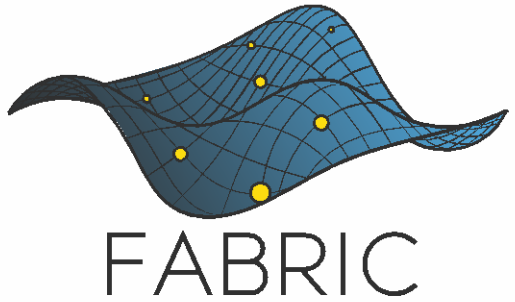


What is FABRIC?

Anita Nikolich

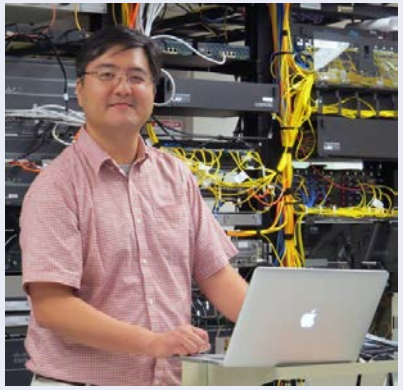
- Illinois Institute of Technology

- Cyber Policy Institute, Harris School of Public Policy, U Chicago

- DEFCON AI Village

ESnet
ENERGY SCIENCES NETWORK

FABRIC Leadership Team

Ilya Baldin (RENCI) 	Anita Nikolich (IIT) 	Inder Monga (ESnet) 	Jim Griffioen (UKY) 	KC Wang (Clemson) 
Dale Carder (ESnet) 	Tom Lehman (Virnao) 	Paul Ruth (RENCI) 	Zongming Fei (UKY) 	

Why FABRIC?

- The mantra of the last 20 years – 'Internet is showing its age.'
  - Applications designed around discrete points in the solution space
  - Inability to program the core of the network
- What changed?
  - Cheap compute/storage that can be put *directly in* the network
  - Multiple established methods of programmability (OpenFlow, P4, eBPF, DPDK, BGP flowspec)
  - Advances in Machine Learning/AI
  - Emergence of 5G, IoT, various flavors of cloud technologies
- Opportunity for the community to push the boundaries of distributed, stateful, 'everywhere' programmable infrastructure
  - More control *or* dataplane state, or some combination? Multiple architectures (co)exist in this space.
  - Network as a big-data instrument? Autonomous network control?
  - New protocols and applications that program the network?
  - Security as an integral component?

FABRIC

FABRIC for everyone

FABRIC Enables New Internet and Science Applications

- Stateful network architectures, distributed applications that directly program the network

FABRIC Advances Cybersecurity

- At-scale realistic research facilitated by peering with production networks

FABRIC Integrates HPC, Wireless, and IoT

- A diverse environment connecting PAWR testbeds, NSF Clouds, HPC centers and instruments

FABRIC Integrates Machine Learning & Artificial Intelligence

- Support for in-network GPU-accelerated data analysis and control

FABRIC helps train the next generation of computer science researchers

FABRIC

FABRIC Core

FABRIC

FABRIC Edge


SRI
International


Georgia
Tech


FIU
FLORIDA
INTERNATIONAL
UNIVERSITY


Colorado State University


UMassAmherst


POWDER
THE
UNIVERSITY
OF UTAH


INTERNET
2


TACC


renci


CLEMSON
UNIVERSITY


COSMOS


LEARN
LONESTAR EDUCATION AND RESEARCH NETWORK


MAX
MID-ATLANTIC CROSSROADS


UK


1766
RUTGERS


3ROX
THREE RIVERS OPTICAL EXCHANGE


PITTSBURGH
SUPERCOMPUTING
CENTER


CENIC


STARLIGHT SM
The Optical STAR TAP SM


COLUMBIA UNIVERSITY
IN THE CITY OF NEW YORK


PRP
PACIFIC RESEARCH
PLATFORM


usignite


BERKELEY LAB


UNIVERSITY OF
MICHIGAN


ILLINOIS NCSA


UC San Diego
SDSC
SAN DIEGO
SUPERCOMPUTER CENTER


Chameleon


FABRIC


EASTERN
REGIONAL
NETWORK


THE UNIVERSITY OF
CHICAGO


GPN
GREAT PLAINS NETWORK


PRINCETON
UNIVERSITY

What is a FABRIC node?

- Core and edge nodes have compute, storage and programmable networking capabilities
  - Network programming at the level of OpenFlow, P4, eBPF, DPDK
  - GPUs to support ML applications
  - Ability to interpose compute, memory and storage into the path of fast packet flows
  - Processing speeds at 25Gbps, 40Gbps, 100Gbps, Nx100Gbps
  - Experimenters access hardware directly (programmable network cards, GPUs, FPGA cards)
- The key is node placement
  - *13 core* nodes located in telco locations at the intersection of multiple high-capacity *dedicated* optical links. Provide sliceable, programmable switching, hierarchical storage and in-network compute
  - *16 initial edge* nodes (also known as ‘hanks’) located on campuses, in lab datacenters to provide base load, serve as gateways for facilities to connect to FABRIC

FABRIC

Measurement capabilities

- Enhanced FABRIC node measurements
  - CPU, GPU, Programmable NIC, memory, and disk utilization
  - Interface/port packet stats across all data plane interfaces
- PacketGPS – precise time and location stamping of all packets as they pass through network nodes.
- Anywhere packet tracing, classification, labelling, and recording
- Optical layer measurements in parts of the core – per-wavelength optical power, pre- and post-FEC error counts

FABRIC

What FABRIC IS:

- FABRIC is an ‘everywhere-programmable’ network combining *core* and *edge* components that also link to many outside facilities.
- FABRIC is a multi-user facility with support for concurrent experiments of differing scales facilitated through federated authn/authz system with allocation controls.
- FABRIC is a place to experiment on new Internet architectures, protocols and distributed applications using a mix of resources from FABRIC, its facility partners, connected campuses and opt-in users.
- FABRIC is extensible – it will continue to connect new facilities like cloud, networking, other testbeds, computing facilities and scientific instruments. BYOE is also an option.

What FABRIC is NOT:

- FABRIC is not an isolated testbed – it will peer at Layer 2 and Layer 3 with a variety of networks, allowing experiment slices to connect to a wide variety of external resources
- FABRIC is not a place for long-term production workloads - it is intended for CI experiments short- or long-lived.
- FABRIC is not a place for real-world protected (PII or other) data – you can develop such new applications on FABRIC, but the infrastructure cannot support regulated data.
- FABRIC is not a fast new pipe for data between its connected facilities – ESnet, Internet2, and the regional networks provide production capacity, FABRIC provides a place to experiment with new approaches.

Science Design Drivers and Applications

- Four ‘Science Design Driver’ teams
  - FABRIC-ready experiment use-cases and applications
  - Help formulate design requirements
  - Help validate and commission the facility
  - Leave lasting experimental artifacts - software, experiment profiles, case studies
- Focusing on security, IoT, ML in the network, NDN, advanced transport protocols

FABRIC

SRI International

University of Virginia

Georgia Tech

FIU Florida International University

Construction Timeline

- Planning
- Prototyping
- Software development
- Community building

- Begin phase 1 deployment
- Testing, commissioning
- Design driver on-boarding

- Complete Phase 1
- Design driver experiments and early users
- Begin Phase 2 deployment

- Complete Phase 2 deployment
- Prepare for operations

FABRIC

FABRIC Community

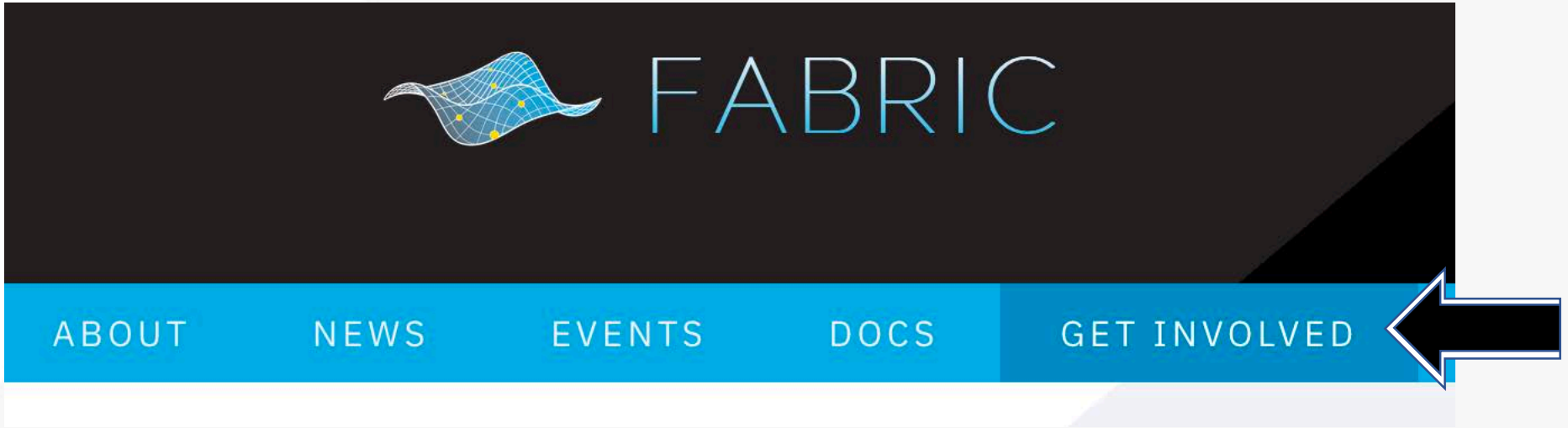
- Looking to build a vibrant community of stakeholders:
  - Experimenters
  - Facility partners
  - Regional and national network providers
  - Government agencies
  - Industry
- Community Visioning workshop April 2020 to share the vision and collect feedback
- Future Workshops!

FABRIC

How do I get involved in FABRIC?

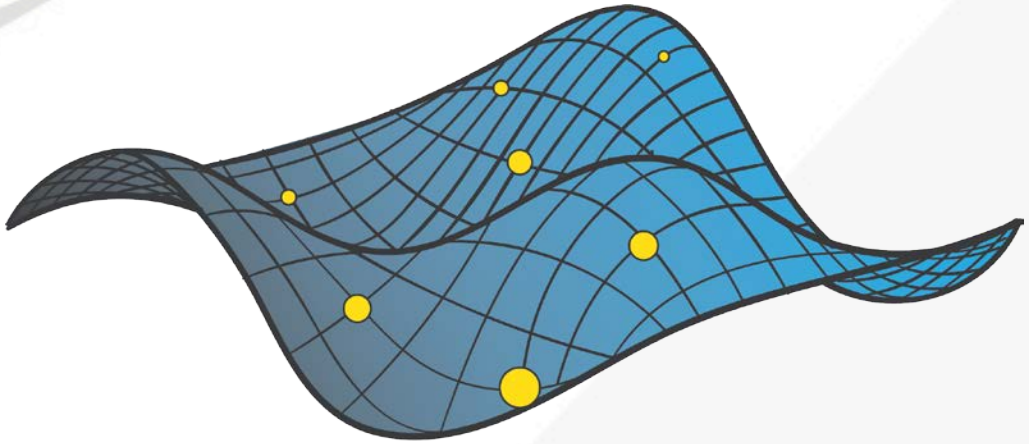
- Learn more
- Discuss connecting your network or facility
- Volunteer contributing a ‘hank’ (FABRIC node) on your campus
- Discuss using it for research being done on your campus

https://whatisfabric.net



FABRIC

Thank you!



FABRIC

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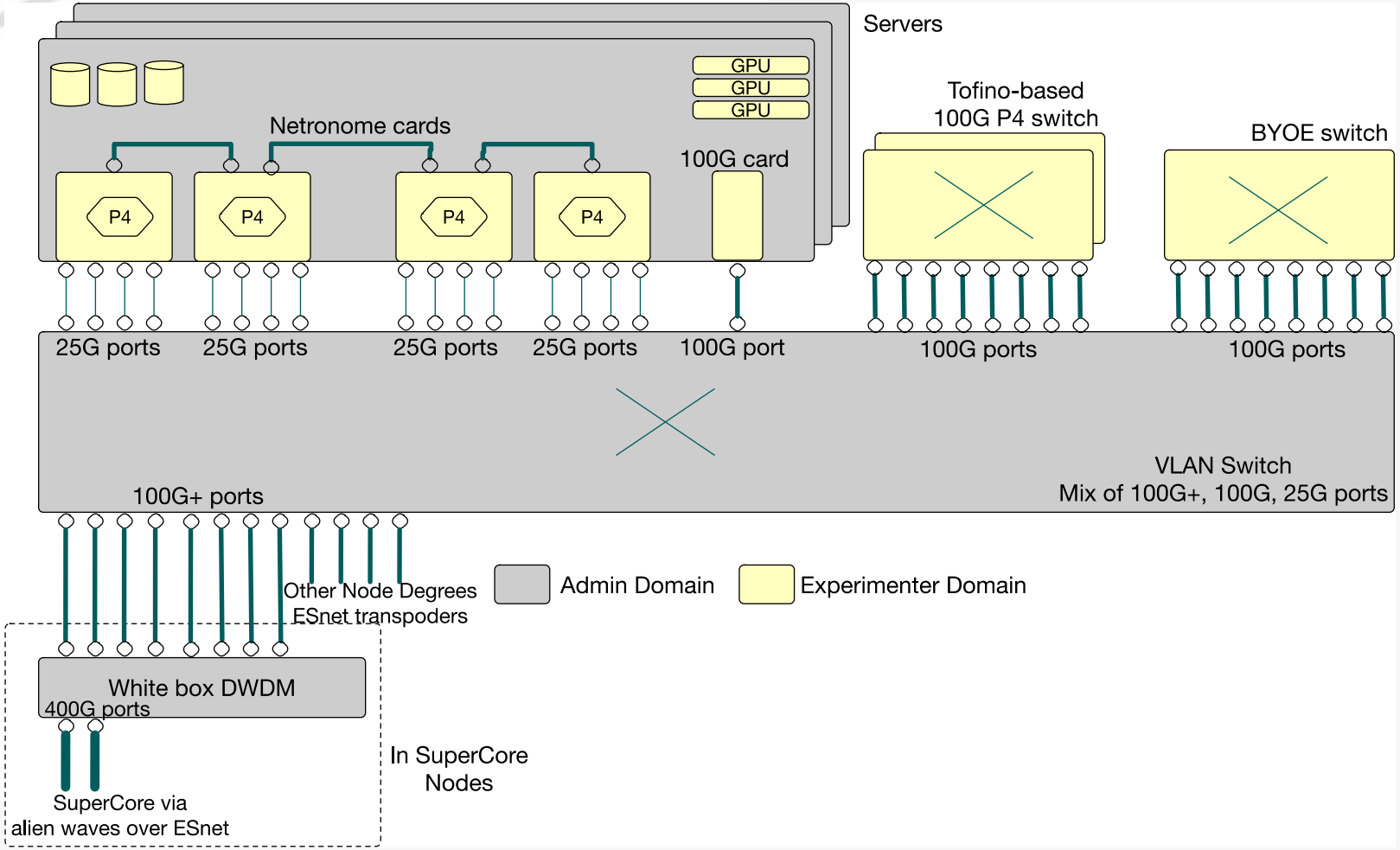
Proposed FABRIC node ('hank')



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