SSL Architecture hybrid systems, deployments, developer support

Lincoln Bryant Enrico Fermi Institute University of Chicago iris hep

IRIS-HEP AS-SSL Blueprint @ NYU June 21, 2019



Desired SSL capabilities



- Support a diverse catalog of deployment patterns & models
- Experiment patterns (scalability tests)
- Usability
 - Modality, Reservation
 - Metrics, logging, analytics
- Operation & Support
- Openness
 - to providers to contribute
 - to developers to conduct experiments

- Recording value
 - Analysis platform
 "blueprints" :
 - Single site/region deployments
 - Multi-region deployment
 - Multi-cloud hybrids e.g. SSL+GCP+CERN, etc..
 - Demonstrations & archival of demo artifacts

An architecture that implements...



- a community platform
- supports groups and projects
- bespoke resources & configurations
- declarative & reproducible deployments
- services to build & manage artifacts
- scalable up and back down
- reduce cognitive load for developers and deployers.



Some ingredients..



Community platform

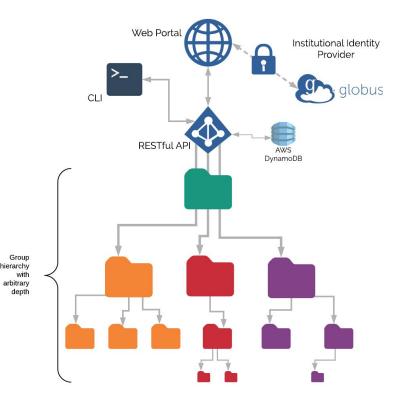


- Open to all working on software infrastructure in HEP
- CILogon, Globus to provide single-sign on and federated identity
- Lightweight user and group (project) management system
- Infrastructure itself composable, reusable

Groups and projects

- Web and CLI interfaces for user management
- Groups organized as a tree structure with arbitrary depth
- Users can invite others, create sub groups, etc.
- Smart clients inspect the tree and implement appropriate provisioning of resources









- Mix of bespoke dedicated resources and capability for users to bring allocations on others
- Container-based service orchestration on dedicated resources
- VC3-like technology to connect to HPC/HTC resources for batch
- Facilitate integration of commercial cloud resources when needed

Orchestrating services in the SSL



- Need flexible infrastructure for supporting the workloads we expect from SSL
- Dynamically reconfigure existing hardware to be a HTCondor cluster today, Spark tomorrow, whatever is needed.
- Containerized services are getting a lot of attention in Industry right now- can we take advantage of the momentum?
- Want to "glue" clusters together, but abstract away infrastructure to whatever extent possible clear a smooth road for the developers
- Potentially mimic cloud native groupings: e.g. create "zones" of resources





 Repurposed UChicago CS research cluster

Vintage but nice: (~50)

- CPU: 2 x Intel Xeon E2650 v3 12-core processor, 2.3GHz, 30MB cache
- DRAM: 16 x 16GB TruDDR4 Memory 2133MHz, 256GB
- Disks: 2 x 800GB SATA MLC SSD, 1.6TB
- 10G NICs
- 2x40 Gbps to SciDMZ
- Rebuilding as Kubernetes
- Explore federation to aggregate w/ others



Federated ID access (institutional, CERN account), edge services hosting, Unix account provisioning, LHC software env.

Kubernetes (k8s)



- Open source container orchestration platform
- Automate deployment, management, scaling
- Has origins in Google/Borg
- Supported/managed by Cloud Native Foundation
- Declarative model for deployments

Declarative infrastructure



- Want infrastructure built under the SSL to be easily reusable and deployable to other sites
 No more twikis with install guides!
- Declarative nature of Kubernetes is a good fit and gets us a long way down that road.
- SSL as an incubator for projects which then "graduate" to become full-fledged infrastructures that run on production resources.

Federating platforms



- Expect users to outgrow the dedicated pool of resources we have now.
- Need an interface and mechanism to allow users of the SSL reach into resources at a heterogeneous collection of sites
- Many approaches in the Kubernetes community, waiting to see what survives & what will be most appropriate for us

Extending into HPC/HTC



- Foresee workloads that require some service infrastructure in the SSL, but want to do batch computing elsewhere
- Want to facilitate by using technologies derived from VC3, HEPCloud and others
- Provision compute schedulers, data managers on SSL, schedule workers to HPC resources via overlays

Artifact build and management

- Provide resources for building and registering containers, compiling software, etc.
- Off-the-shelf tools plugged into SSL resources with a little bit of glue.
 - Why wait 30 minutes for DockerHub to build your container?
- Is this obviated by CERN services? Perhaps more valuable for non-LHC experiments

15

SSL "Glass"

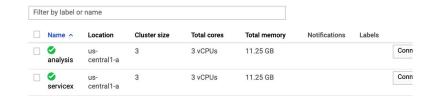
- Portal for visibility and organization
 - groups (projects)
 - resources
 - artifacts
- Metrics, logging, analytics
- Regional, national and international scopes



WBS 6.3 Functional Testing

Until SSL base platform operational we can use GKE for testing. Early deployments for iDDS/ServiceX

• • • Kubernetes Engine - ServiceX × +									
\leftrightarrow \rightarrow C \triangle	.go Q	☆	1	۲	0				
≡ Google Clou	d Platform 🔹 ServiceX 👻		۹	۰	1	0			
Kubernetes E	ngine Kuberneus	sters							



A Kubernetes cluster is a managed group of VM instances for running containerized applications. Learn more

 			Point Cong NVP Tires	e Ange	-ði:			R	30.00		
Coogle Cloud Platform ServiceX Workloads C REFRESH Deploy Delate Workloads are deployable units of computing that can be created and managed in a cluster. ServiceX ServiceX ServiceX Satus Time Satus ServiceX OK Deployment 1/1 ServiceX Satus ServiceX OK Deployment 1/1 ServiceX ServiceX ServiceX OK ServiceX ServiceX ServiceX ServiceX ServiceX ServiceX <t< th=""><th>• •</th><th>Kubernetes English</th><th>jine - ServiceX × +</th><th></th><th></th><th></th><th></th><th></th><th></th><th></th><th></th></t<>	• •	Kubernetes English	jine - ServiceX × +								
Workloads C REFRESH Dellor	← -	→ C 🏠 🔒 http	s://console.cloud.google.com/	kubernetes	s/workl	oa Q 🖍	0	0 0	G	() :	
Image: Servicex kafka 200keeper OK Deployment 1/1 servicex Image: Servicex kafka OK Deployment 1/1 servicex Image: Servicex kafka OK Deployment 1/1 default servicex Image: Servicex kafka OK Deployment 1/1 default servicex Image: Servicex kafka OK Deployment 1/1 default servicex Image: Servicex kafka OK Deployment 1/1 servicex servicex Image: Servicex kafka OK Stateful Set 3/3 kafka servicex Image: Servicex kafka OK Stateful Set 3/3 kafka servicex Image: Servicex kafka OK Stateful Set 3/3 kafka servicex Image: Servicex kafka OK <td< td=""><td>≡ (</td><td>Google Cloud Platform</td><td>🔹 ServiceX 👻 🔍</td><td></td><td></td><td>3</td><td>- 5.</td><td>9 (</td><td>9 .</td><td>: 🙆</td><td></td></td<>	≡ (Google Cloud Platform	🔹 ServiceX 👻 🔍			3	- 5.	9 (9 .	: 🙆	
Image: Servicex kafka 200keeper OK Deployment 1/1 servicex Image: Servicex kafka OK Deployment 1/1 servicex Image: Servicex kafka OK Deployment 1/1 default servicex Image: Servicex kafka OK Deployment 1/1 default servicex Image: Servicex kafka OK Deployment 1/1 default servicex Image: Servicex kafka OK Deployment 1/1 servicex servicex Image: Servicex kafka OK Stateful Set 3/3 kafka servicex Image: Servicex kafka OK Stateful Set 3/3 kafka servicex Image: Servicex kafka OK Stateful Set 3/3 kafka servicex Image: Servicex kafka OK <td< td=""><td></td><td></td><td></td><td>LETE</td><td></td><td></td><td></td><td></td><td></td><td></td><td>and the same</td></td<>				LETE							and the same
a duster.	W	Workioads		LLIL							
Image: System object : False ♥ Fitter workloads X ♥ Columns ▼ Image: Name ^ Status Type Pods Namespace Cluster Image: Name ^ Status Type Pods Namespace Cluster Image: Name ^ Status Deployment 1/1 servicex servicex Image: Namespace OK Stateful Set 3/2 kaffaa	\oplus		s of computing that can be created and manage	ed in							
 Name ^ Status Type Pods Namespace Cluster Names ^ Status Pods Status Status Component (1/1) services services attas-base O K Deployment (1/1) services services invariant-mass-analysis O Running Pod (1/1) default services kaftacat O Running Pod (1/1) kafta services services O K Deployment (1/1) services services services O K services Status O Running Pod (1/1) kafta services services O K services Status O Running Pod (1/1) kafta services services O K services V A Running Pod (1/1) kafta services testclient O Running Pod (1/1) kafta services transform-cli O Running Pod (1/1) services services 	14	a orașteri									
Name Name Status Type Pods Namespace Cluster Image: Status Image: Status Deployment 1/1 servicex servicex Image: Status Image: Status Image: Status Deployment 1/1 servicex Image: Status Image: Status Image: Status Image: Status Image: Status servicex Image: Status Image: Status Image: Status Image: Status servicex Image: Status Image: Status Image: Status Image: Status servicex Image: Status Image: Status Image: Status Image: Status servicex Image: Status Image: Status Image: Status Status servicex Image: Status Image: Status Image: Status Status servicex Image: Status Image: Status Image: Status Image: Status servicex Image: Status Image: Status Image: Status Image: Status servicex Image: Status Image: Status Image: Status Image: Status servicex Image: Status Image: Status Image: Status Image: Status servicex Image: Status Image: Status Image: Status Image: Status	A	= Is system object : Fa	Ise 🛞 Filter workloads			× ©	Columns 👻				
I atlase-base O K Deployment 1/1 servicex I did finder O K Deployment 1/1 servicex I mivariant-mass-analysis O Running Pod 1/1 default servicex Kaffacat O Running Pod 1/1 kaffaca servicex exricex O K Deployment 1/1 servicex servicex.kaffaa O K Deployment 1/1 servicex servicex.kaffaa O K Deployment 1/1 servicex servicex.kaffaa O K Stateful Set 3/3 kaffaa servicex iservicer.kaffaa O K Stateful Set 3/3 kaffaa servicex iservicer.kaffaa O Running Pod 1/1 servicex servicex itansform-cli Running Pod 1/1 servicex servicex		Name ^	Status	Туре	Pods	Namespace	Cluster				
I utvariant-mass-analysis Panning Pod 1/1 default servicex I wariant-mass-analysis Running Pod 1/1 kafka servicex I servicex Ø OK Deployment 1/1 servicex servicex I servicex-kafka Ø OK Stateful Set 3/3 kafka servicex I servicex-kafka Ø OK Stateful Set 3/3 kafka servicex i servicex-kafka Ø OK Stateful Set 3/3 kafka servicex i testclient Ø Running Pod 1/1 kafka servicex i tansform-cli Ø Running Pod 1/1 servicex		atlas-base	🔮 ок	Deployment	1/1	servicex	servicex				
kafkacat Ø Running kafkacat Ø Running servicex Ø OK beployment // // servicex servicex/kafka Ø OK Stateful Set // // servicex servicex/kafka-zookeeper Ø OK Stateful Set // // servicex testolient Pod // // servicex transform-dil Ø Running Pod // servicex	•	did-finder	🥝 ок	Deployment	1/1	servicex	servicex				
servicex Ø OK Deployment 1/1 servicex servicex servicex/kafka Ø OK Stateful Set 3/3 kafka servicex servicex/kafka-zookeeper Ø OK Stateful Set 3/3 kafka servicex testclient Ø Running Pod 1/1 kafka servicex transform-cli Ø Running Pod 1/1 servicex		invariant-mass-analysis	🥝 Running	Pod	1/1	default	servicex				
servicex-kafka S OK Stateful Set 3/3 kafka servicex servicex-kafka-zookeeper OK Stateful Set 3/3 kafka servicex testclient Running Pod 1/1 kafka servicex transform-cli Running Pod 1/1 servicex		kafkacat		Pod	1/1	kafka	servicex				
servicex-kafka-zookeeper Ø OK Stateful Set 3/3 kafka servicex testclient Ø Running Pod 1/1 kafka servicex transform-cli Ø Running Pod 1/1 servicex servicex											
testclient Image: Running Pod 1/1 kafka servicex transform-cli Image: Running Pod 1/1 servicex servicex											
transform-di ORunning Pod 1/1 servicex servicex											
Construction of the service of the s											
	嵩	transformer	Does not have minimum availability	Deployment	1/1	servicex	servicex				

Current status



- Group/identity bits are being developed for multiple projects, being repurposed for SSL.
- Kubernetes conversion of River cluster underway.
 - 4 nodes online, backfilling w/ OSG via SLATE
 - Brave early adopters come talk to me afterwards!
- Looking for partners to contribute infrastructure and a bit of effort – experiment with how to federate resources.

Wrap up



• To briefly recap:

- Institutional Identity and group management
- Container-based, declarative software deployment and service orchestration
- Mix of dedicated and non-dedicated resources
- Exploring options for Federation
- Building tightly integrated "pane of glass" for it all
- Integrate with industry best practices where practical!

Discussion



- All of this is very nice, but we need to meet the needs of the community.
- We need input from Analysis Systems and others!



