FABRIC

(an NSF Midscale CyberInfrastructure Project)

ILYA BALDIN

FABRIC Project Director

RENCI Director of Network Research & Infrastructure

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FAB FABRIC Across Borders

renci

ESnet ENERGY SCIENCES NETWORK

CLEMSON UNIVERSITY

FABRIC

an NSF Mid-scale Research Infrastructure, empowers researchers to **securely prototype** and **validate disruptive designs** in wide-area networks. With its inclusion of advanced hardware uncommon in routers and switches, FABRIC facilitates experiments that **closely emulate real-world production** environments. By prioritizing connectivity with existing research and compute facilities, FABRIC enhances its usability and relevance.

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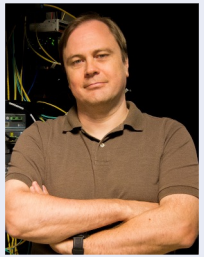
Leadership Team

Ilya Baldin (RENCI) 	Zongming Fei (UKY) 		Jim Griffioen (UKY) 	Tom Lehman (Virnao) 
Inder Monga (ESnet) 	Anita Nikolich (UIUC) 	Paul Ruth (RENCI) 	Bryttany Todd (RENCI) 	KC Wang (Clemson) 

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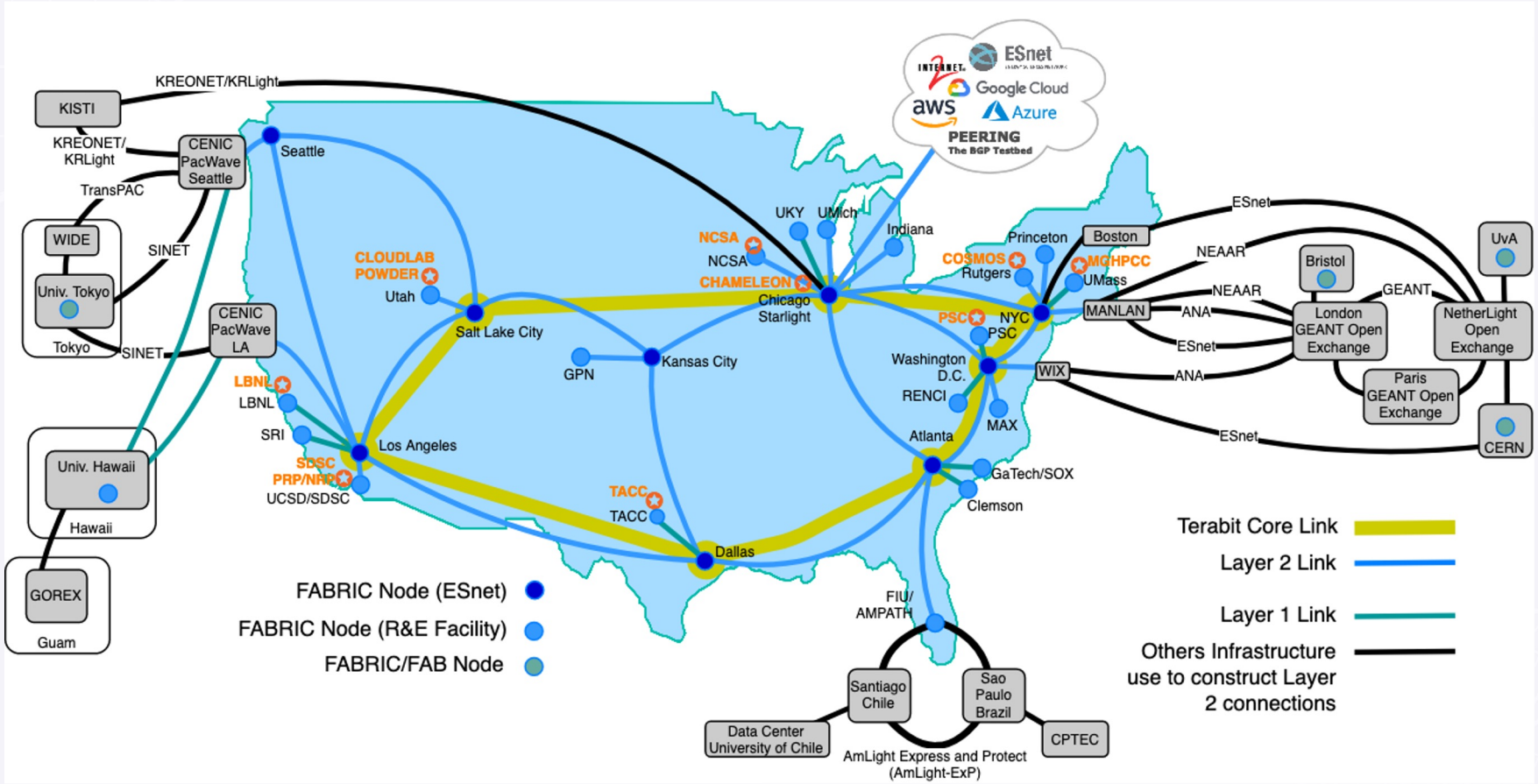
FABRIC: Experiments at Scale



Campus Cyberinfrastructure

- Edge computing with the cloud
- Campus instruments, compute centers, and facilities
- Campus Science DMZs

Data Staging & Transfer

- Access to data repositories/instrument streams
- Dissemination of results
- Inter-domain data transfers (cloud, compute centers, campus)

Remote Device Control

- Microscopes, telescopes, medical devices, etc.

Scientific Computing: Across Networks

Facilities

- HPC Compute Centers
- Public/Private Clouds
- Campuses
- Data Repositories
- Large Instruments (microscopes, etc.)

Infrastructure

- Internet2, ESnet, regional RENs
- Data Transfer Nodes (DTNs)
- Science DMZs

Tools & Features

- Workload Managers (SLURM, etc.)
- Data Transfer tools (Globus)
- Workflow Managers (Pegasus, etc.)

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Scientific Computing: Resources and Tools

Applications are Limited to Running at the *Edge*

- Limited by edge-to-edge protocols
- Growing emphasis in Edge-Core-Cloud paradigm

End-to-end Performance

- Network performance between data repos, instruments, campuses and compute centers
- Requires Internet2 AL2S, optimized DTNs and/or Science DMZs

Multi-facility Computation

- Distributed workflows
- Edge-core-cloud paradigm

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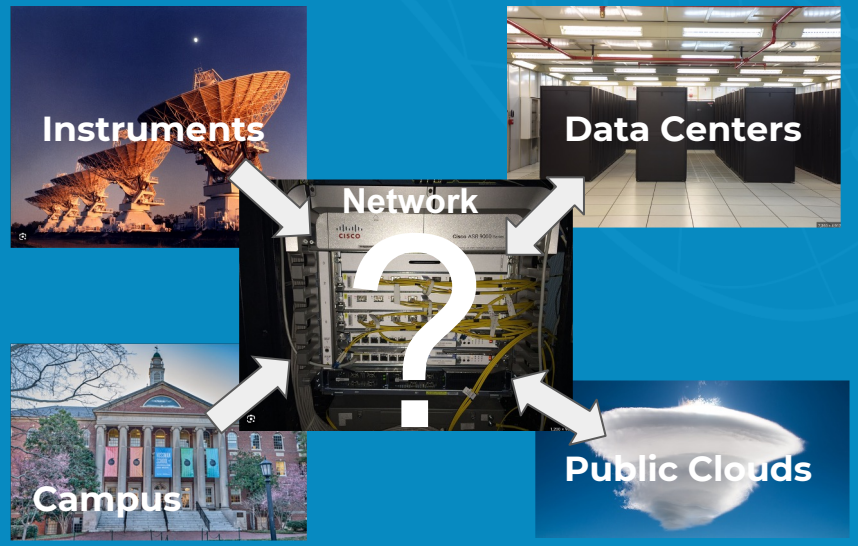
Realities & Trends



FABRIC: Smart Programmable Cyberinfrastructure

"If I had asked people what they wanted, they would have said faster horses."

– Henry Ford, (maybe)

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FABRIC: Smart Programmable Cyberinfrastructure

"If I had asked people what they wanted, they would have said faster Networks."

– Henry Ford, (maybe)

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Run Applications Everywhere

- Edge, cloud, or routers in between
- Real facilities
- In-network compute, storage, and accelerators

Sandboxed Experimentation

- Minimize security exposure
- Rapid test-fix-test cycles

Production Scale

- Geographic and performance

Tools & Apps

- Refine and invent novel tools and applications required for using programmable hardware in the network

Impact on Cyberinfrastructure

Science Unbound

- Applications natively running across platforms and domains
- Smart in-network processing, caching, and data collection/distribution

Full Scale Prototypes

- Production scale
- Connected to real facilities
- Measured validation of expensive/risky systems
- Path for transition to production deployments

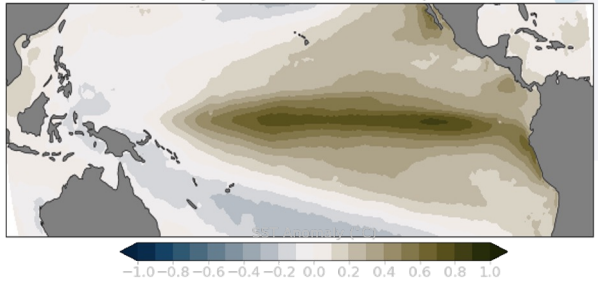
Educating the Next Generation

- Hands-on learning
- Experiment in the network core with minimal impact

FABRIC Does Climate: El Niño Forecasting

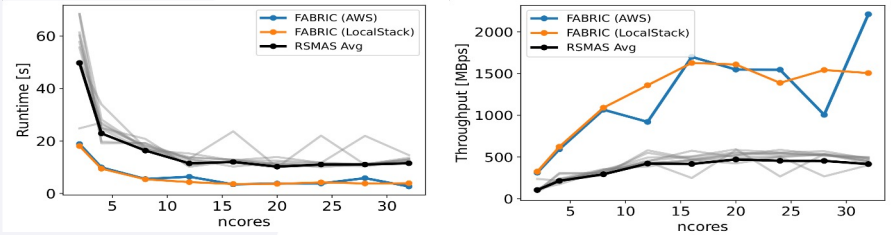
Existing El Niño forecasts use Global Climate Models issuing forecasts by modeling the physics of the atmosphere and ocean

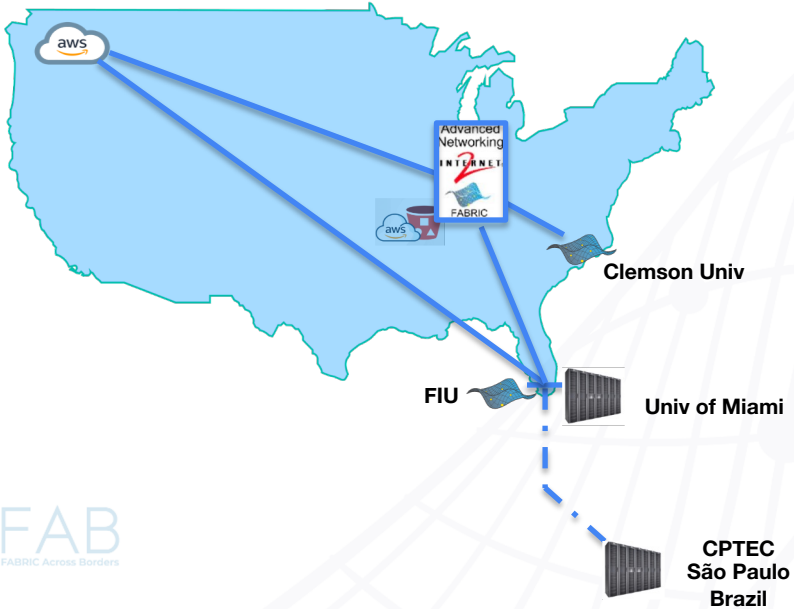
Goal: Combine data from satellite observations with a pool of six Climate model forecasts (North American Multi-Model Ensemble) and CPTEC (Brazil) using machine learning to issue better El-Niño forecasts



Convolutional Neural Network to forecast El-Niño on FABRIC nodes

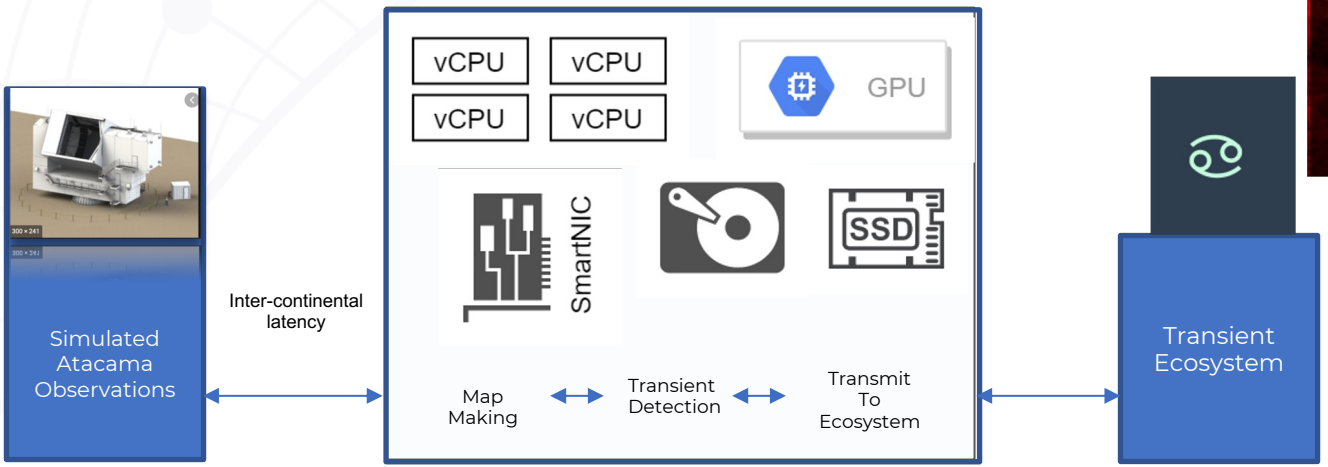
- Dr. Ben Kirtman (U of Miami)
- Dr. Leo San Pedro Siqueria (U of Miami)
- Dr. Kuang-Ching (KC) Wang (Clemson)





FABRIC Does Astronomy: CMB-S4

With 12 telescopes at the South Pole and in the Chilean Atacama desert surveying the sky with 500,000 cryogenically-cooled superconducting detectors for 7-10 years, CMB-S4 will deliver transformative discoveries in fundamental physics, cosmology, astrophysics, and astronomy.

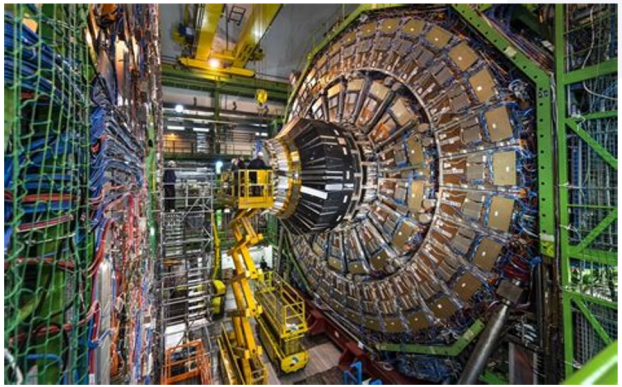


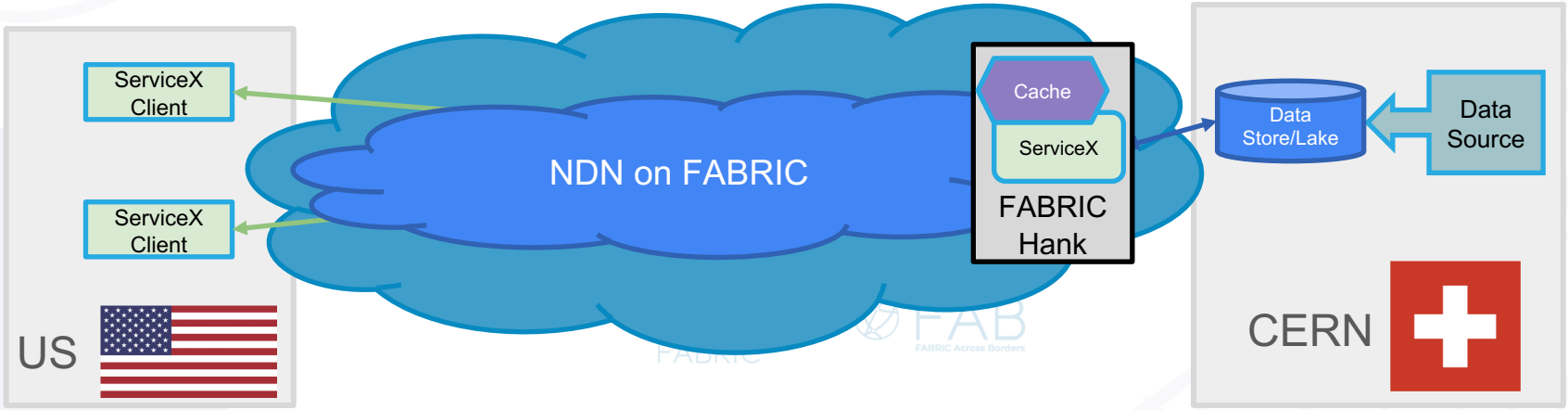
- Don Petravick, Gregory Daues (UIUC/NCSA)
- Designed/deployed CMB-S4 experiment(s) on FABRIC
- Simulated observatory source at FIU (projected actual path)
- In-network data processing
- Implemented a shell on top of FABlib to control their experiment

FABRIC Does HEP: ServiceX for LHC Atlas

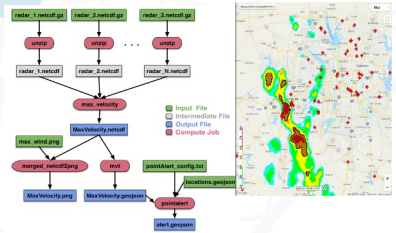
ServiceX over NDN on FABRIC

- Incorporates in-network caching
- Extend the FABRIC ServiceX deployment by replacing TCP/IP flows with NDN data transfers that cache results at every hop in the network
- University of Chicago, University of Michigan

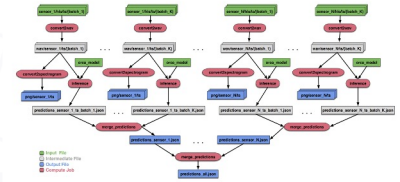




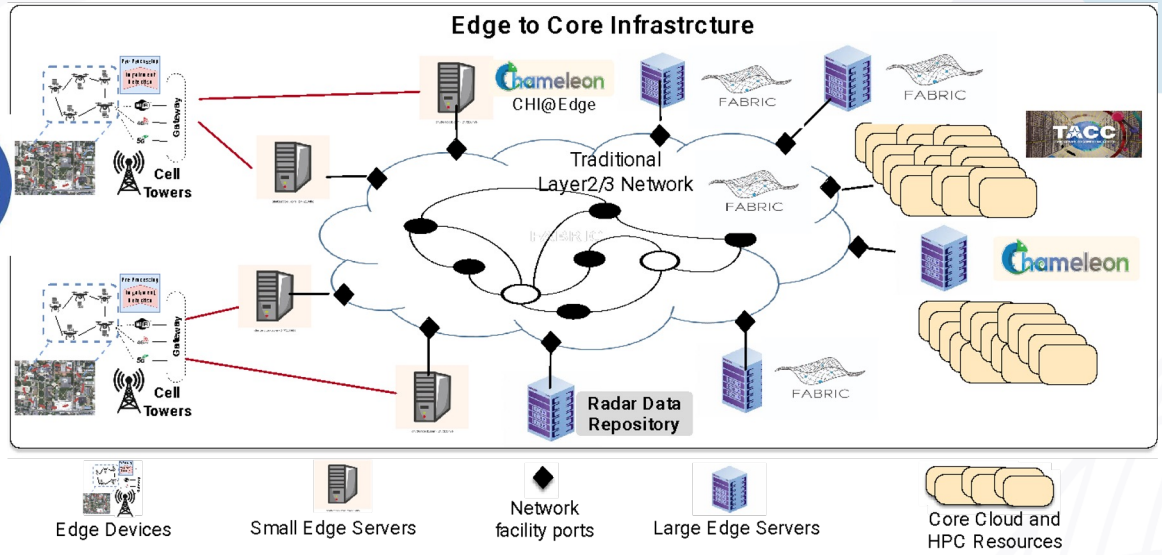
FABRIC Does Edge Computing: FlyNet



CASA Wind Workflow



Orcasound Workflow



Scientific workflows deployed by the Pegasus workflow management system in the edge-to-cloud continuum leveraging the FlyNet architecture; Using resources from Chameleon and/or FABRIC and utilizing the FABRIC network to move data

M. Zink (UMass Amherst), E. Deelman (USC/ISI), A. Mandal (RENCI/UNC), P.Calyam (U of Missouri), G.Papadimitriou (USC), A. Esquivel (U of Missouri), Cong Wang (RENCI/UNC), Komal Thareja (RENCI/UNC)

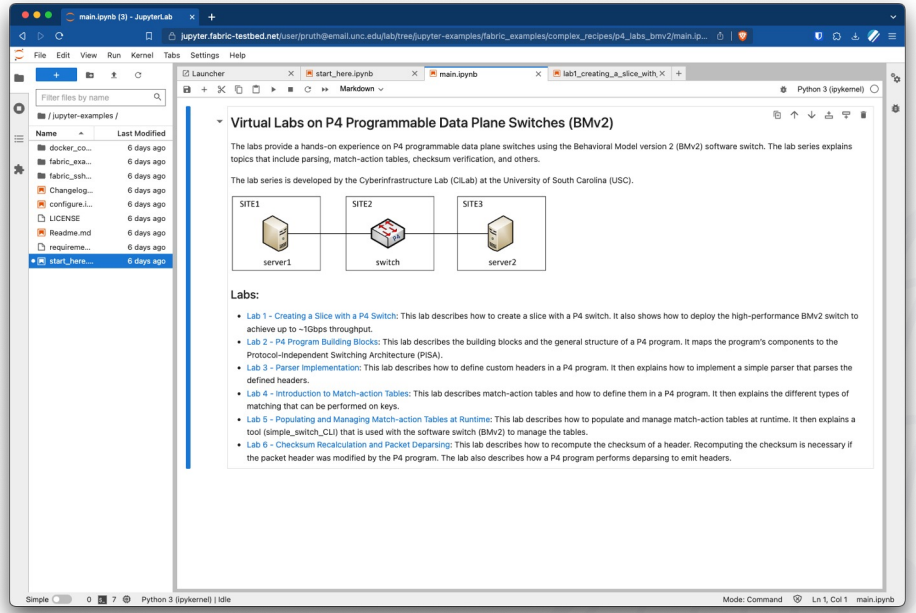
FABRIC Does Education: P4 Labs

Educational Laboratory

- Cyberinfrastructure Lab (CILab) at U of SC
- Prof. Crichigno and his team created a set of P4 Tutorials/Labs for FABRIC
- Available in FABRIC's JupyterHub

P4 Experiments on FABRIC

- Deploy software P4 BMv2 on FABRIC
- Learn match action tables
- Deploy across real distributed infrastructure
- Tofino P4 Switches (coming soon)



UNIVERSITY OF South Carolina

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Join the Community!

FABRIC Account

https://portal.fabric-testbed.net/

FABRIC + You

- Collaborate with FABRIC
- Add FABRIC hardware
- Conduct experiments

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Thank You!

Questions?

Visit https://whatisfabric.net

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