - SLATE's Stable Catalog

We have migrated Faucet OpenFlow SDN Controller to the stable applications catalog after testing, making it easier to deploy as part of a groups infrastructure. The SLATE Faucet exports metrics to Prometheus, Grafana, InfluxDB

*Faucet is a compact open source OpenFlow controller, which enables network operators to run their networks the same way they do server clusters. Faucet moves network control functions (like routing protocols, neighbor discovery, and switching algorithms) to vendor independent server-based software.*

# SLATE provisioning

- To install SLATE
  - You install Kubernetes 1.24.x, download **SLATE** client and register your cluster
  - Details are provided below and the SLATE team can help in case of problems or questions.
- Please try it out at your site!
  - https://slateci.io/docs/cluster



# Conclusion

- While the **distributed computing model** and **software** will evolve, certain principles will always remain in our domain:
  - **distributed trust, resource aggregation & sharing, central & local ops**
- But we need **new** ones too:
  - **declarative, reproducible infrastructure** (as code)
  - federation operations (towards "NoOps")
  - open source technology alignment and leverage
- The SLATE project **wraps up this summer** but we plan to find ways to continue our work and evolve SLATE as a useful framework.

# Acknowledgements

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Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

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# Questions?