



OSDF and ESnet — Now and Beyond

Fabio Andrijauskas

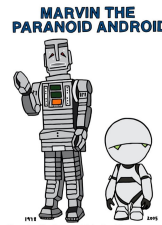
University of California San Diego

OSDF and ESnet — Now and Beyond

Fabio Andrijauskas - UCSD

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(619) 752-4597



Name: Marvin the Paranoid Android
Also known as: Marvin
First pop culture appearance: The Hitchhiker's Guide to the Galaxy (1978 Radio series)
Also known for: The Hitchhiker's Guide to the Galaxy (1981 TV series), The Hitchhiker's Guide to the Galaxy (2005 Movie), novels and comic books, and for being the inspiration for Neil deGrasse Tyson's song *Paranoid Android* (1997 song)
Fictional year of manufacture: not known
Type of robot: Sentient People Personification Prototype Android



Pelican Platform

Pelican is a tool for creating/managing **Data Federations**.

- Data owners may come and go as they like
- Data owners have the ultimate authority to choose how their data is used/distributed
- Unified namespaces, decentralized storage – to a user, everything feels like it's coming from the same source
- Through combining resources while respecting individual needs, we can tackle bigger challenges → Scalability!





Over the last 12 months, the OSDF transferred

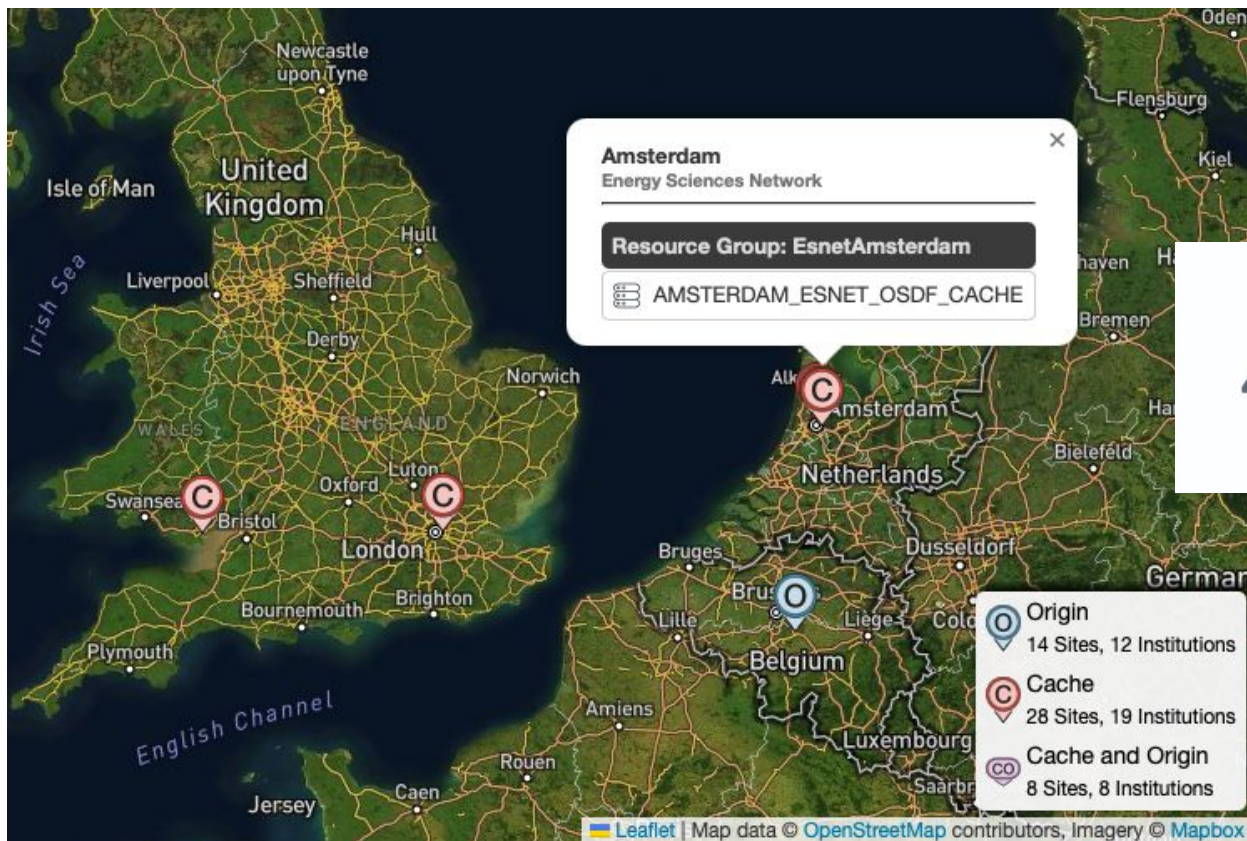
>218 PB &

105 files/s

Data used by
15 science
collaborations
&
~120 OSPool
users



OSDF and ESnet - Amsterdam 41,203,059 hits



Total read
46.3PB

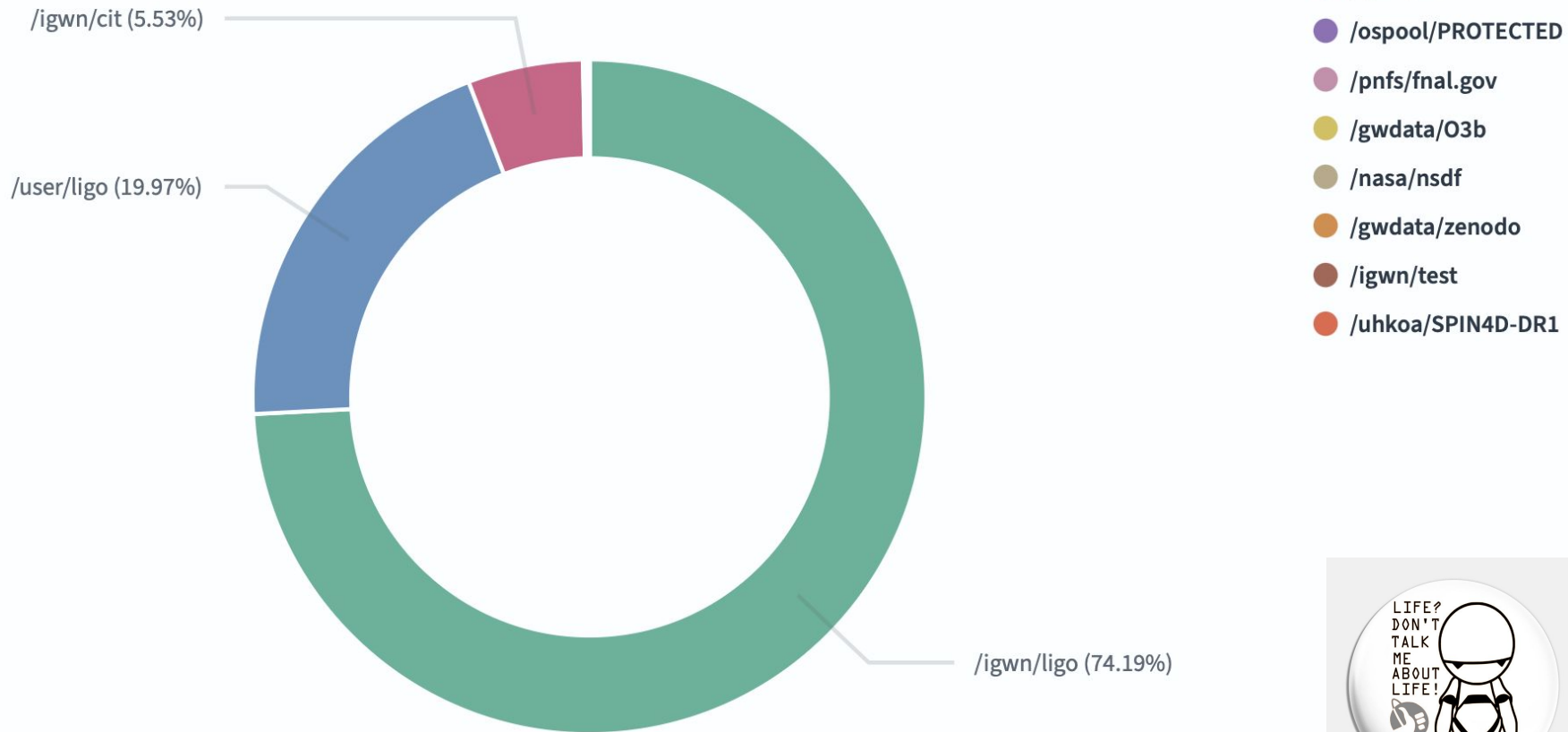
OSDF and ESnet - London

13,856,757 hits

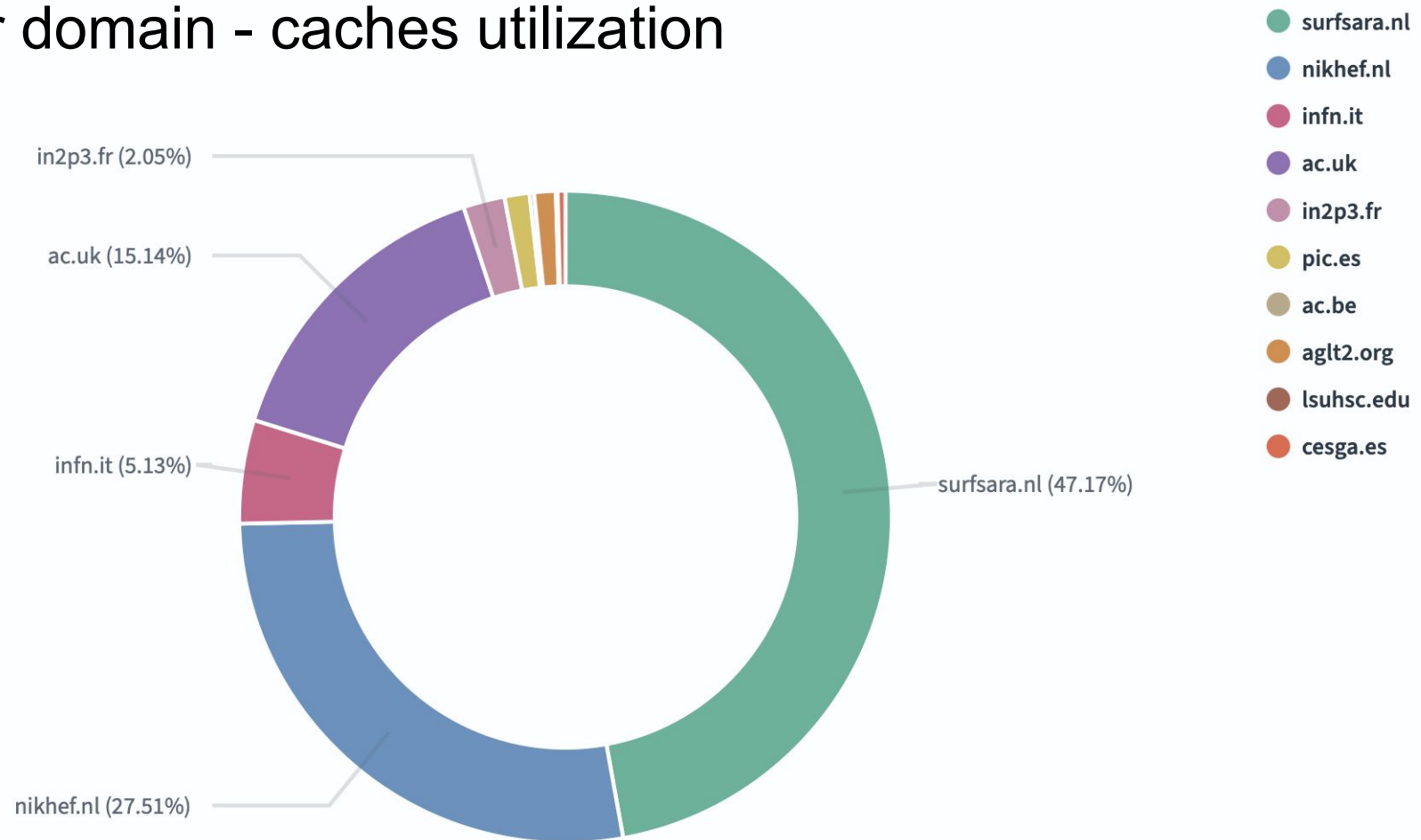


Total read
15.6PB

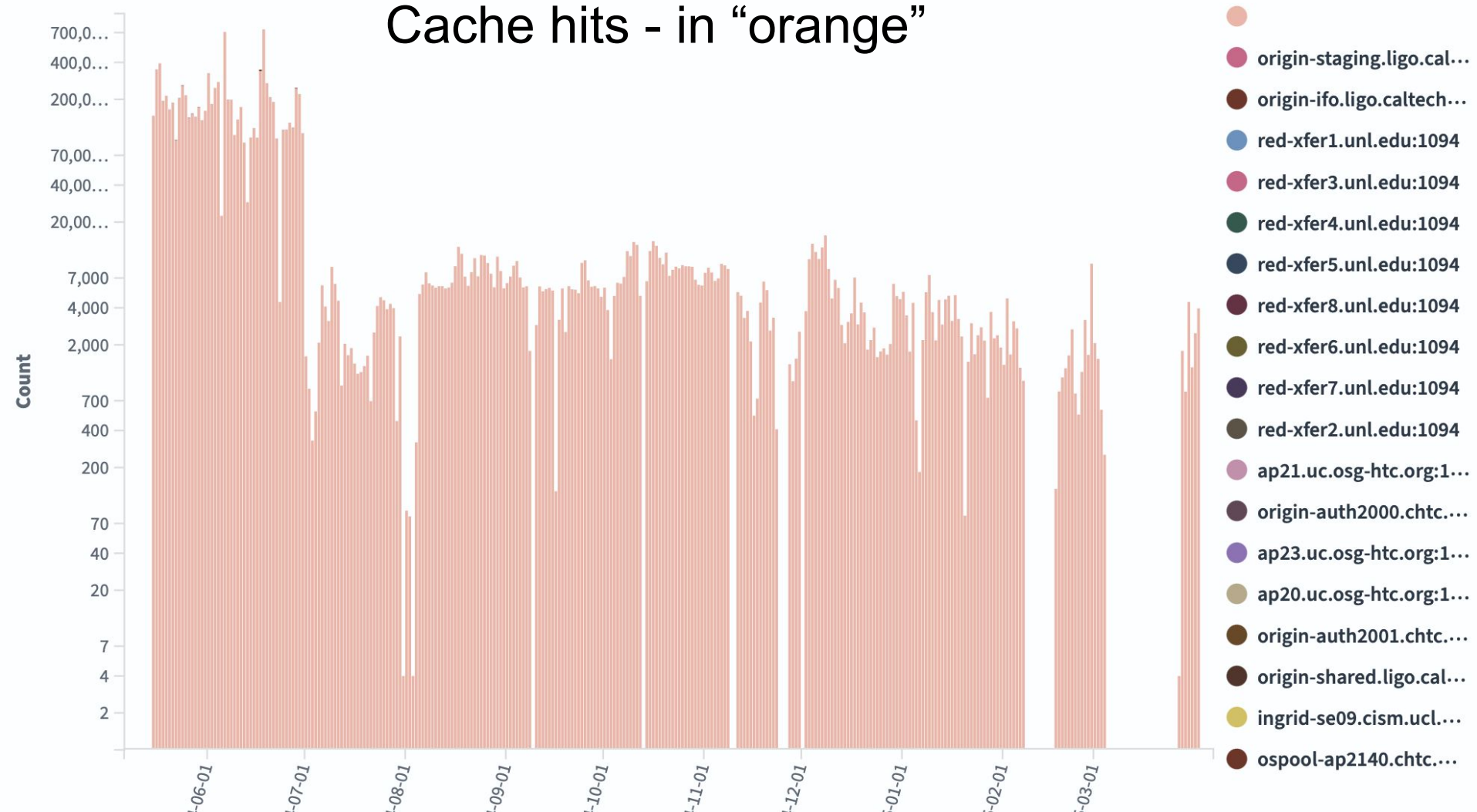
Directory - cache utilization



User domain - caches utilization

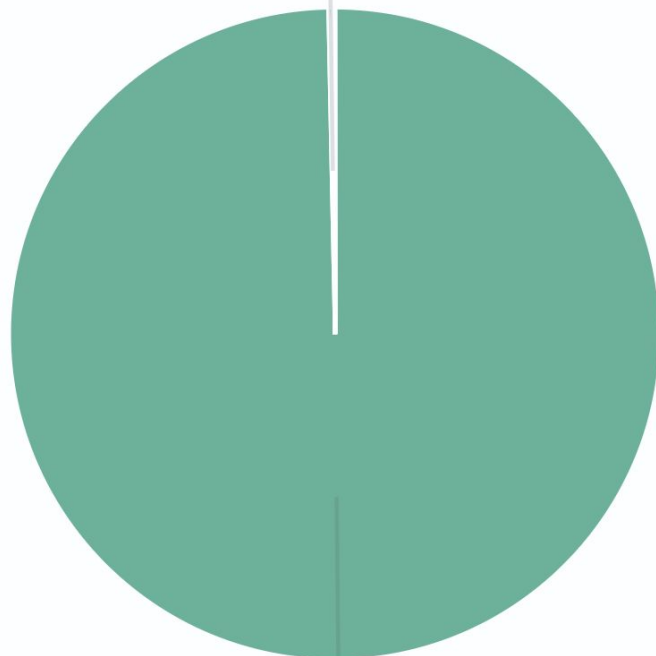


Cache hits - in “orange”



Network, network and more network

-ifo.ligo.caltech.edu:1095 (0.22%)



(99.68%)

- origin-ifo.ligo.caltech...
- origin-staging.ligo.cal...
- ingrid-se09.cism.ucl...
- red-xfer1.unl.edu:1094
- red-xfer3.unl.edu:1094
- red-xfer6.unl.edu:1094
- red-xfer7.unl.edu:1094
- red-xfer2.unl.edu:1094
- red-xfer5.unl.edu:1094
- Other

Saved at least 20PB in the last 15 months

Conclusion

- Caches are helping the “network space” in Europe.
- Several project are using the caches.
- In some moments, the caches have been overloaded.
- Saved at least 20PB in the last 8 months

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From SSH to TLS: Best Practices, Benchmarks, and Lessons Learned for Secure Multi-Site Science

Flavio Castro

Argonne National Laboratory

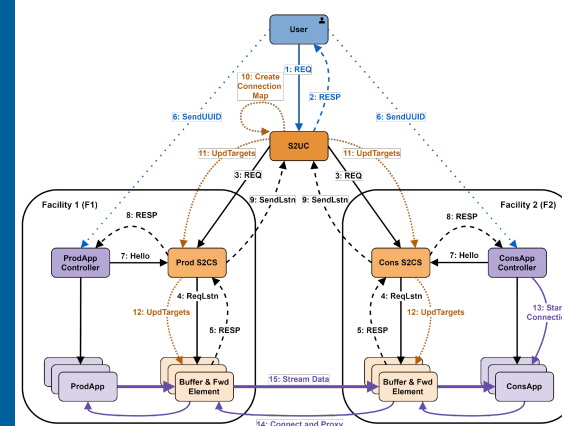
Confab 25



From SSH to TLS: Best Practices, Benchmarks, and Lessons Learned for Secure Multi-Site Science

Flavio Castro

Argonne National Laboratory



April 9th, 2025

What are our options for secure data streaming?

What are our options for secure data streaming?

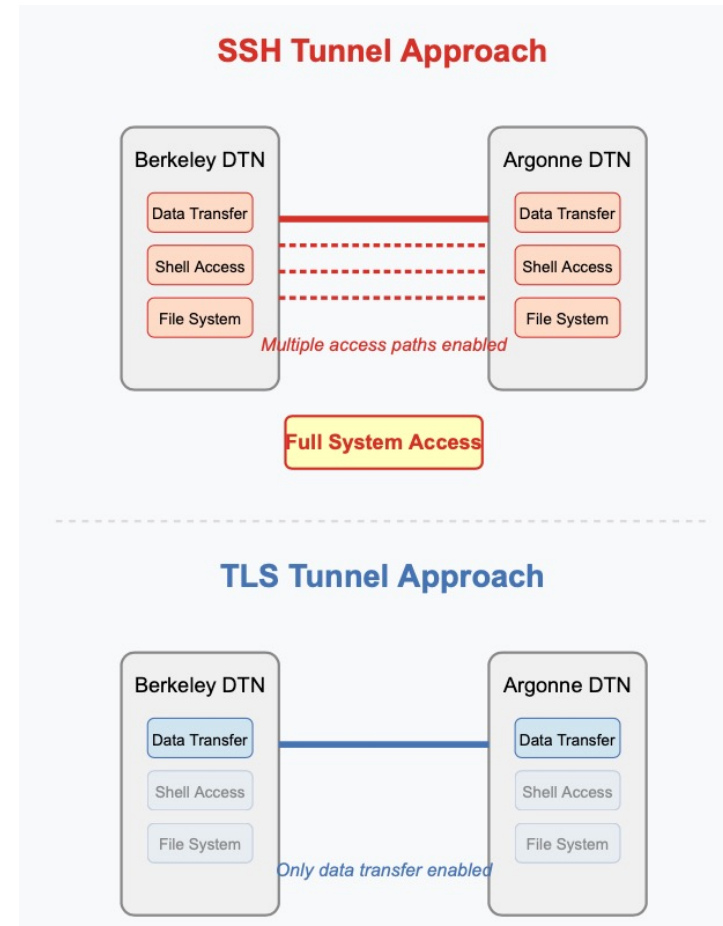
- **It's SSH.**
- **Or file transfers**

Raise your hand... If you seen this command

```
ssh -f -N -L 8000:secret.gov:8000 root@bastion
```

SSH Security

- Requires login
- Provides shell access
- Access to file system
- SSH keys can be compromised



SSH Performance vs TLS

Metric	TCP (46ms)	TLS1.3(46ms)	TLS1.2(46ms)	SSH (46ms)
Iperf3	5.91 Gbps	4.29 Gbps	2.75 Gbps	0.18 Gbps
Iperf3 -P 4	24.78 Gbps	16.96Gbps	10.62 Gbps	1.14 Gbps
HTTP 1GB file transfer	3.82 Gbps	2.97 Gbps	2.20 Gbps	0.31 Gbps

46ms RTT between Berkeley and ANL
100Gbps NICs on ESNET

Beyond Technology: Community Standards

- We need collaborative frameworks
- Standardized interfaces between institutions
- Common authentication protocols
- Agreed benchmark thresholds



Future work

- Better benchmarks, better metrics
 - Beyond throughput
 - Time-to-science?
- Scistream 2.0
 - Join us defining the next generation Streaming APIs
 - Application integration
- Secure streaming standards?
 - Which security standards are acceptable?

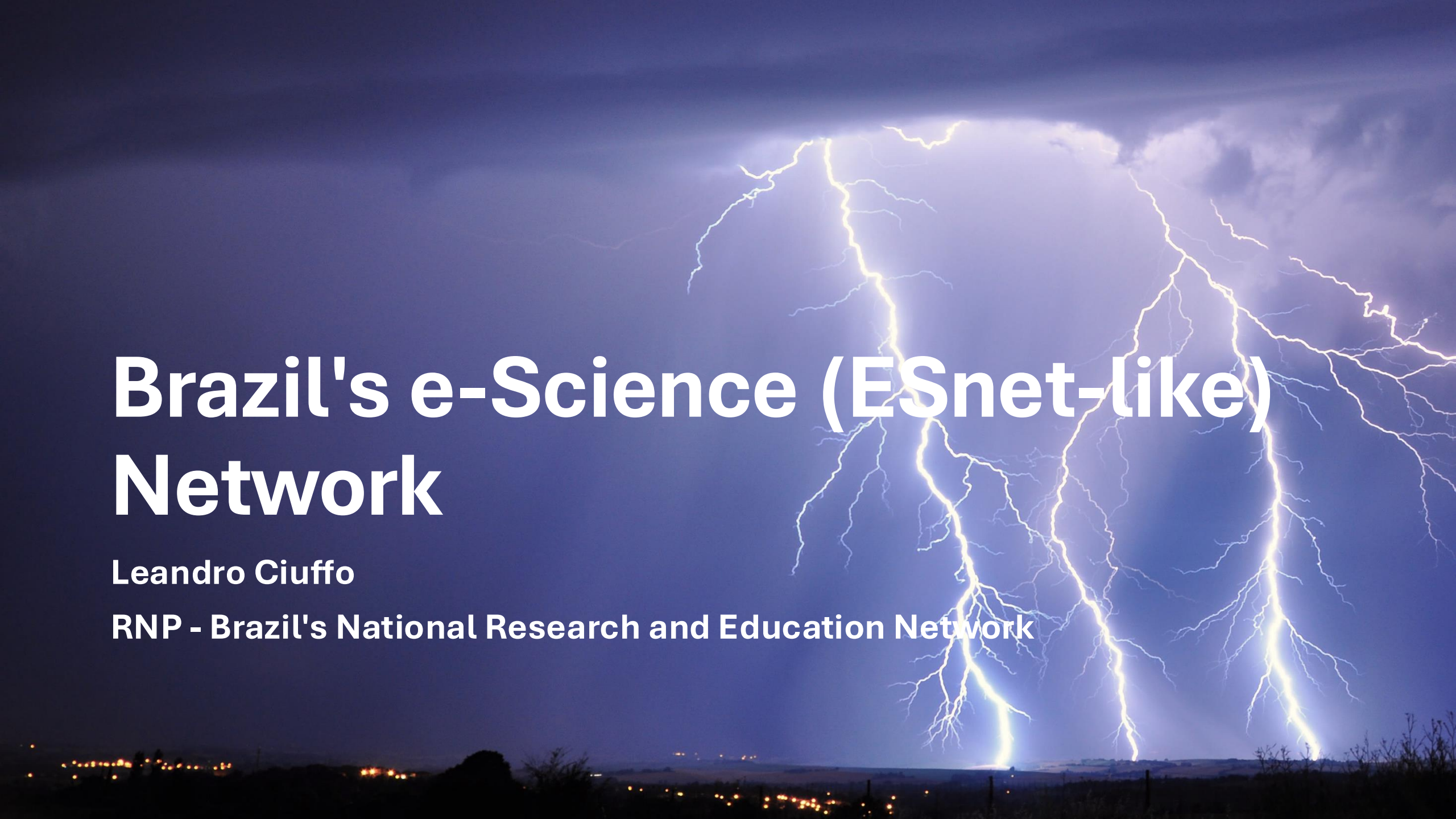
Thanks!

Acknowledgments



Key takeaways

- SSH tunnels: not that secure
- SSH tunnels: performance doesn't scale with latency
- We need community standardization
- SciStream 2.0: Help us define the future of secure streaming



Brazil's e-Science (ESnet-like) Network

Leandro Ciuffo

RNP - Brazil's National Research and Education Network



RNP

Educação, Pesquisa
e Inovação em Rede

Rede de e-Ciência

Brazil's e-Science (ESnet-like) Network

Leandro Ciuffo

Associate Director for e-Science

RNP - Brazil's National Research and Education Network

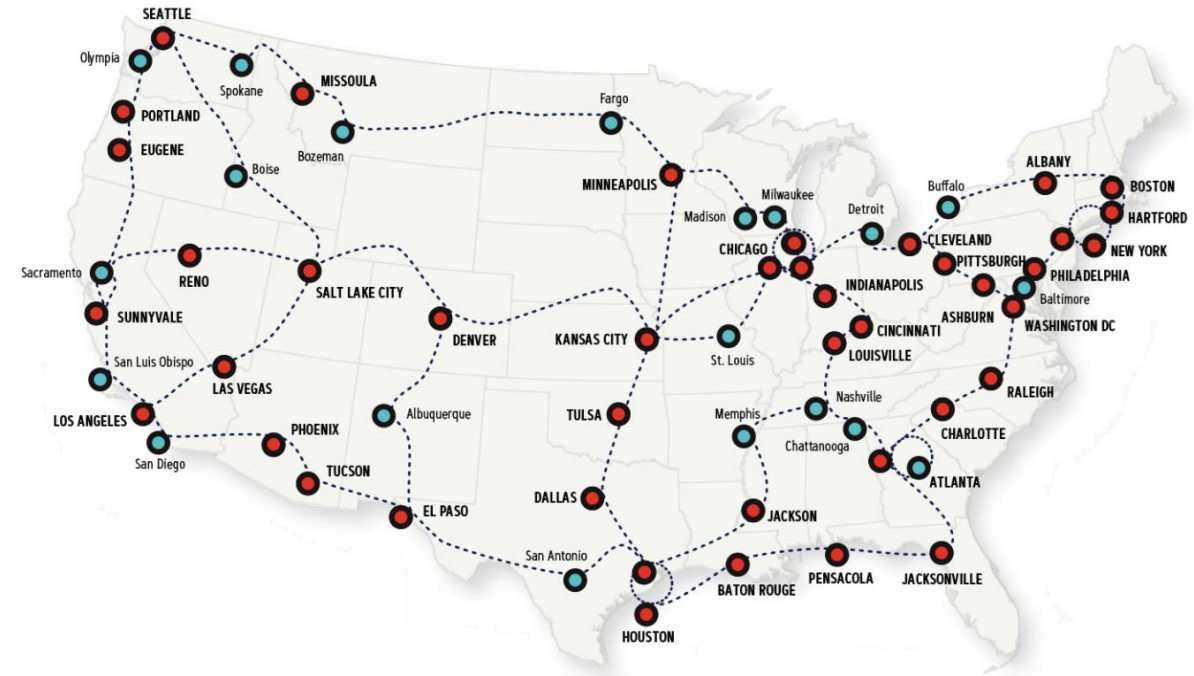
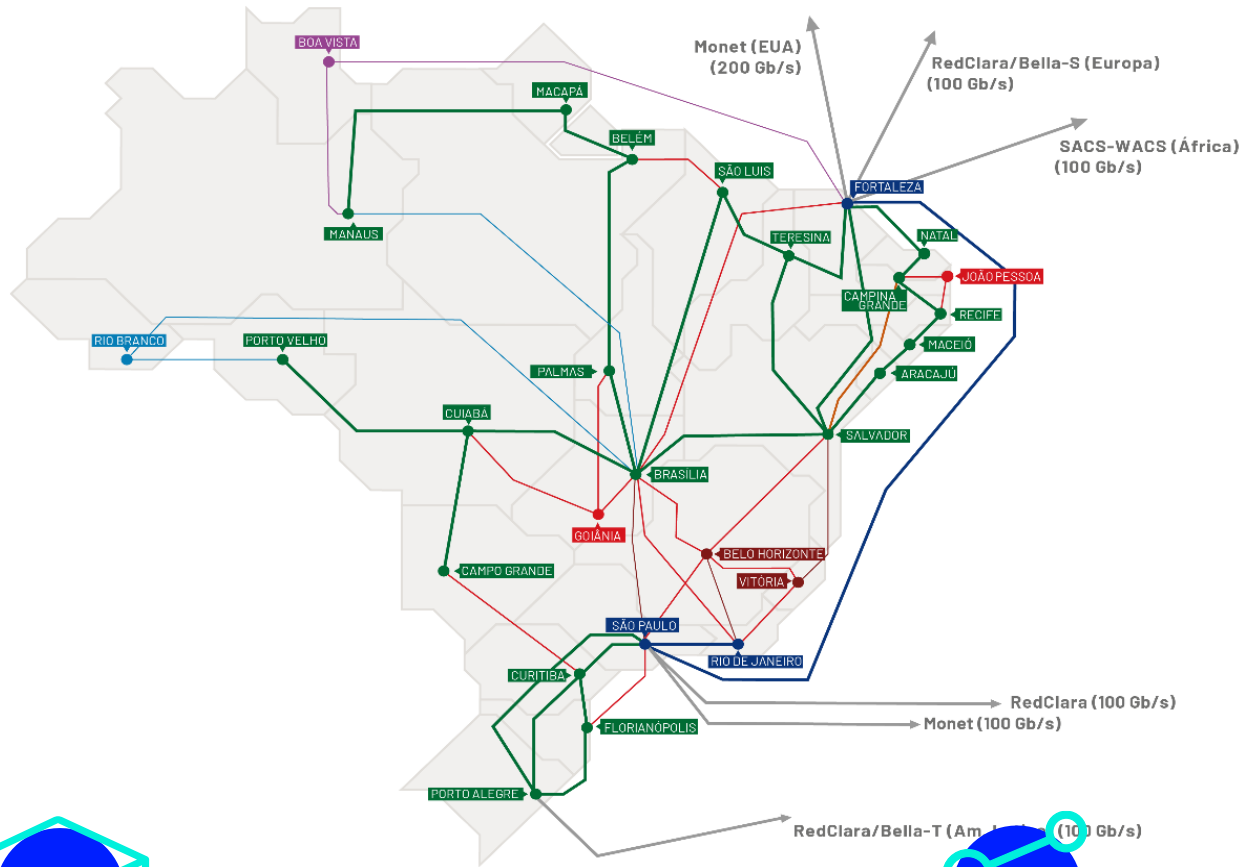
leandro.ciuffo@rnp.br

Confab25 / 09 - April - 2025

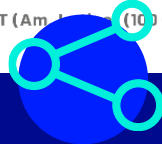
RNP System



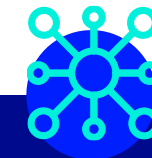
RNP ≈ Internet2



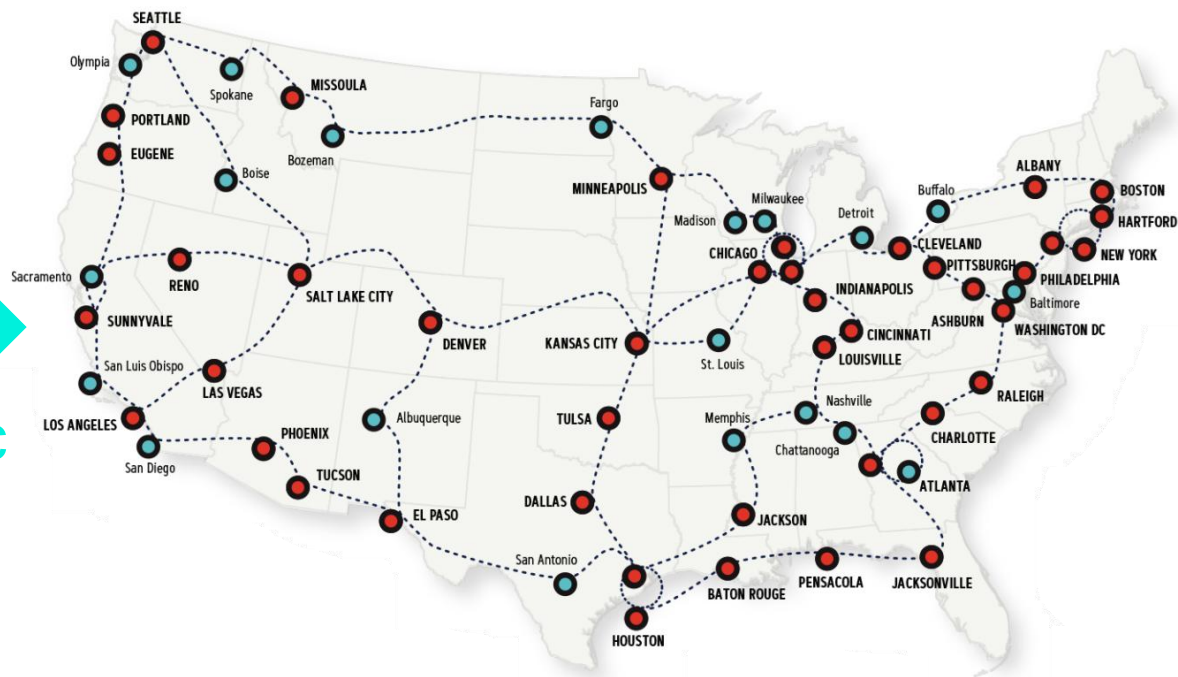
Higher Education Institutions,
Teaching Hospitals, Museums,
cultural organizations, ...



Cloud Services, eduroam,
Trust & Identity Federation
Collaboration tools...



Hundreds of
organizations



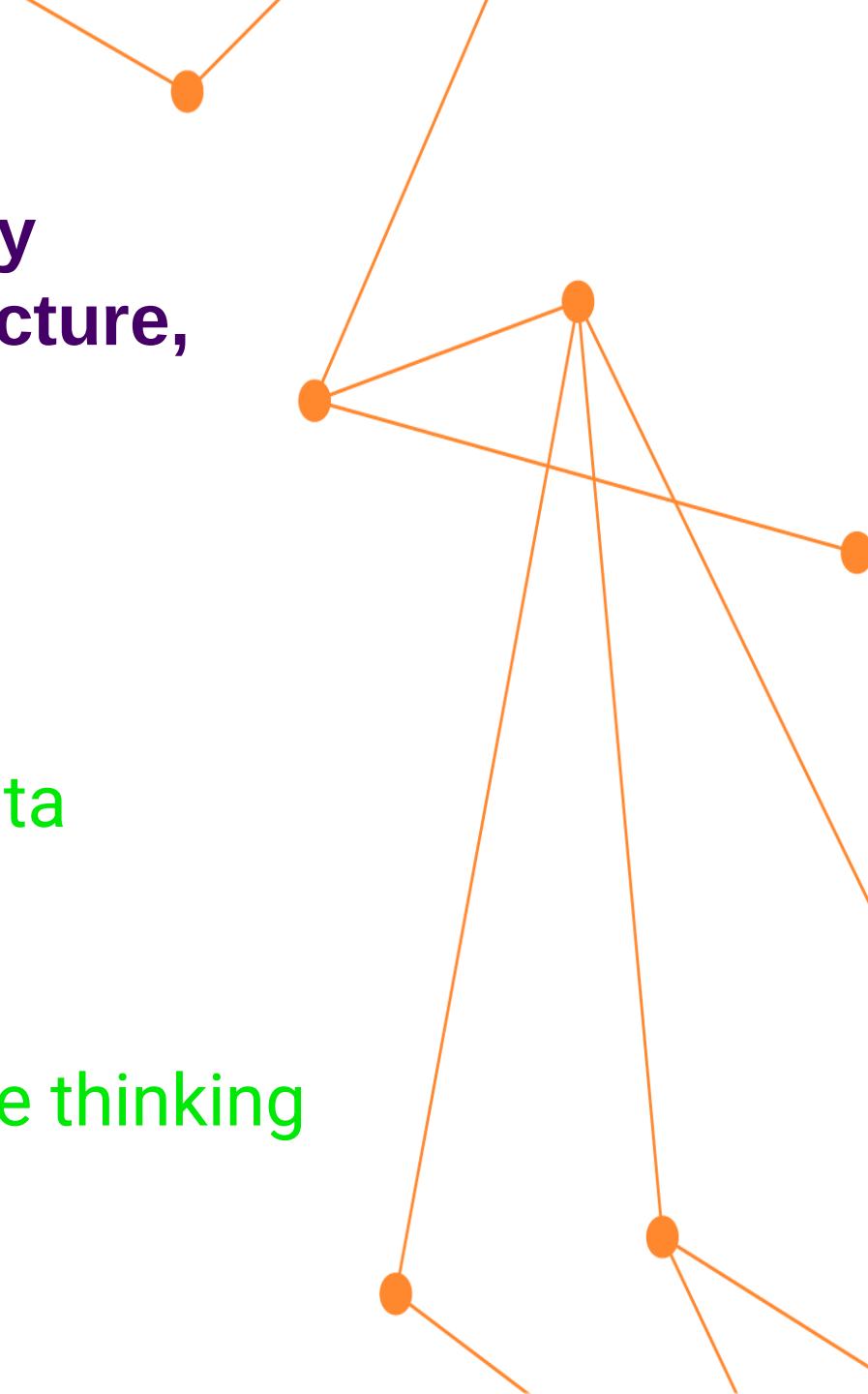
The eScience Network shares the ESnet mission:

**To enable and accelerate scientific discovery
by delivering unparalleled network infrastructure,
capabilities, and tools**

Motivation

Scientific experiments are producing larger data sets as instruments become more advanced and precise

Most scientists don't want to spend much time thinking about their networking needs.

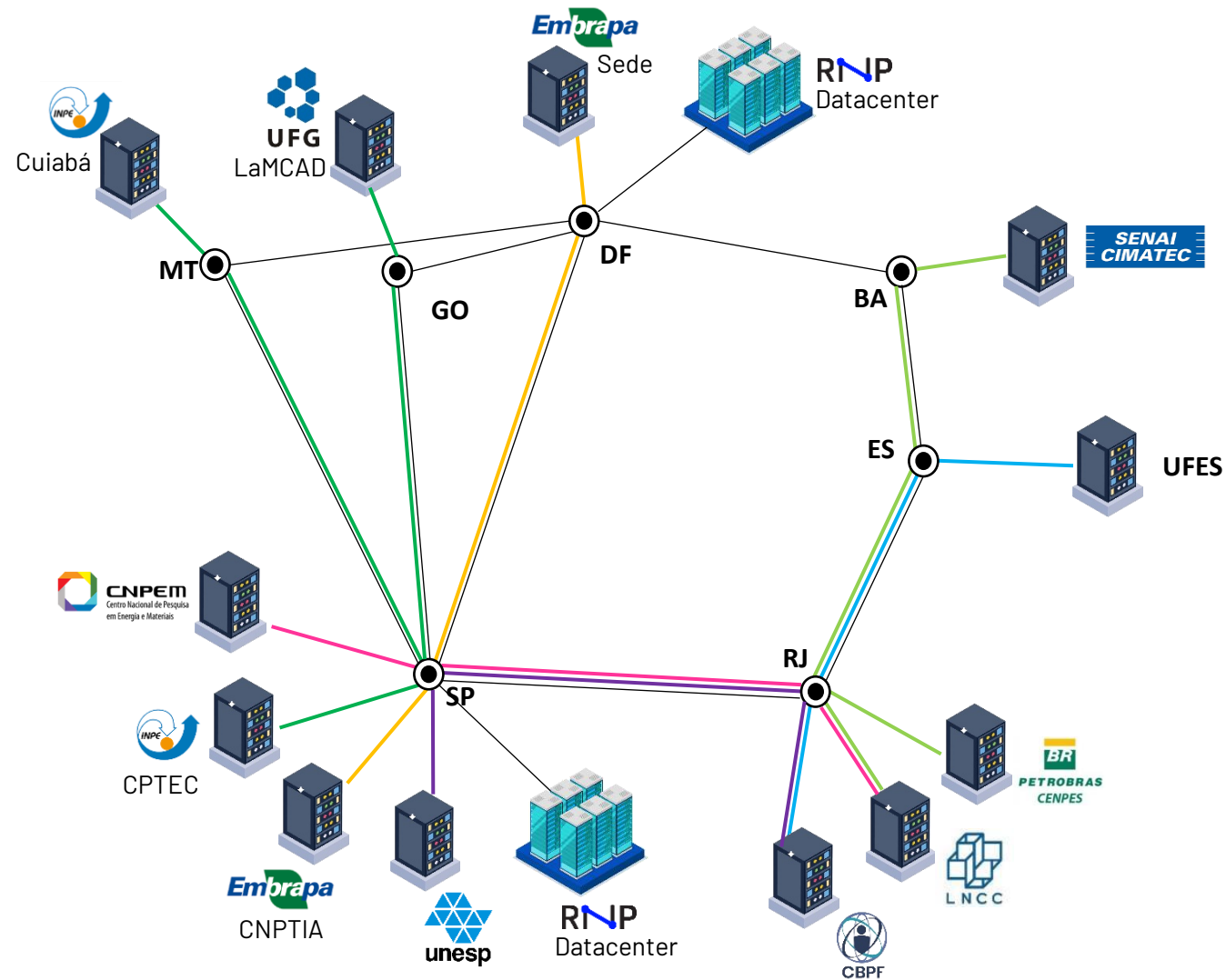


Design principles



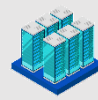
- **Science DMZ architecture by design**
- **A Network of DTNs with no public Internet connection**
- **Cross-facility collaboration is a requirement**
- **User sites selected by invitation or from public Open Calls**
 - **User sites need to demonstrate at least 1 use case with a 100Gbps (or higher) requirement**

eScience Network at a glance

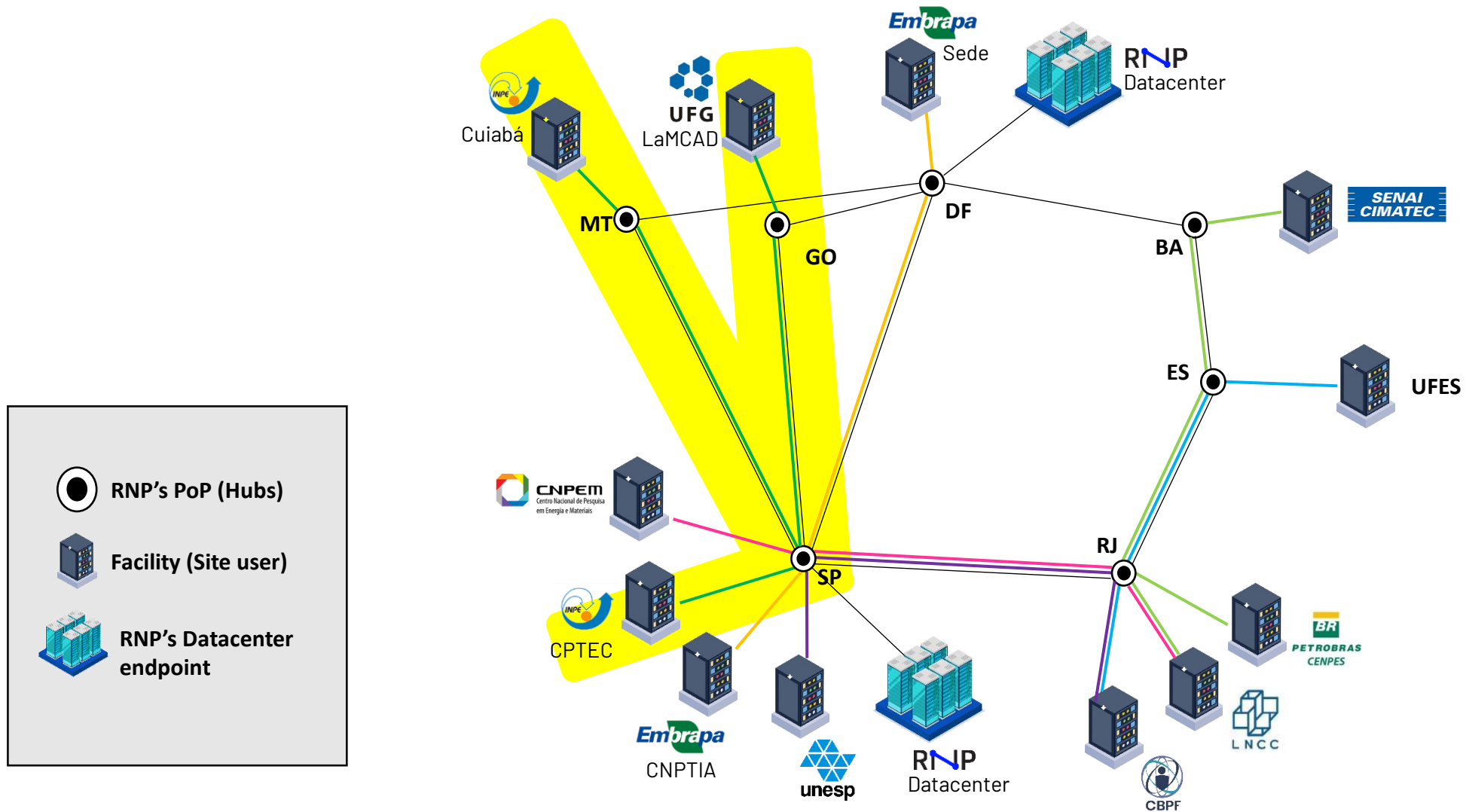


 RNP's PoP (Hubs)

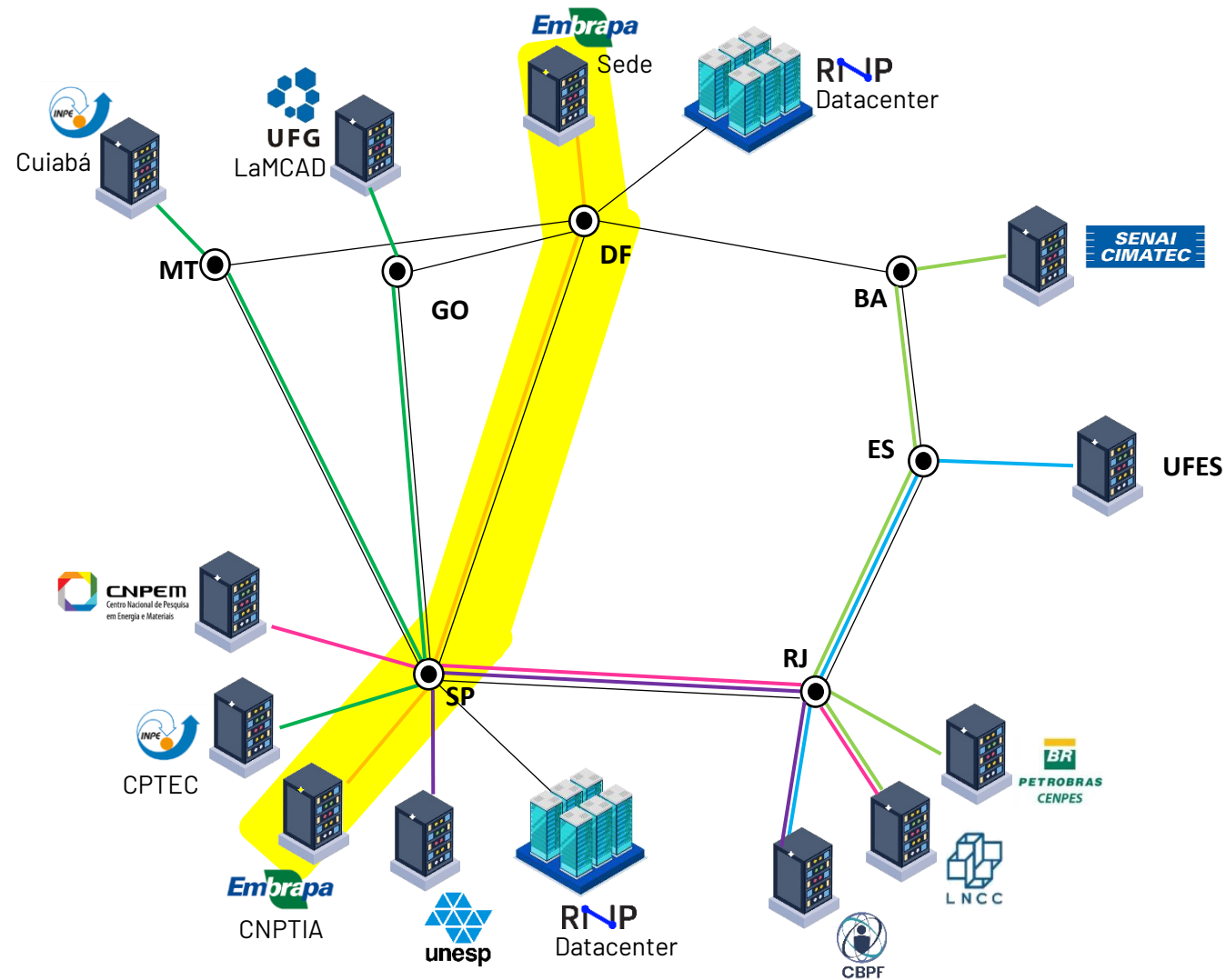
 Facility (Site user)

 RNP's Datacenter endpoint

eScience Network – Cross-collaboration facilities



eScience Network – Cross-collaboration facilities

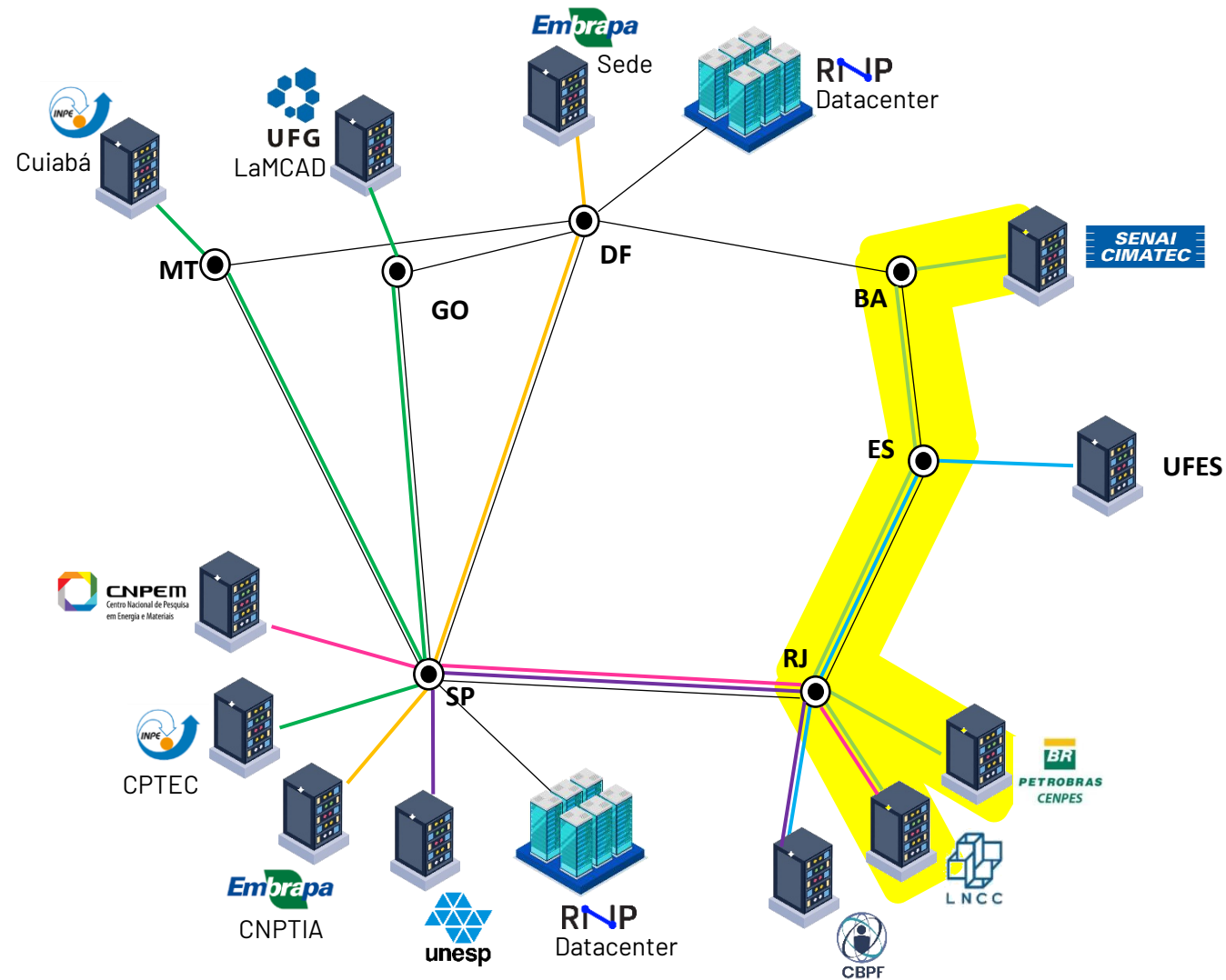


● RNP's PoP (Hubs)

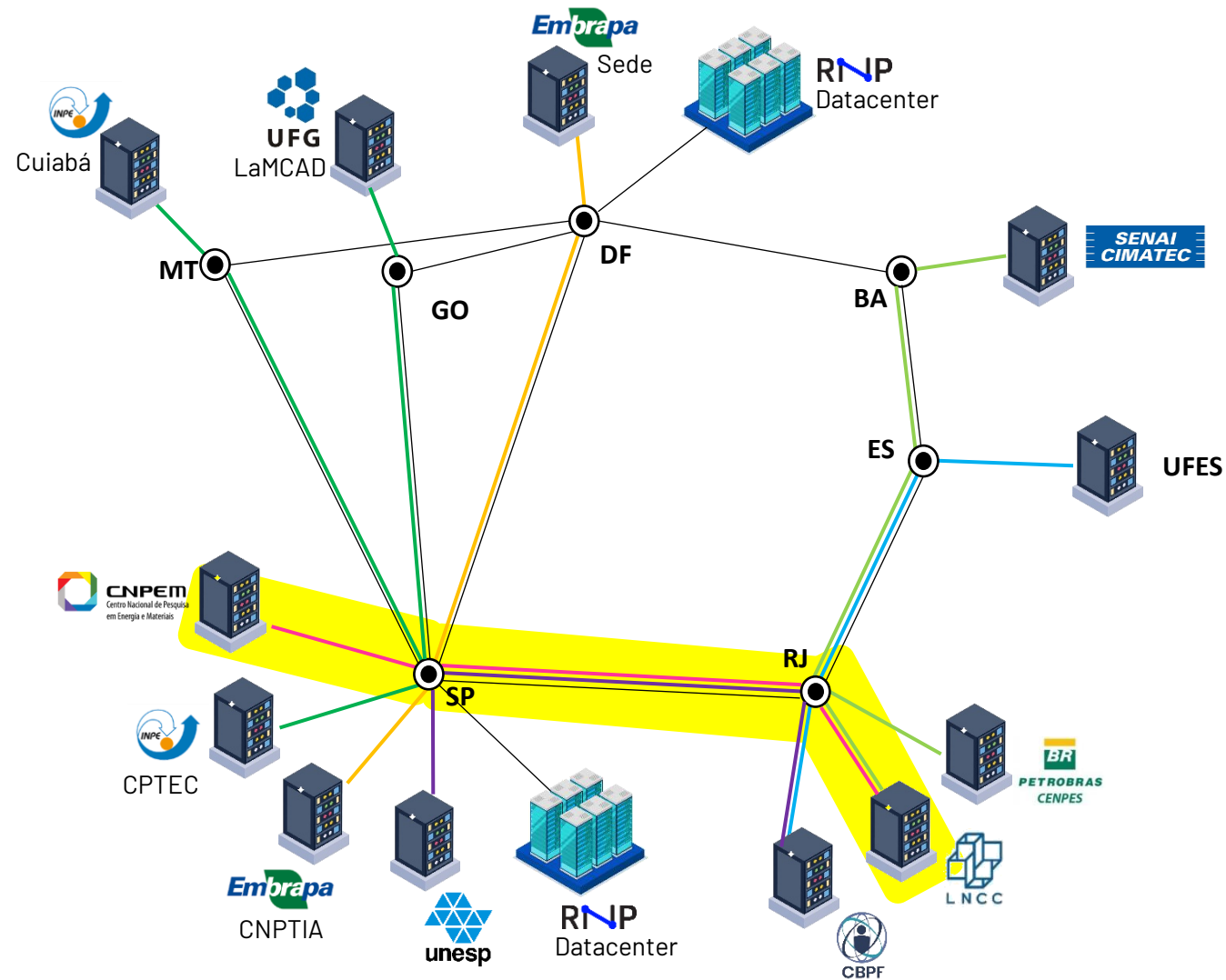
■ Facility (Site user)

■ RNP's Datacenter endpoint

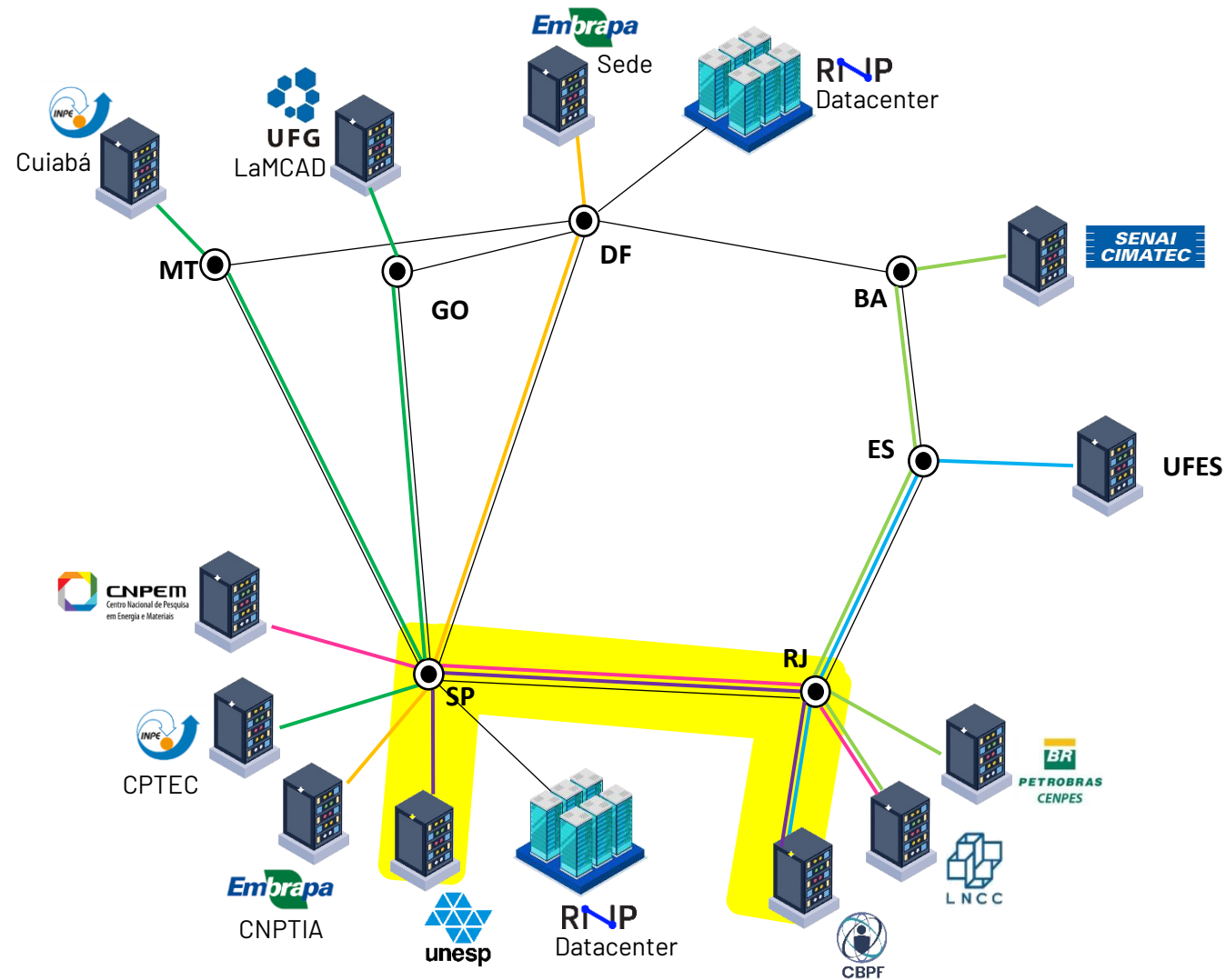
eScience Network – Cross-collaboration facilities



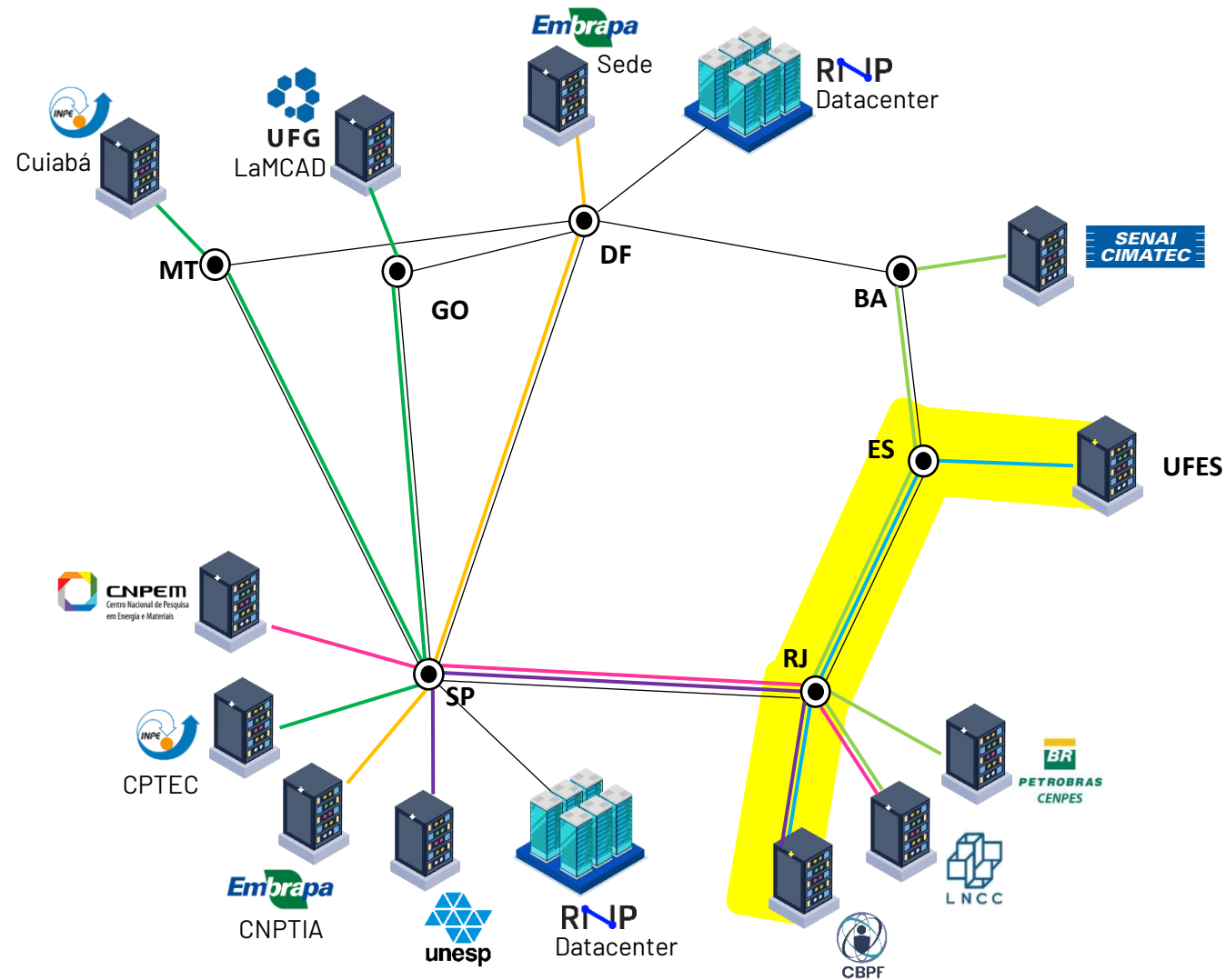
eScience Network – Cross-collaboration facilities



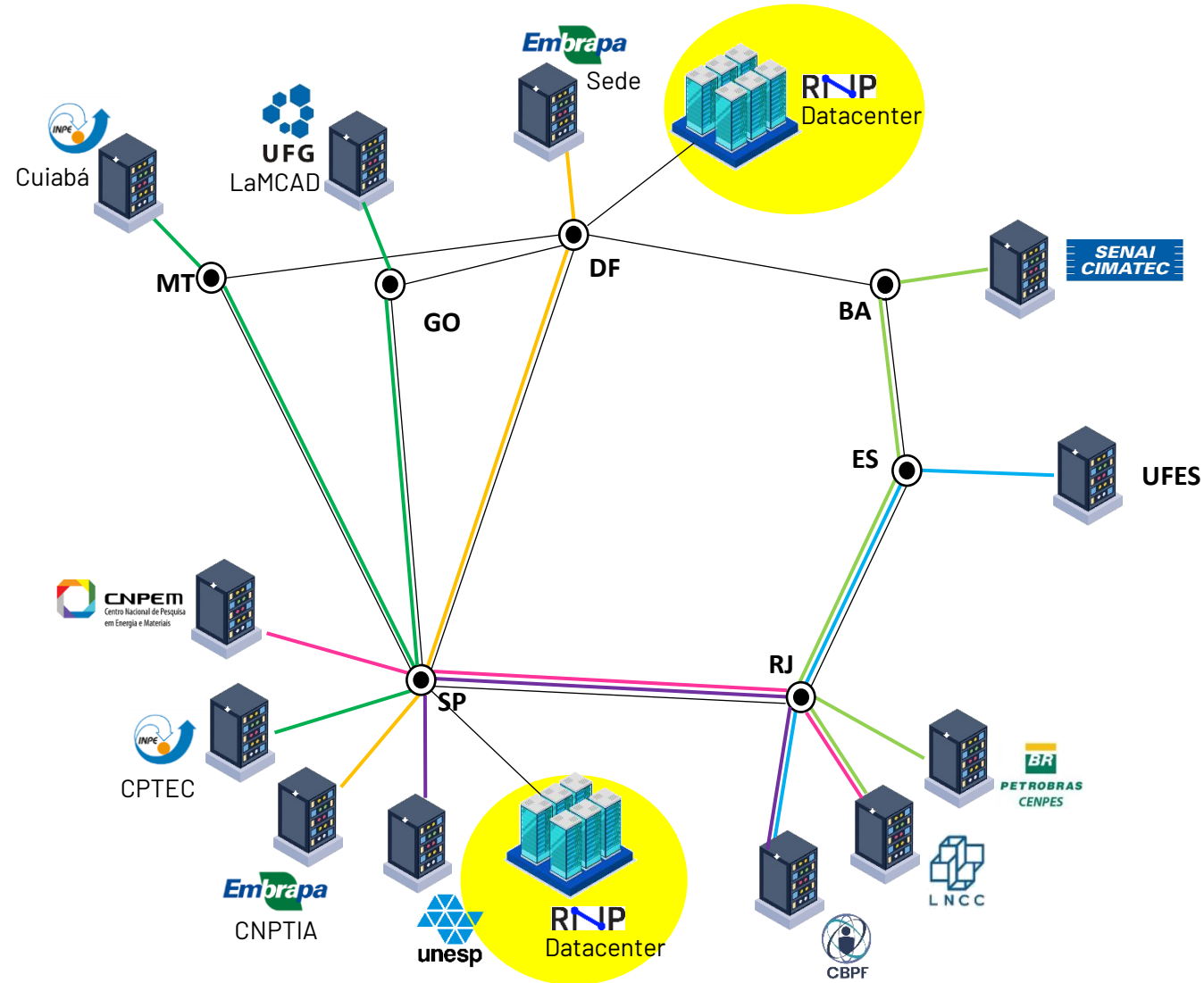
eScience Network – Cross-collaboration facilities



eScience Network – Cross-collaboration facilities

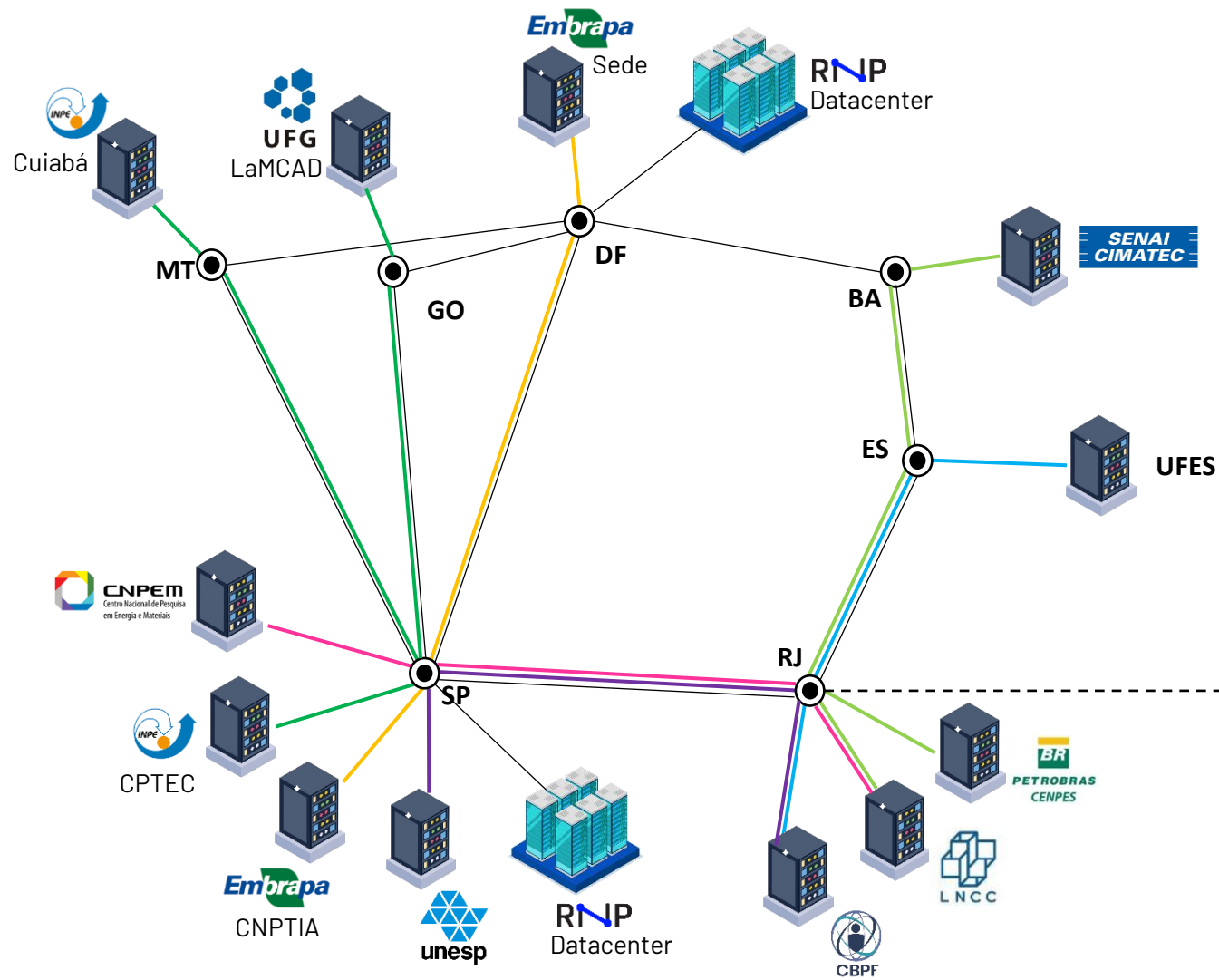


eScience Network – co-location service at RNP datacenter



eScience Network – by 2026

+6 facilities to join
(to be announced next week)



**RNP's PoP (Hubs)**

**Facility (Site user)**

**RNP's Datacenter endpoint**

**CNPq**
Centro Nacional de Pesquisa em Energia e Materiais

**Embrapa**
CNPTIA

**unesp**

**RNP Datacenter**

**CBPF**

**LNCC**

**PETROBRAS CENPES**

**UFES**

**SENAI CIMATEC**

**RNP Datacenter**

**Embrapa Sede**

**UFG LaMCAD**

**Cuiabá**

**MT**

**GO**

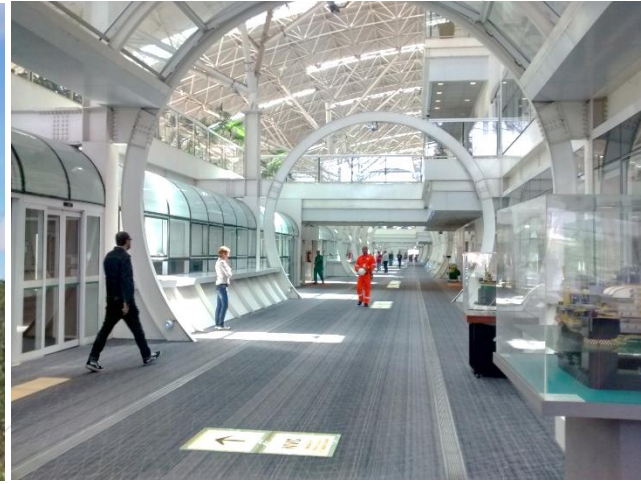
**DF**

**BA**

**ES**

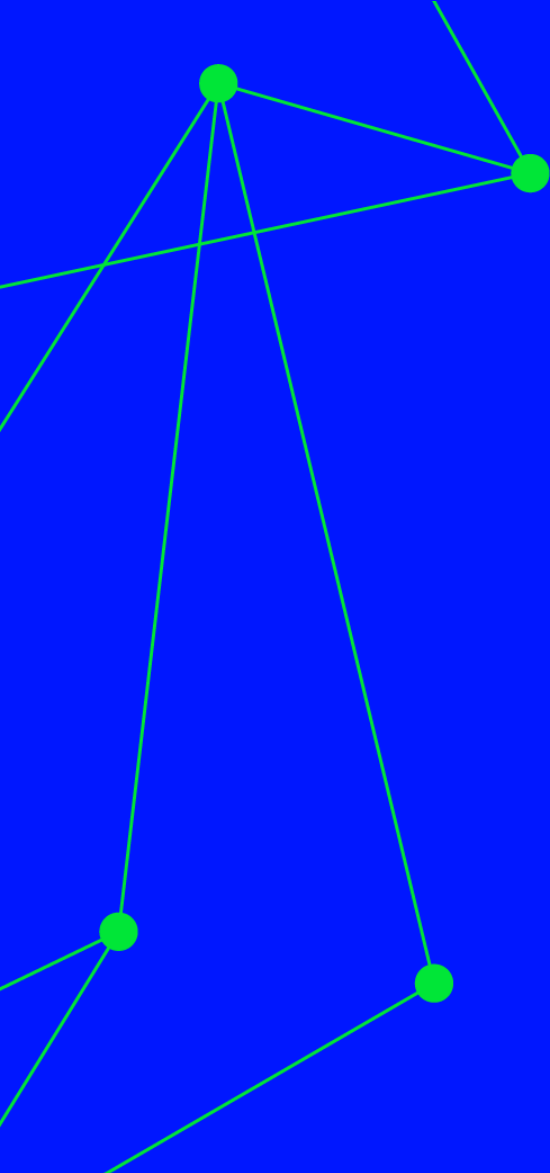
**RJ**

**SP**



USE CASES (so far)

- **Climate** (Weather forecast and disaster prevention)
- **Geosciences** (Oil & Gas exploration)
- **Genomics** (Agriculture and Health sectors)
- **Material Science** (nanotechnology and biorenewables)
- **High Energy Physics** (LHC experiments)
- **Cosmology** (Vera Rubin – LSST)



Obrigado / Thank You!

Leandro Ciuffo

leandro.ciuffo@rnp.br



MINISTÉRIO DA
CULTURA

MINISTÉRIO DA
DEFESA

MINISTÉRIO DA
SAÚDE

MINISTÉRIO DAS
COMUNICAÇÕES

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EDUCAÇÃO

MINISTÉRIO DA
CIÊNCIA, TECNOLOGIA
E INOVAÇÃO





Deploying Cross-facility, Interactive Containerized Streaming Workflows

Samuel Welborn

NERSC

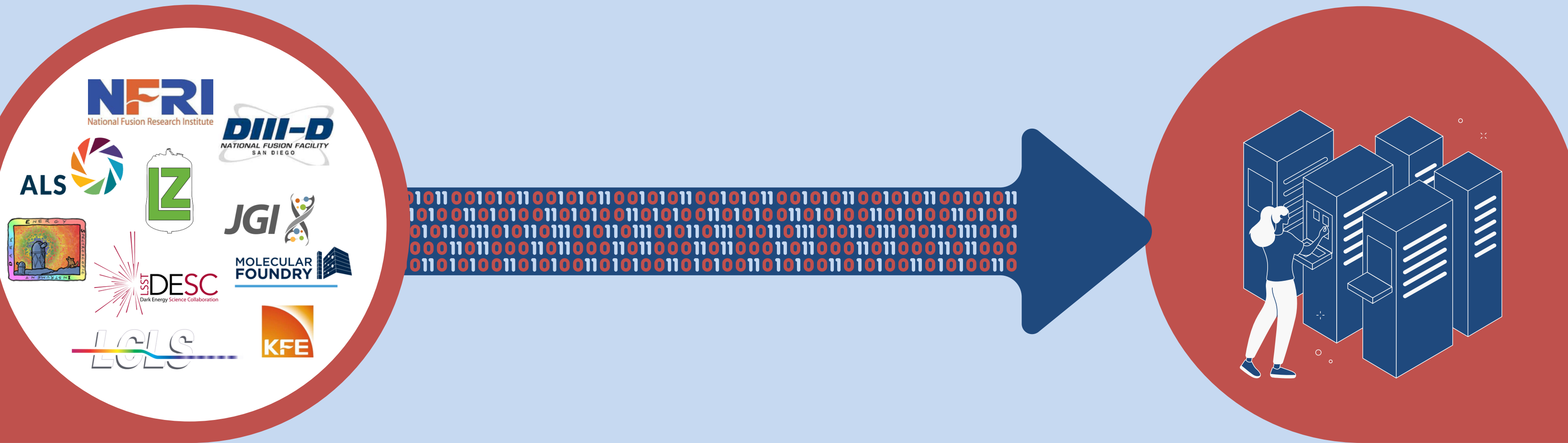


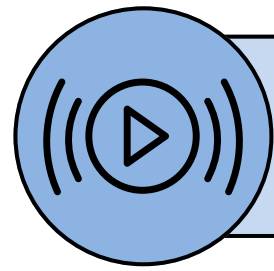
Deploying cross-facility, interactive containerized streaming workflows

Sam Welborn: NERSC Postdoc

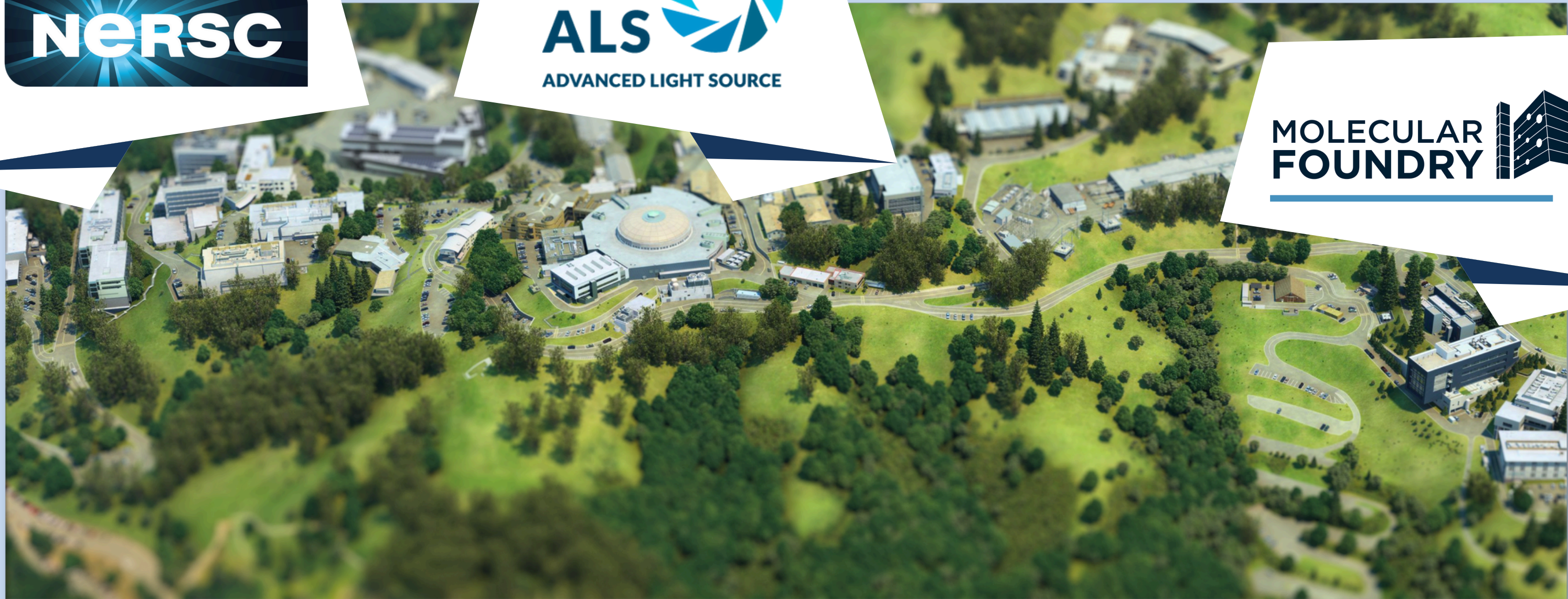
Wednesday, April 9, 2025

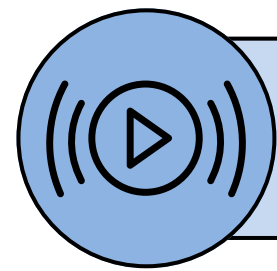
Confab 25





Two streaming pathfinding projects



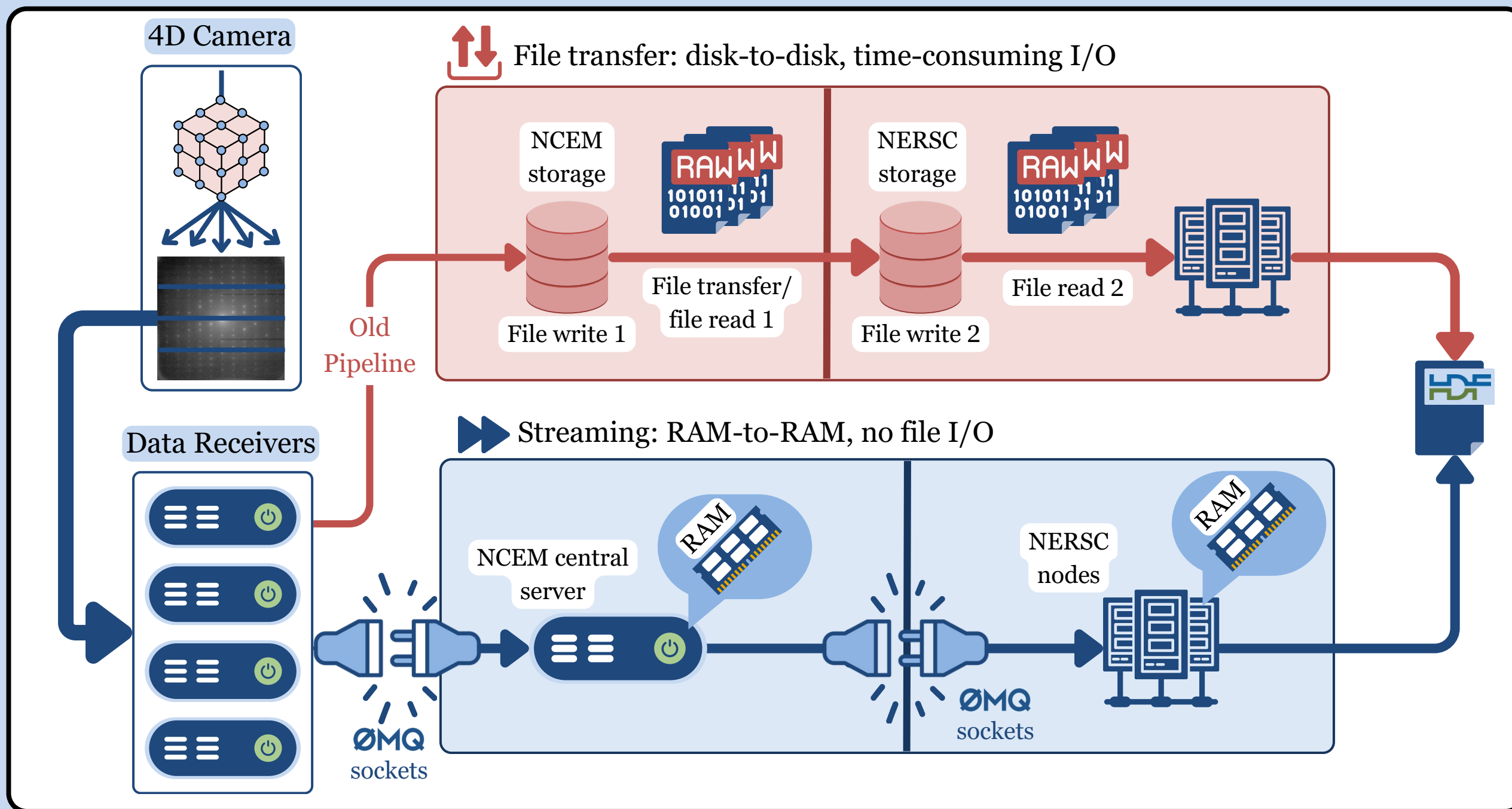


Streaming in production at NCEM

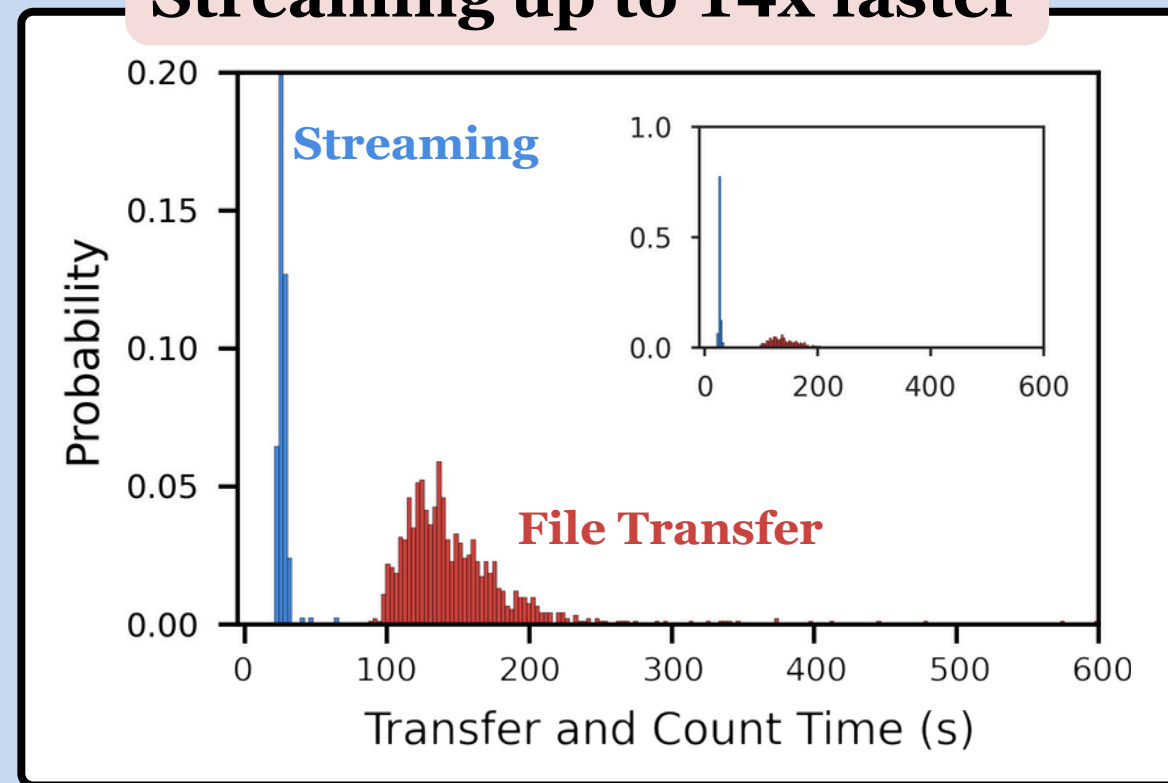
Primary POC

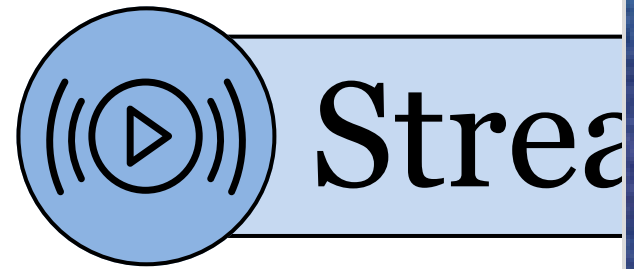


Peter Ercius



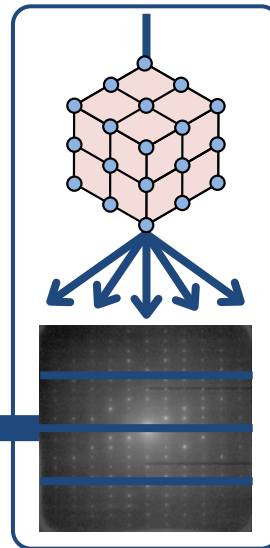
Streaming up to 14x faster





Stream

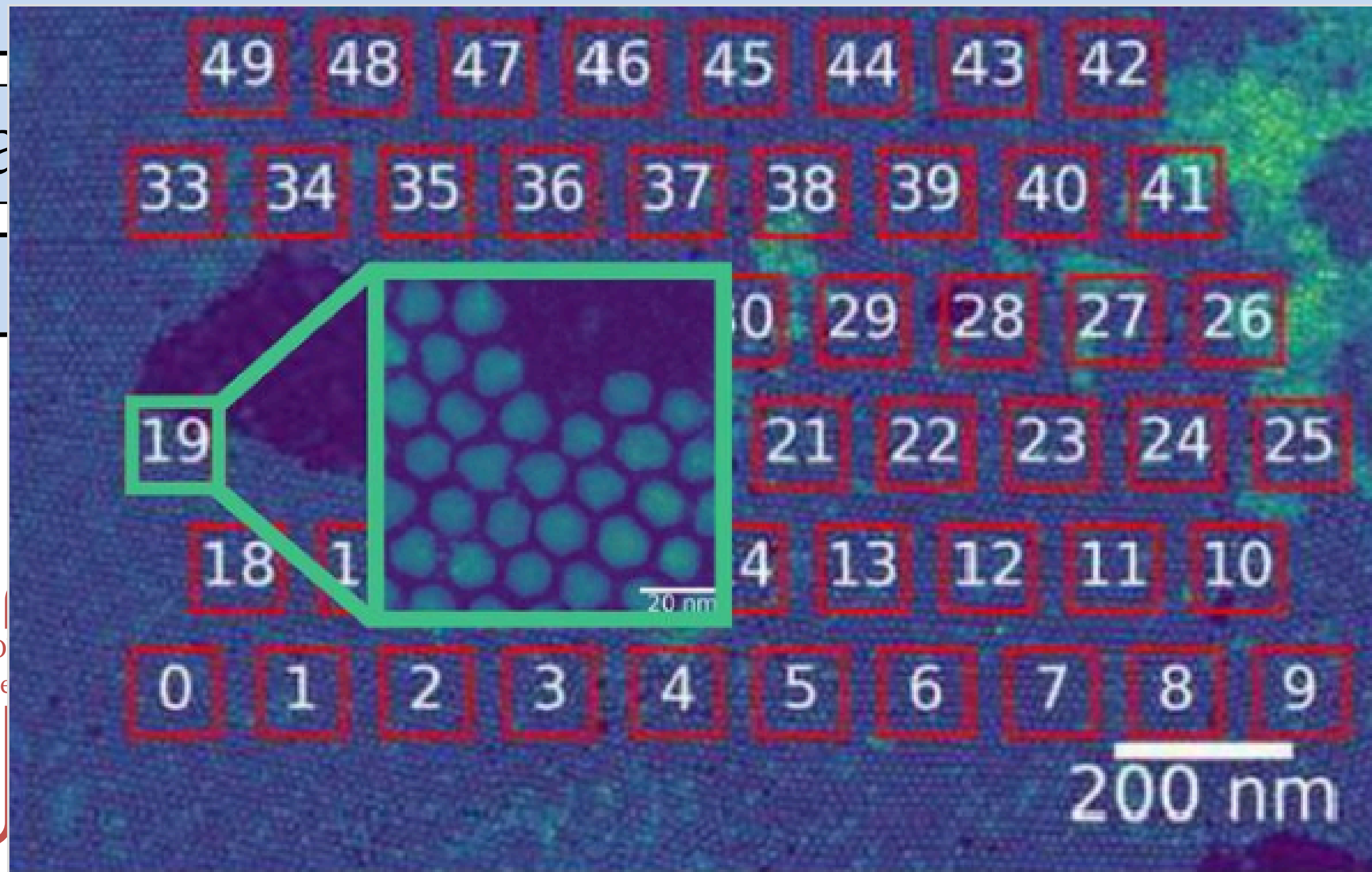
4D Camera



Data Receivers



Pipe



A New Age of Electron Microscopy: Magnifying Possibilities with Automation

Automated electron microscopy meets supercomputing in the web-based platform Distiller

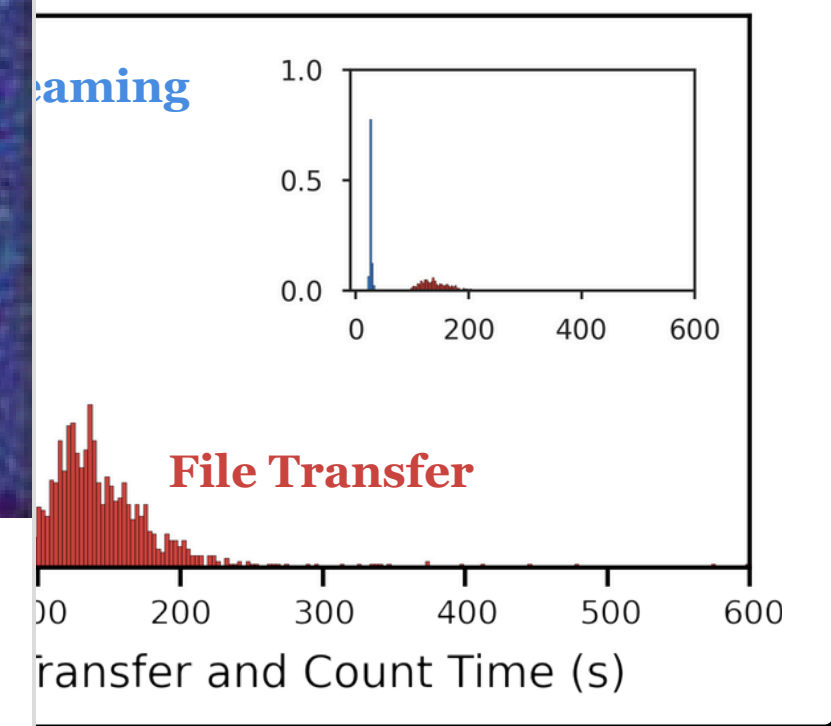
Berkeley Lab News Center / Apr 7

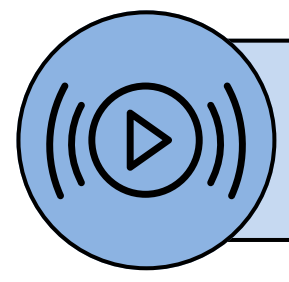
Primary POC



Peter Ercius

ing up to 14x faster





Streaming in production at ALS

Primary POC

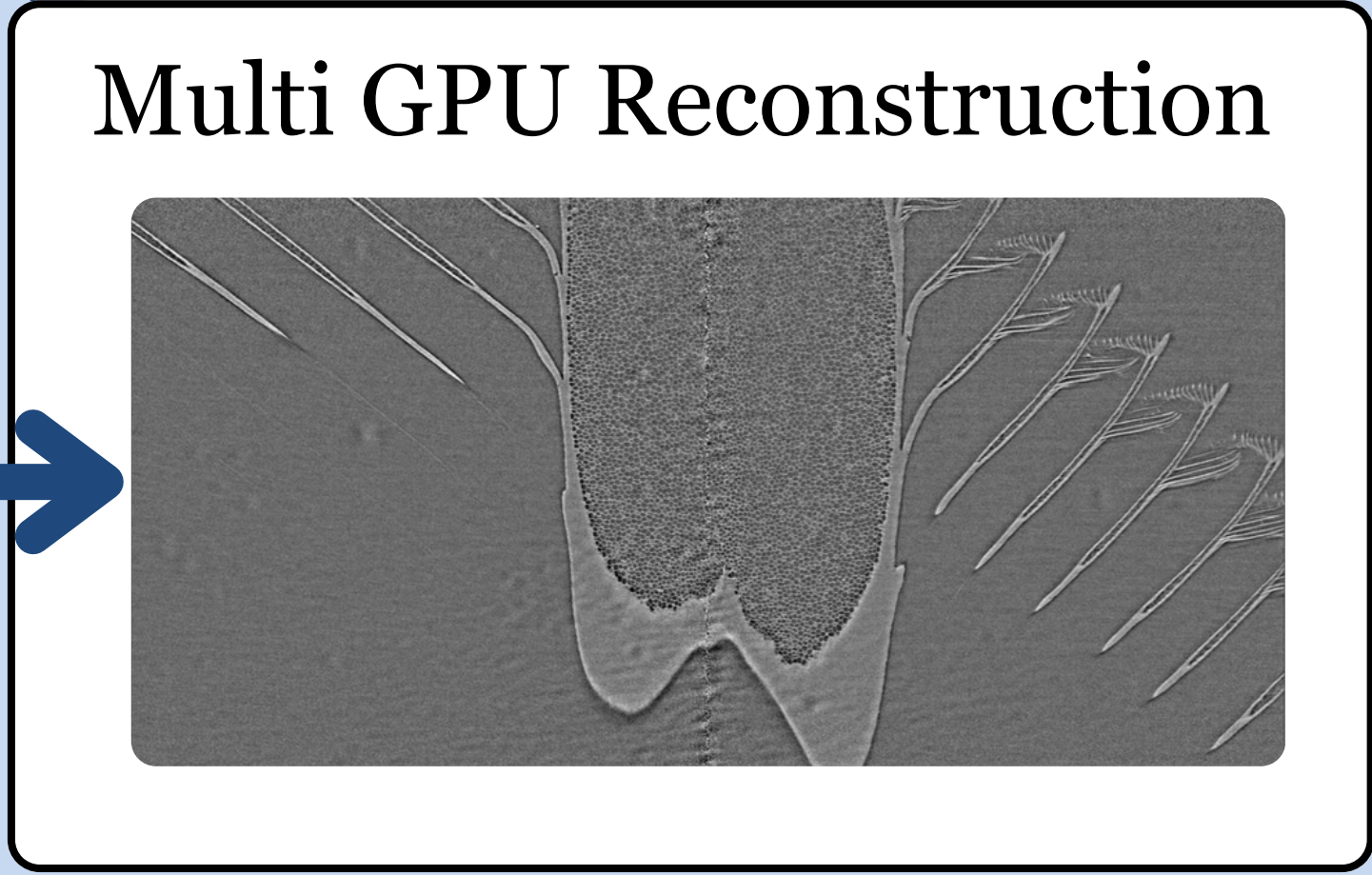
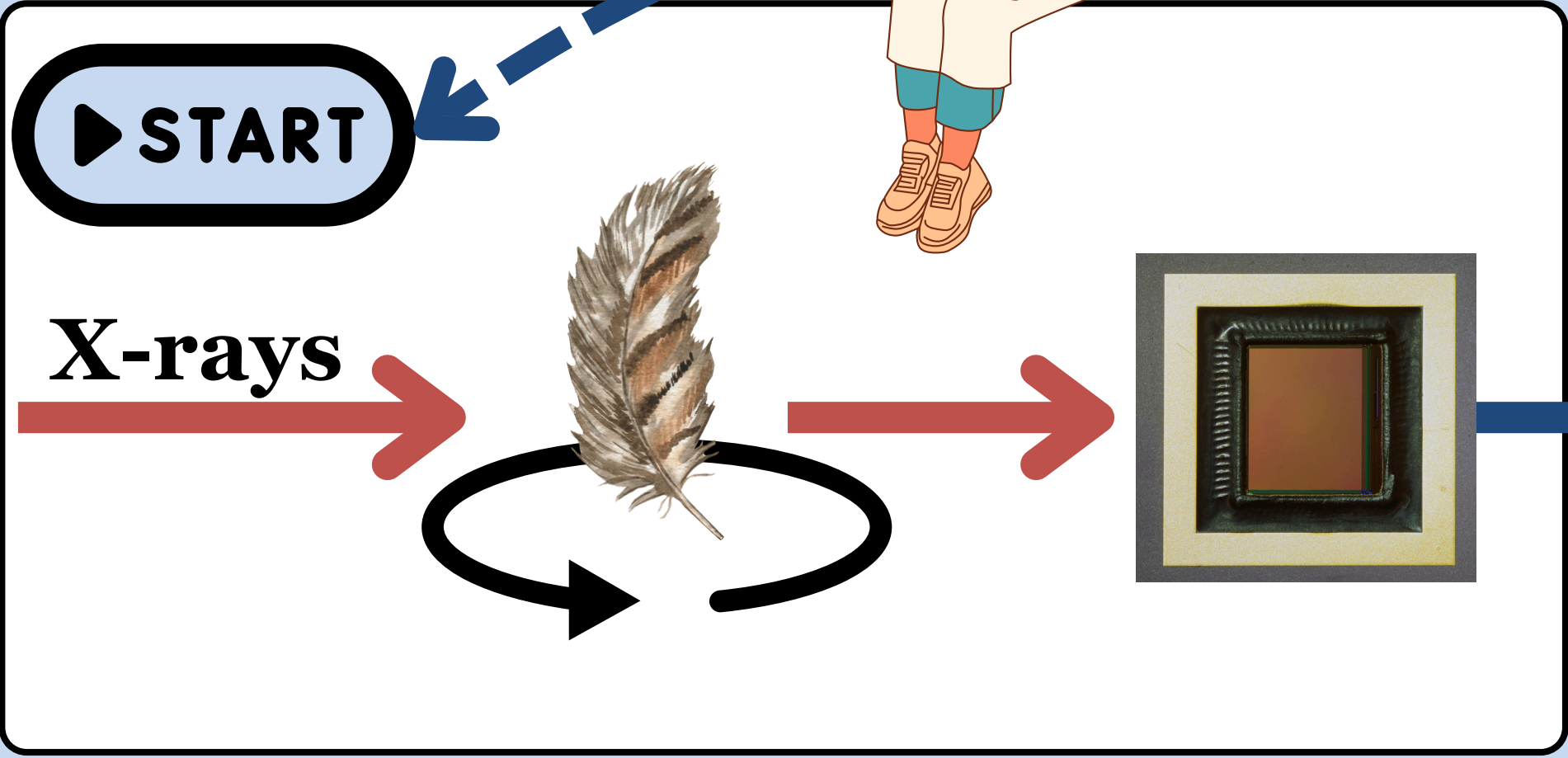


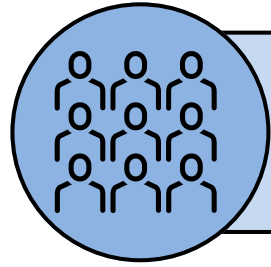
Dula Parkinson

>20
minutes → **<10**
seconds



User





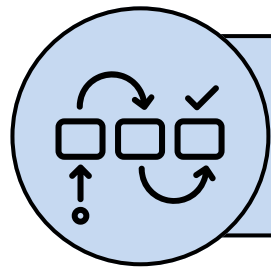
User knowledge and desire for HPC

What users know

- How to use their instrument
- The right algorithms to process their data
- How to tune processing parameters to get the right output from their data
- How to interpret the processing output

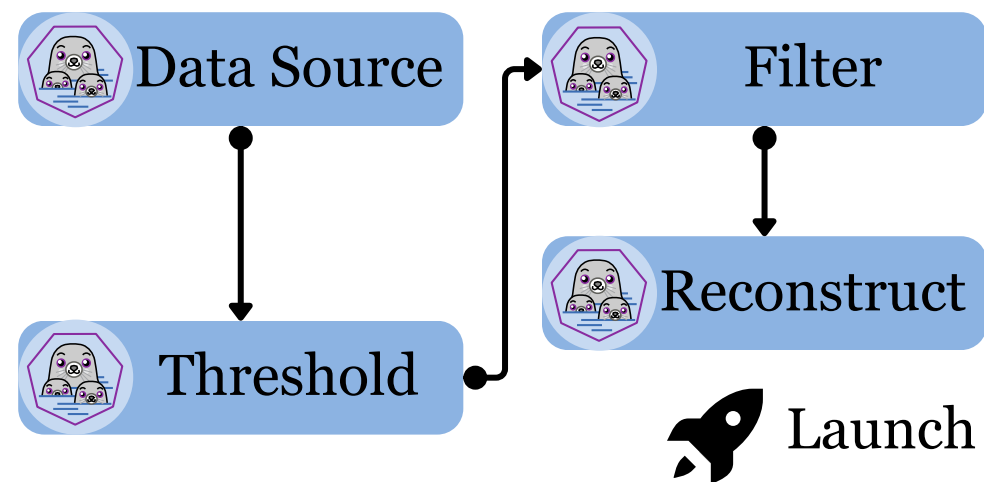
What users want

- Tune their processing parameters quickly to “lock in” their processing for a sample
- Visualize their data in real time
- **To see results as fast as possible to make an experimental decision**

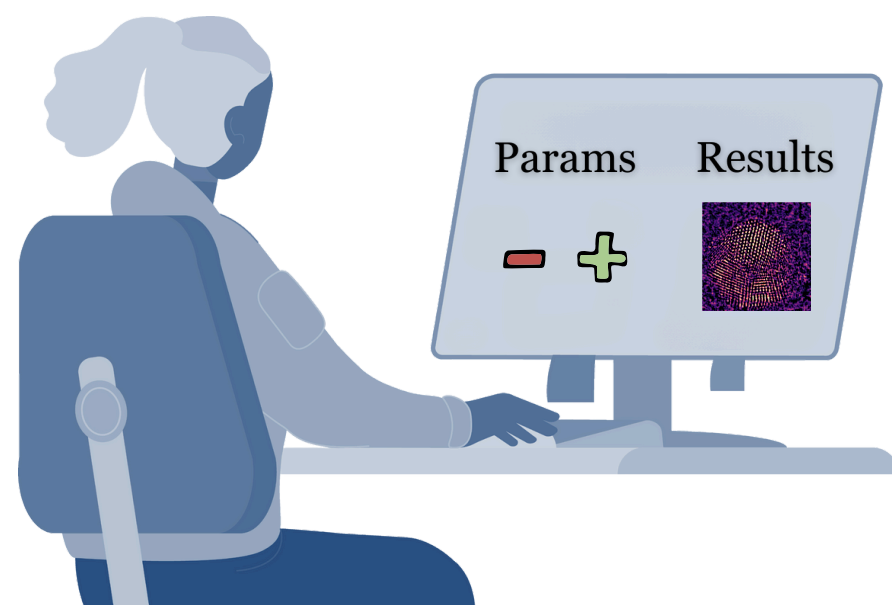


Flow-based programming for streaming

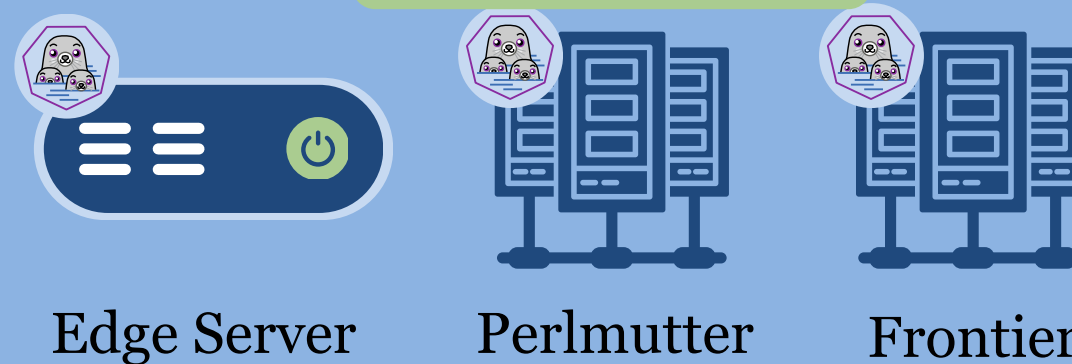
(a) Create pipeline in web frontend



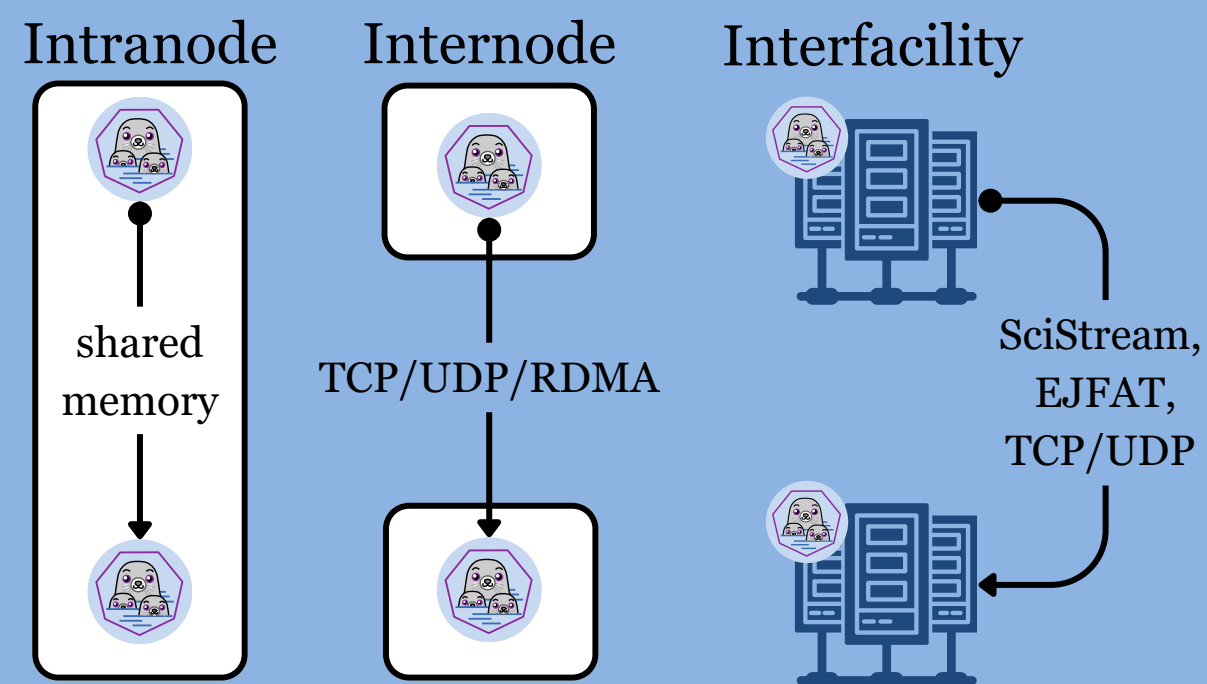
(d) Tune parameters and observe results in web frontend



(b) Containerized operators created on remote resources

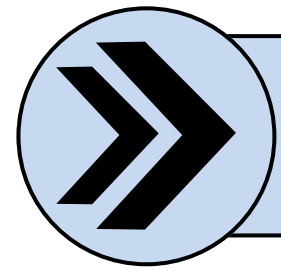


(c) Operators connect and stream data



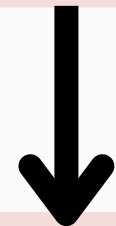
github.com/NERSC/interactEM



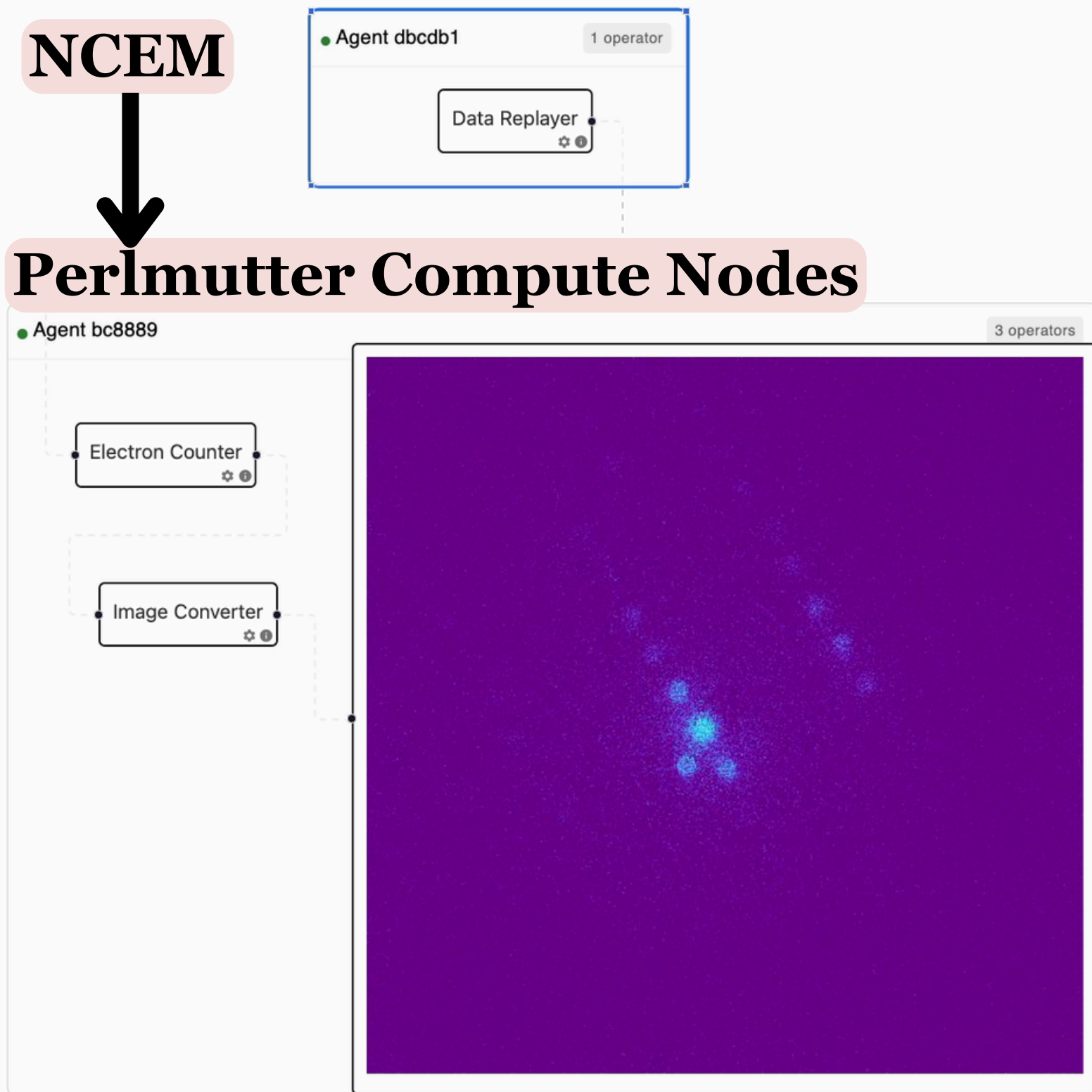


Our progress and future work

NCEM



Perlmutter Compute Nodes

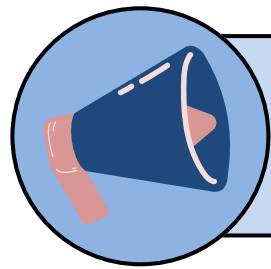


What we have accomplished

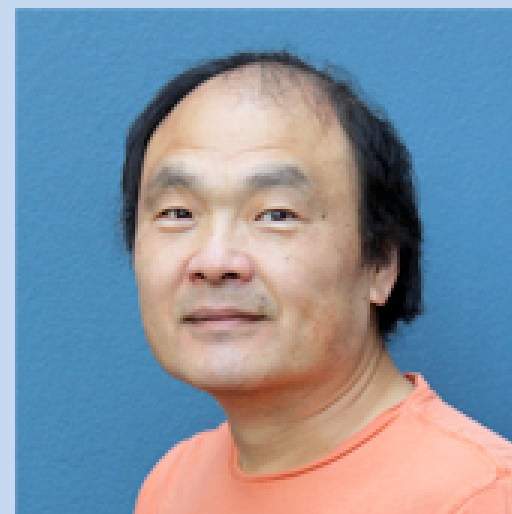
- Tunable parameters from frontend
- Remote launch on NERSC compute nodes
- Automatic TCP connections using ZeroMQ
- Kubernetes deployment using helm
- NATS control plane

What is next

- Integration with other data plane backends (e.g., RDMA, EJFAT)
- Operator parallelization
- User client for “updates”



Acknowledgements



Lee Yang



Dylan McReynolds



Dula Parkinson



Chris Harris



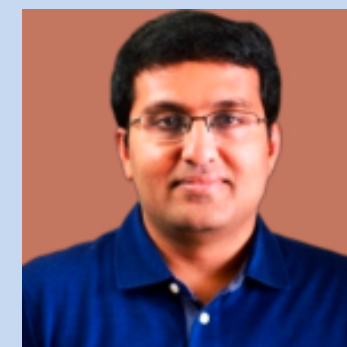
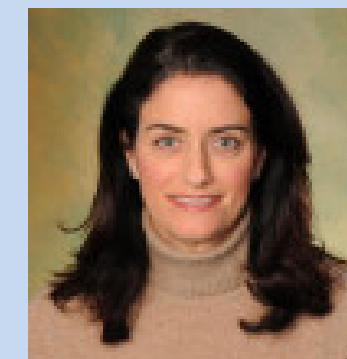
Bjoern Enders



Peter Ercius



Shane Canon



Tavia Stone
Gibbons, Ashwin
Selvarajan



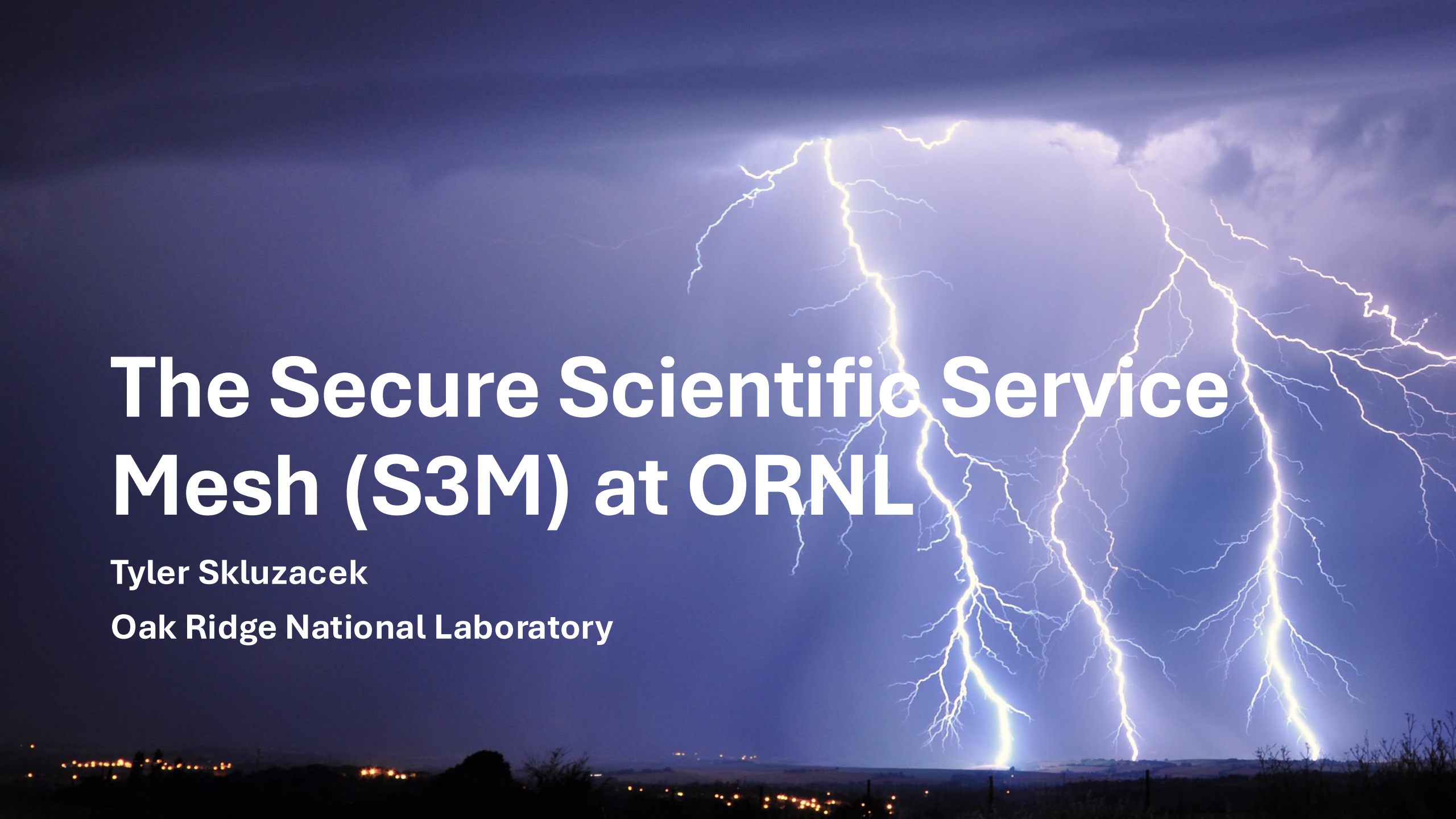
Debbie Bard



U.S. DEPARTMENT OF
ENERGY

Office of
Science

DE-AC02-05CH11231
BES-ERCAP0024753
BES-ERCAP0024754



The Secure Scientific Service Mesh (S3M) at ORNL

Tyler Skluzacek

Oak Ridge National Laboratory



April 09, 2025 | Confab '25 Lightning Talk

The Secure Scientific Service Mesh (S3M)

Tyler J. Skluzacek

Oak Ridge National Lab; OLCF
Workflows and Ecosystem Services Group

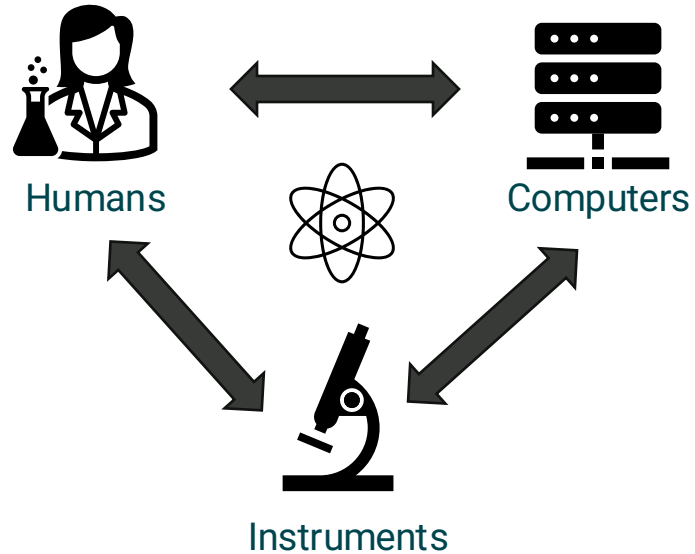


U.S. DEPARTMENT OF
ENERGY

ORNL IS MANAGED BY UT-BATTELLE LLC
FOR THE US DEPARTMENT OF ENERGY



A flexible and automated compute fabric for integrating OLCF's resources



Support workflows that are:

1. Autonomous.
2. Time-sensitive.
3. Data / feedback driven.
4. Reusable.

The Secure Scientific Service Mesh (S3M)

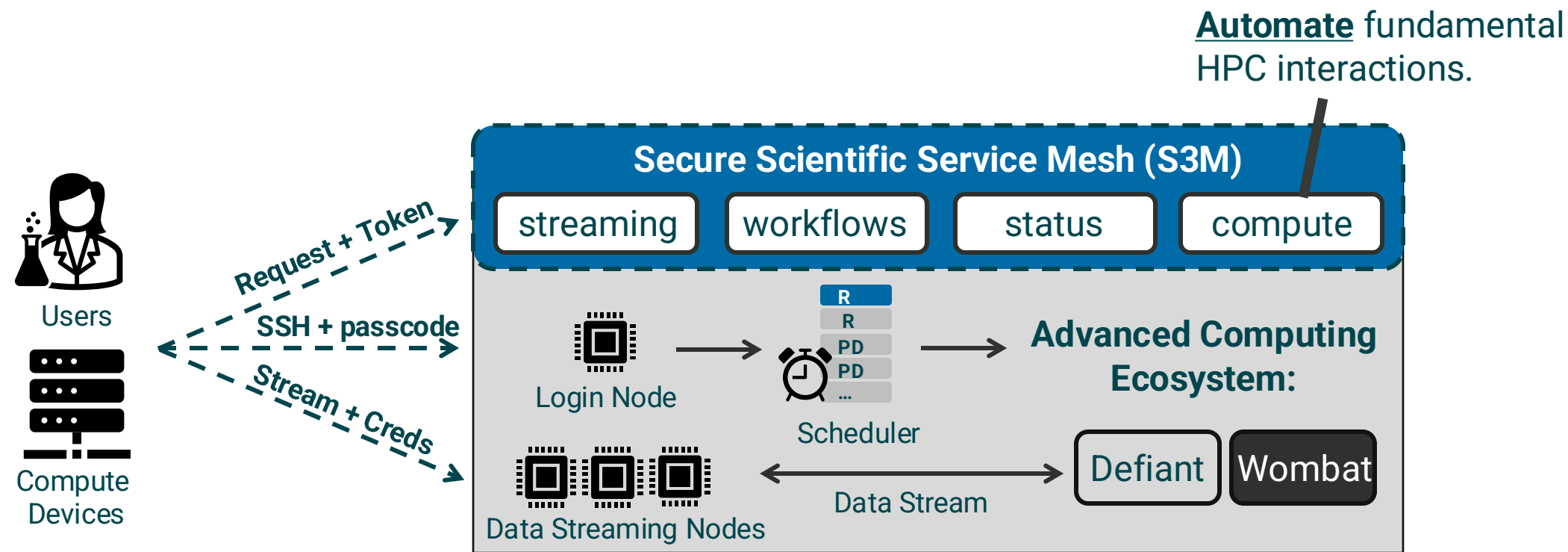
A software architecture that manages communication between a mesh of independent microservices.

- **Extensible:** can easily add new capabilities.
- **Trustworthy:** observability to see when authority passed from human to machine.
- ... load balancing traffic management, mTLS encryption.

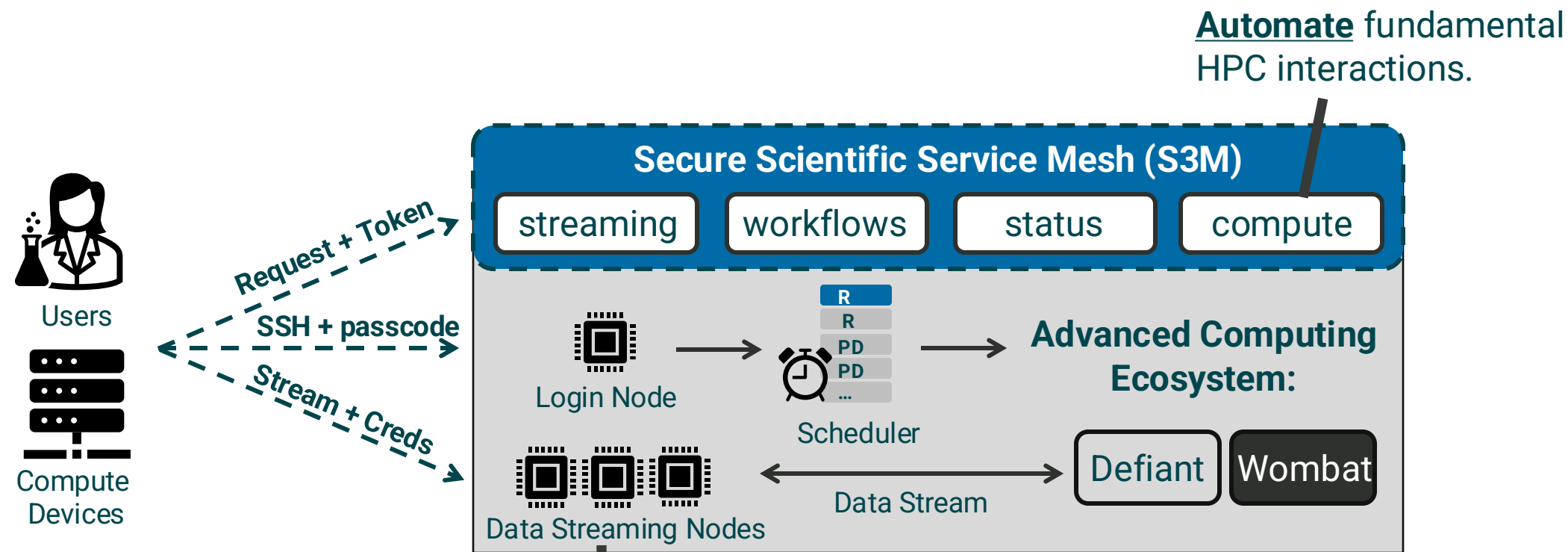
While incorporating many elements of

- NERSC Superfacility API, Globus Flows/Compute, TACC Tapis, CSCS FireCrest

The Secure Scientific Service Mesh (S3M)



The Secure Scientific Service Mesh (S3M)

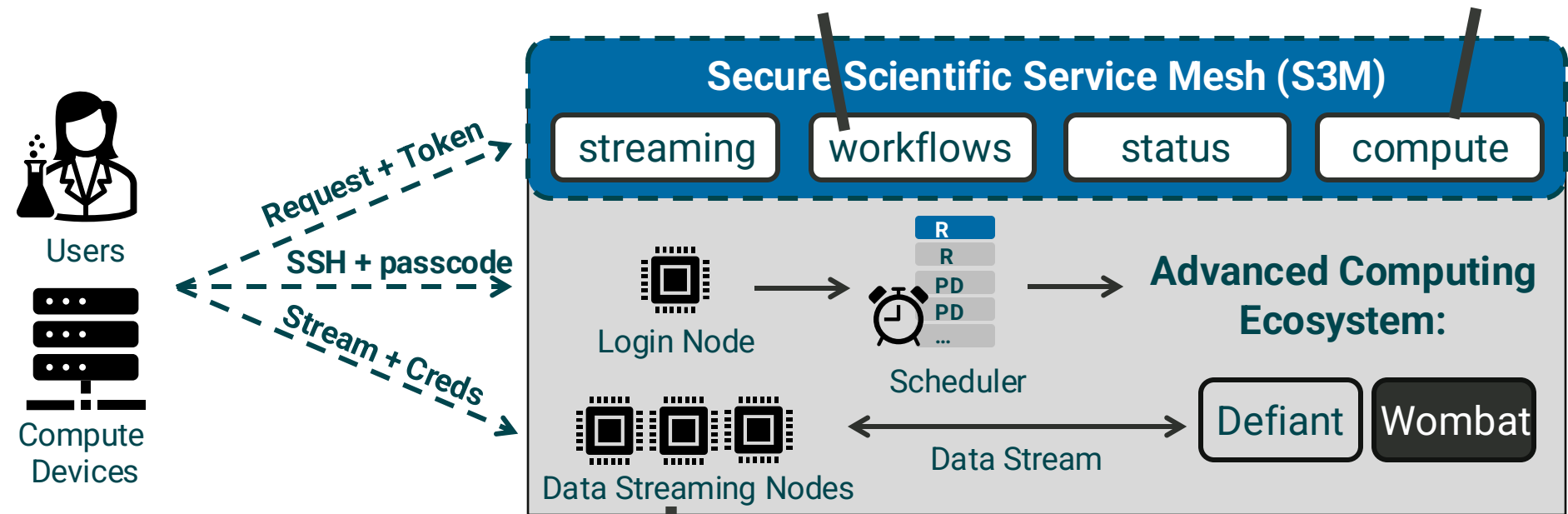


Streaming: Provision and manage pre-configured Data Streaming Nodes (DSNs).

The Secure Scientific Service Mesh (S3M)

Workflows: Promote reusability and resilience by enabling users to invoke workflow templates.

Automate fundamental HPC interactions.

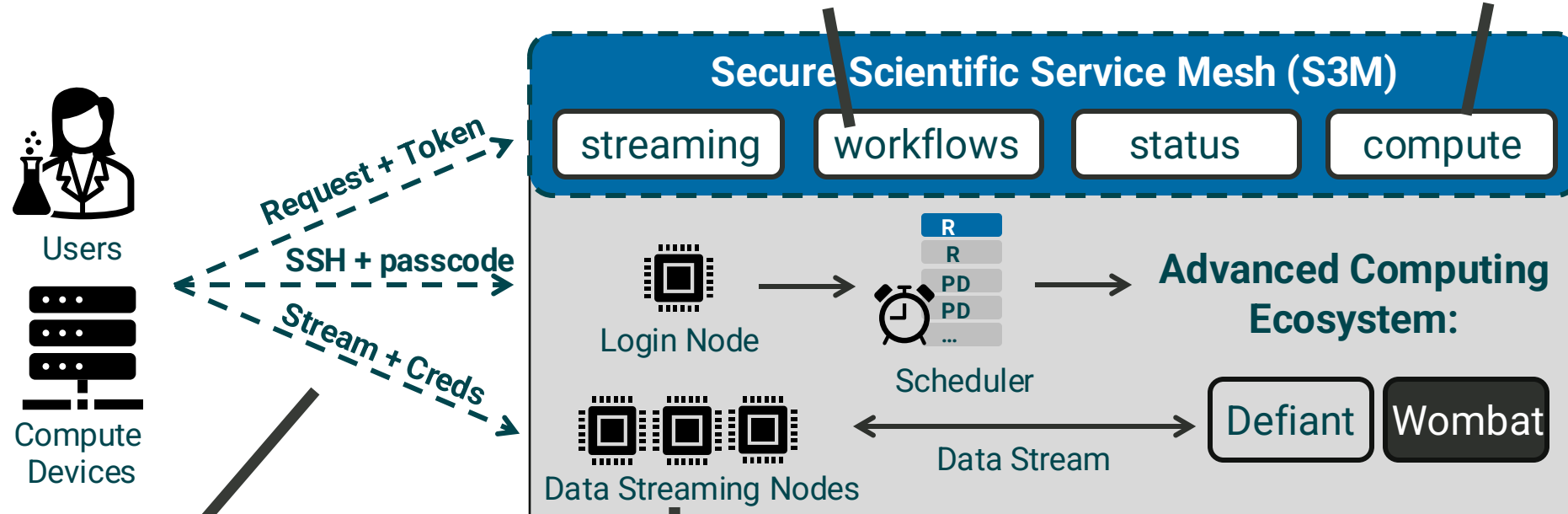


Streaming: Provision and manage pre-configured Data Streaming Nodes (DSNs).

The Secure Scientific Service Mesh (S3M)

Workflows: Promote reusability and resilience by enabling users to invoke workflow templates.

Automate fundamental HPC interactions.



Provide **secure access** appropriate for a given resource, project, and user.

Streaming: Provision and manage pre-configured Data Streaming Nodes (DSNs).

The Secure Scientific Service Mesh (S3M)

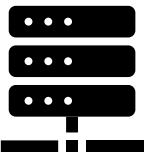
Workflows: Promote reusability and resilience by enabling users to invoke workflow templates.

Automate fundamental HPC interactions.

Extend to new capabilities.



Users

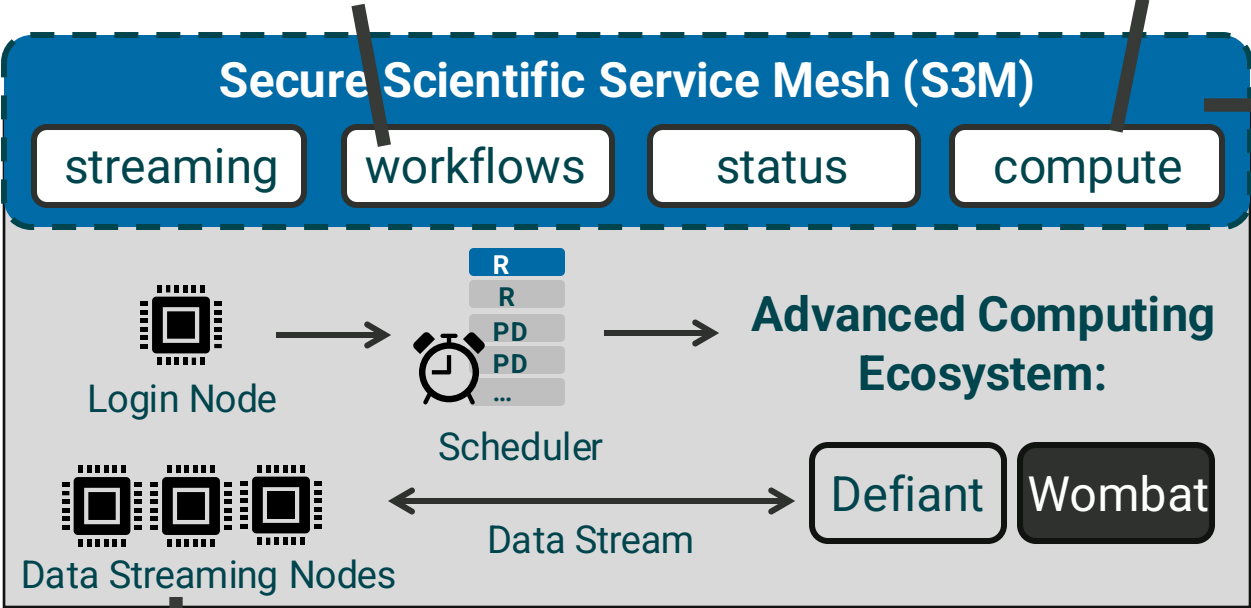


Compute Devices

Request + Token

SSH + passcode

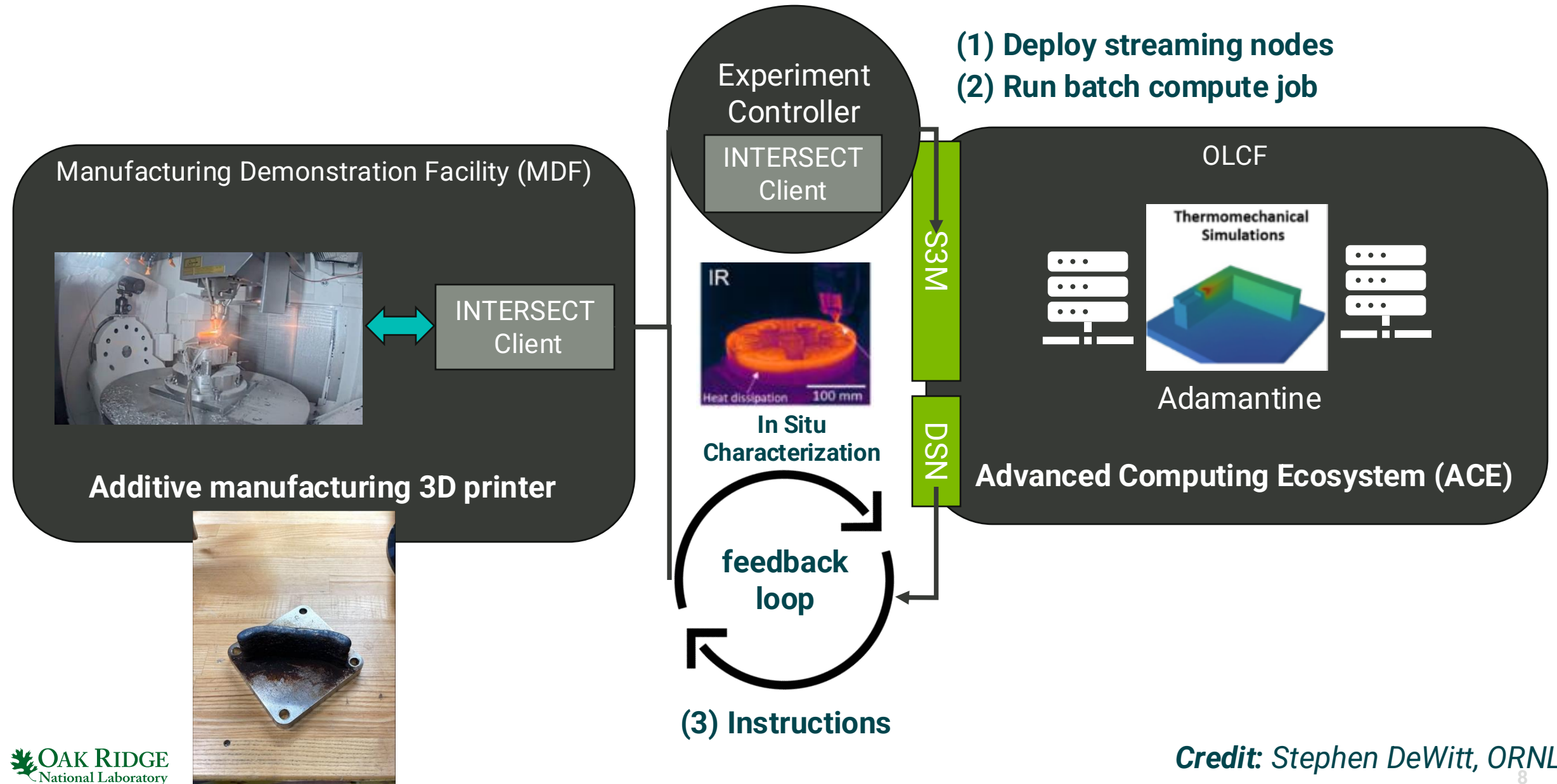
Stream + Creds



Provide **secure access** appropriate for a given resource, project, and user.

Streaming: Provision and manage pre-configured Data Streaming Nodes (DSNs).

Use Case: Additive Manufacturing Simulation



S3M is a secure, flexible, and powerful framework for enabling IRI workflows at OLCF

```
from olcf_s3m_api.client import OLCFAPIClient
from olcf_s3m_api.services import ComputeService, StreamingService

client = OLCFAPIClient(api_token=os.environ['S3M_TOKEN'])
compute_service = ComputeService(cluster_name='defiant', api_client=client)
stream_service = StreamingService(service_name="rabbitmq", api_client=client)

# *** Ensure that Defiant is online (token optional) ***
system_status = compute_service.get_system_status().status

if system_status != 'OPERATIONAL':
    print("Defiant unavailable! Please try again")
    exit()
else:
    print("Defiant online! Continuing to submit job...")

# ** Provision RabbitMQ Cluster **
stream_service.start_cluster(
    cluster_name="manuf-cluster",
    node_count=1, cpu_count=4, ram_gib=4)

# *** Submit a job to Defiant and retrieve job ID ***
job_id = compute_service.submit_job(
    job_name="Manufacturing Demonstration",
    script_contents='#!/bin/bash
srunc bash -c "source mini-venv/bin/activate && python3 analysis.py";',
    job_queue='batch-gpu',
    project='ornl-123',
    workdir="/lustre/polis/project_name",
    env_vars=["my_env=SECRET"],
    node_count=1,
    time_minutes=5
).job_id
```

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