SLATE
A new approach for DevOps in distributed scientific computing facilities

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Outline

- What is SLATE?
- The motivation
- The SLATE Vision
- Current technology explorations
- Challenges and open questions
- Wrap up
What is SLATE?

- NSF DIBBs award, "SLATE and the Mobility of Capability" (NSF 1724821)
- Equip the ScienceDMZ with service orchestration capabilities, federated to create scalable, multi-campus science platforms
- Platform for service operators & science gateway developers
Motivation: enabling multi-institution collaborative science
XENON - Dark Matter Search in Gran Sasso Laboratory, Italy

165 scientists, 25 institutions, 11 countries

Collaboration

WIMP mass [GeV/c^2] vs. WIMP-nucleon σ_x [cm^2]
Global data & processing platform

EU & US storage

EU & US processing

Example

Job management with HTCondor & workflow pipeline tools

XENON DAO @ LNGS

Detector Settings Run Information

Data Storage @ LNGS

Tivoli Storage Manager

Tape Backup @ PDC Stockholm

RUCIAAX Software connecting XENON Runs DB, Rucio service, and Tape Backup

OSG = Open Science Grid
EGI = European Grid Infrastructure

DAQ Interprocess Communication @ LNGS
DAQ Web Server @ LNGS
Slow Control (Via DAQ API) @ LNGS

FTS @ UChicago

Rucio DB

Rucio Service @ UChicago

XENON Runs DB @ LNGS

XENON Node @ UChicago

OSG dCache @ UChicago

XENON Runs DB Mirror at UChicago and PDC Stockholm

Rucio DB Interactions

XENON Runs DB Interactions

Raw Data

Processed Data

Random Selected Element

Jobs
The Open Science Grid

- OSG is the nation's shared HTC cyberinfrastructure
- Serves over 36 science disciplines
- Used by single PIs to the largest collaborations
- Consortium of over 70 HTC sites in US
- Provides US part of worldwide LHC computing grid
- Produces >1.5B CPU-hours/y  Moves >100s PB/y
Facilitator for "data lake" R&D

- Allow continuous development of caching & delivery services
- Roll out updates centrally
- Configure & Op centrally
Caching network for IceCube & LIGO
Deployment is difficult!

- A broken DevOps cycle!
- Deployment means:
  - Finding a friendly sysadmin at the site
  - Having them procure hardware or a virtual machine
  - Sending them the deployment instructions and hoping for the best
- Operations problems too:
  - Someone has to make sure it actually keeps running
  - Latency in updates across sites make it extremely difficult to rapidly innovate platform services
The SLATE Vision
Campus or Institute HPC resources

SLATE edge platform (in SciDMZ)

Central SLATE Platform Service Factory

SLATE Platform Operators & Science VO Managers
GLOBAL DATA & PROCESSING PLATFORM

EU & US STORAGE

XENON COMPUTING

EU & US processing

Job management with HTCondor & workflow pipeline tools

AUTOMATE DEVOPS

Global data & processing platform
The Open Science Grid

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Caching network deployed for IceCube & LIGO
Services Layer At The Edge

● A ubiquitous *underlayment* -- the missing shim
  ○ A generic cyberinfrastructure substrate optimized for hosting edge services
  ○ Programmable
  ○ Easy & natural for HPC and IT professionals
  ○ Tool for creating "hybrid" platforms

● DevOps friendly
  ○ For both platform and science gateway developers
  ○ quick patches, release iterations, fast track new capabilities
  ○ reduced operations burden for site administrators
SLATE Concepts & Components

- Containerized services in managed clusters
- Widely used open source technologies for growth and sustainability
- SLATE additions
  - Curated services
  - Create a “Loose federation” of clusters & platforms

Welcome to SLATE CI
Services Layer at the Edge and the Mobility of Capability

Platform Elements
A SLATE edge platform within a campus Science DMZ hosts trusted services operated by a central team which might be operating a network of such services across several campuses. Science "sign" developers interact with the SLATE platform service factory to define and launch elements of a science gateway, data caches, or local workflow service.

CLI Registration Script
• Before running this command, you should verify that you have the correct cluster selected

CLI Registration Script

# This is the ID of the VO for whom we are registering the cluster
VO_ID="slate-dev"

# This is the human-readable name that the cluster should be registered under in SLATE
CLUSTERNAME="testing"

# By default we just look for the standard location
KUBECONFIG="$HOME/.kube/config"

New Cluster Registration

Cluster Name

VO ID
slate-dev

Submit
Policy and Trust

- **SLATE** applications curated into a trusted application catalog
- Applications must define and request all needed network, disk, device, etc access.
  - Think application permissions on your phone
- Site policies must be respected
  - Access, privileges, capabilities are controlled and transparent
Deploying an "Application"

```
$ slate-client cluster list
Name   ID                               Owned By
umich  Cluster_d3732e1d-7ea0-4022-96fc-288a0c8a7c5d slate-dev
utah-coreos Cluster_3249cb47-7318-4fd0-a61b-0cf99c1aceb8 slate-dev
uchicago Cluster_98b60d59-b873-4014-8f1d-f9c259c116b3 slate-dev
```

```
$ slate-client app list
Name                          App Version Chart Version Description
jupyterhub                    v0.8.1       v0.7-dev     Multi-user Jupyter installation
osg-frontier-squid-squid-3    1.0          0.2.0       A Helm chart for configuration and deployment o...
osiis-unis                   1.0          0.1.0       Unified Network Information Service (UNIS)
perfsonar                    1.0          0.1.0       perfSONAR is a network measurement toolkit desi...
```

```
$ slate-client app install --vo slate-dev --cluster uchicago osg-frontier-squid proxy-test
Successfully installed application osg-frontier-squid as instance slate-dev-osg-frontier-squid-proxy-test with ID Instance_dd427321-05f5-42a2-b61c-e21169187188
```

```
$ slate-client instance info Instance_dd427321-05f5-42a2-b61c-e21169187188
Name                         Started          VO     Cluster       ID
slate-dev-osg-frontier-squid-proxy-test 2018-Aug-03 slate-dev uchicago Instance_dd427321-05f5-42a2-b61c-e21169187188
```

Services:
```
Name                  Cluster IP  External IP  Ports
```

Configuration: (default)
Summary

- Reduce barriers to supporting collaborative science
- Give science platform developers a ubiquitous "CI substrate"
- Change distributed cyberinfrastructure operational practice by mobilizing capabilities in the edge
- Developing the DevOps model, provider concerns and policies, tooling to give developers consistent environment
- First k8s-based WAN deployments underlay:
  - caching networks for OSG (StashCache) and ATLAS at CERN (XCache)
Thank you!

slateci.io
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