What is FABRIC?

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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 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 Core
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
Measurement capabilities

• Traditional measurements
  • CPU and memory utilization
  • Interface/port packet stats on all dataplane interfaces
• ‘PacketGPS’ - P4-based usec-level jitter measurements in individual nodes
• Time synchronization across core nodes – 10s of usecs
• Optical layer measurements in parts of the core – per-wavelength optical power, pre- and post-FEC error counts
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
Construction Timeline

Year 1
- Planning
- Prototyping
- Software development
- Community building

Year 2
- Begin phase 1 deployment
- Testing, commissioning
- Design driver on-boarding

Year 3
- Complete Phase 1
- Design driver experiments and early users
- Begin Phase 2 deployment

Year 4
- Complete Phase 2 deployment
- Prepare for operations
FABRIC Community

• We are looking to build a vibrant community of stakeholders:
  • Experimenters interested in using FABRIC
  • Facility partners
  • Regional and national network providers
  • Government agencies focusing on research
  • Industry

• Community workshop (Spring 2020) to share the vision, progress and collect feedback
How do I get involved in FABRIC?

• Learn more information about it
• Discuss connecting my network or facility to it
• Volunteer contributing a ‘hank’ (FABRIC node) on my campus
• Discuss using it for my research

https://whatisfabric.net
Thank you!

This work is funded by NSF grant CNS-1935966
Proposed FABRIC node (‘hank’)

- Netronome cards
- 25G ports
- P4
- 100G card
- 100G ports
- VLAN Switch
  Mix of 100G+, 100G, 25G ports

Other Node Degrees
ESnet transponders

Admin Domain
Experimenter Domain

White box DWDM
40G ports

SuperCore via alien waves over ESnet

In SuperCore Nodes

Servers
Tofino-based 100G P4 switch
BYOE switch