

Software-Defined Networking Workshop: Motivations and preliminary findings

Inder Monga

Chief Technologist and Area Lead, ESnet

ON*Vector

March 6th, 2014





Motivation

SDN in simple terms...

...but operational networking is more than this

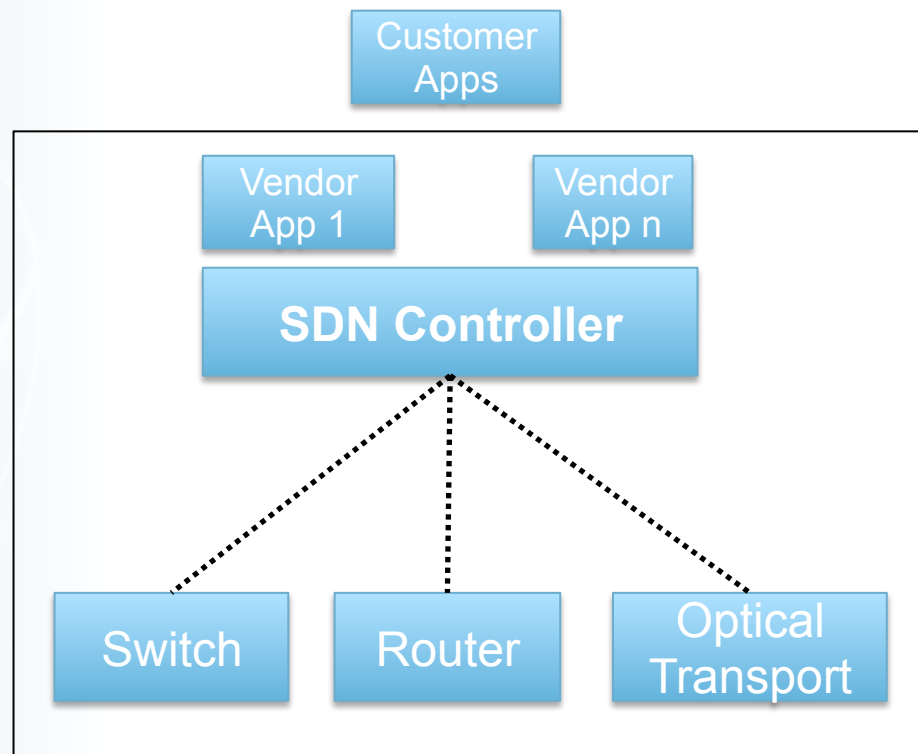


Tools

Software

processes

people



Monitoring & measurement

Fault diagnosis

A silhouette of a person in mid-jump, crossing a gap between two dark, jagged rock formations. The person's arms are outstretched forward and slightly upward, and their legs are in a jumping position. The background is a vibrant blue sky with scattered white clouds. A bright sun is positioned to the right of the person, creating a strong lens flare effect with multiple rays of light. The overall scene conveys a sense of achievement and overcoming a challenge.

**Identified as the
'SDN operational
gap'**

From conversations to position paper to workshop directive





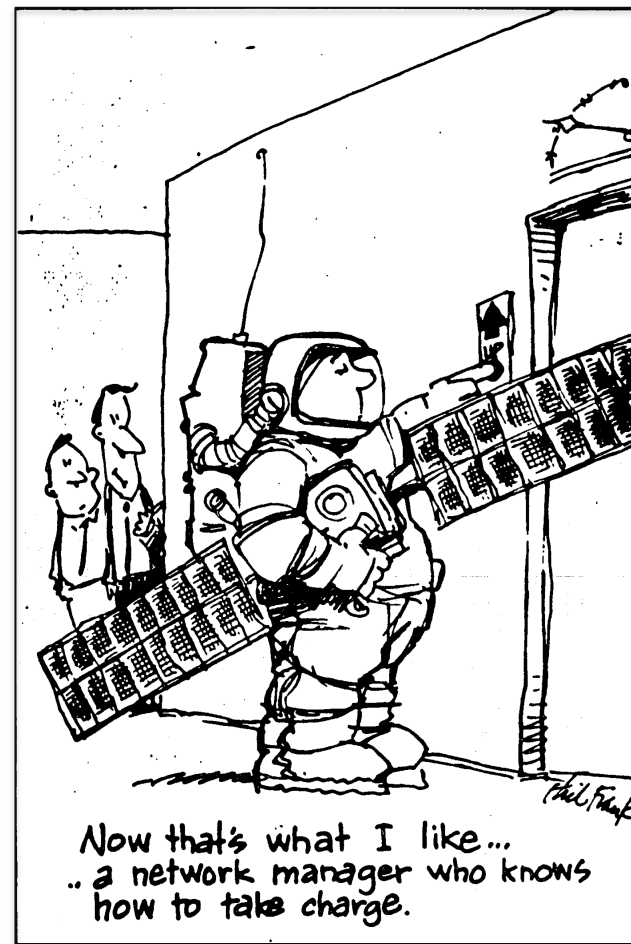
Three Goals

1. Identify the 'operational' gap
 - architecture, tools and policies
2. Deploy and operate **securely** multi-layer, multi-domain SDN networks
 - Interwork with the current set of Internet technologies
3. Identify research, development and technologies needed to support new, innovative users and applications

What does that help achieve?



- Build an ecosystem of security-savvy, operational SDN experts with government and academic networks leading the way
- Rapid prototypes with open-source tools, engage the open-source or startup community
- Share experiences, build knowledge
- Engage operational knowledge with academia, open-source enthusiasts and industry at a larger scale





Workshop

Sponsors



Grant Miller



Vince Dattoria



Bryan Lyles



Workshop Organizers

Workshop PI



Inder Monga



Chip Elliott



Ron Hutchins



Roy



Eric Boyd



Bill Snow

Organizing Committee

Steering Committee

Vince Dattoria (DOE), Bryan Lyles (NSF), Robert Bonneau (AFRL), Matthew Goodman (DARPA), Kevin Thompson (NSF), Bob Walter (DARPA)

Lawrence Berkeley National Laboratory

NSF PIs

Joe Evans and Sean Peisert

U.S. Department of Energy | Office of Science

Workshop Structure



Keynotes - <https://www.ornl.gov/sdnpr2013/>

Breakout groups

- Brainstorming
- Three broad areas
 - Users and Applications (UAM)
 - Technology and Operational Deployment (TOD)
 - Security

Readouts and Discussion

Workshop Report (in progress)

Workshop
Attendance
Dec 17-18, 2013



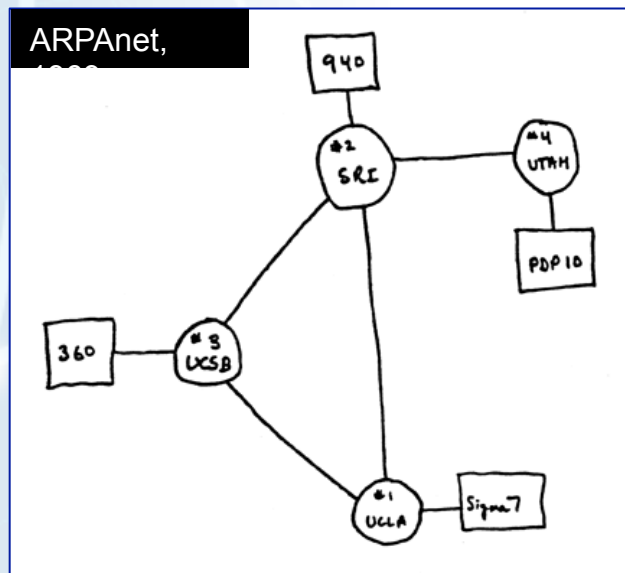


Findings

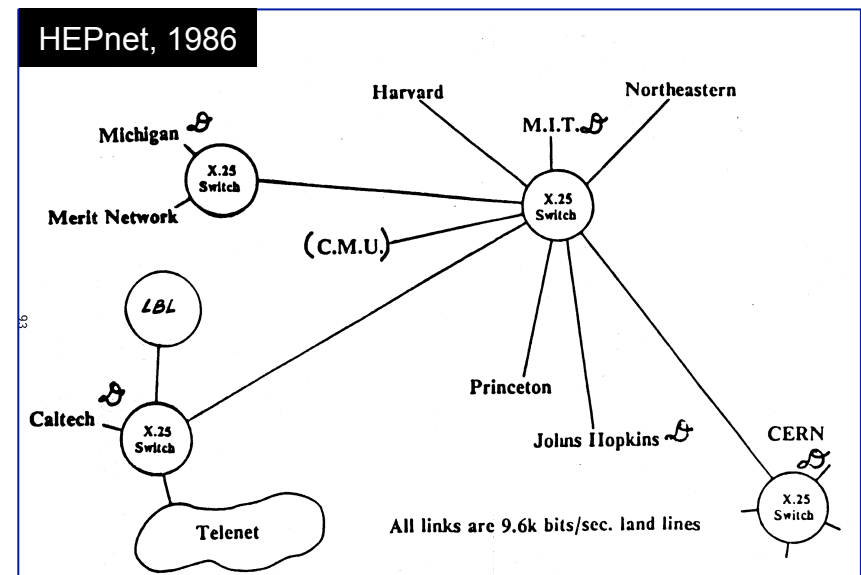
It is about *running* networks (not just about network *research*)



Develop, deploy and (inter)operate
a prototype multi-domain SDN network



http://www.computerhistory.org/internet_history/full_size_images/1969_4-node_map.gif



Future of intersite networking, LBL, 1986

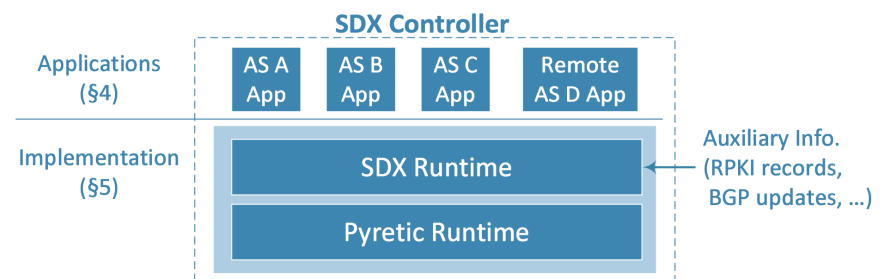
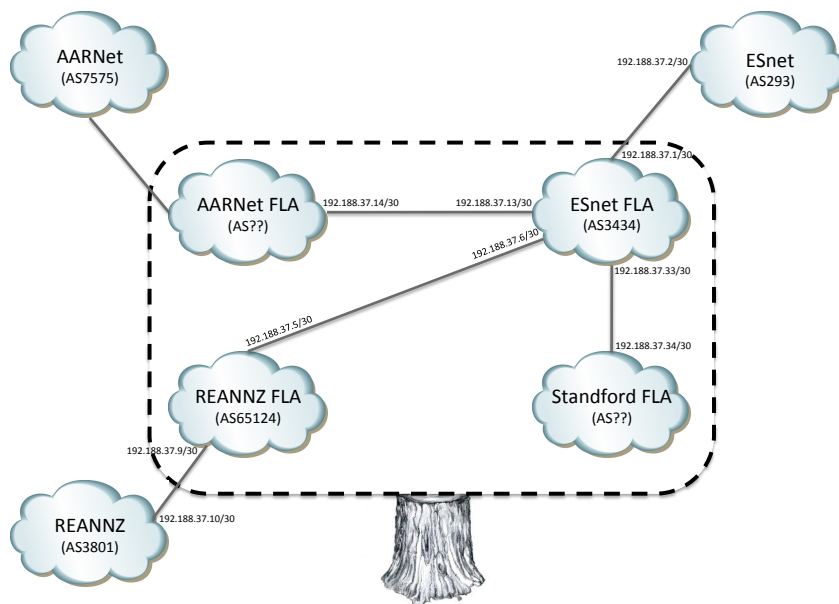
Interoperate with existing IP networks as base capability



Build multiple, community supported Software-Defined eXchanges (SDX)

- Tackling exchanging IP data is table-stakes for a larger deployment

TreeHouse Setup Overview [7/24/2013]



Collaboration with Josh Bailey, Google

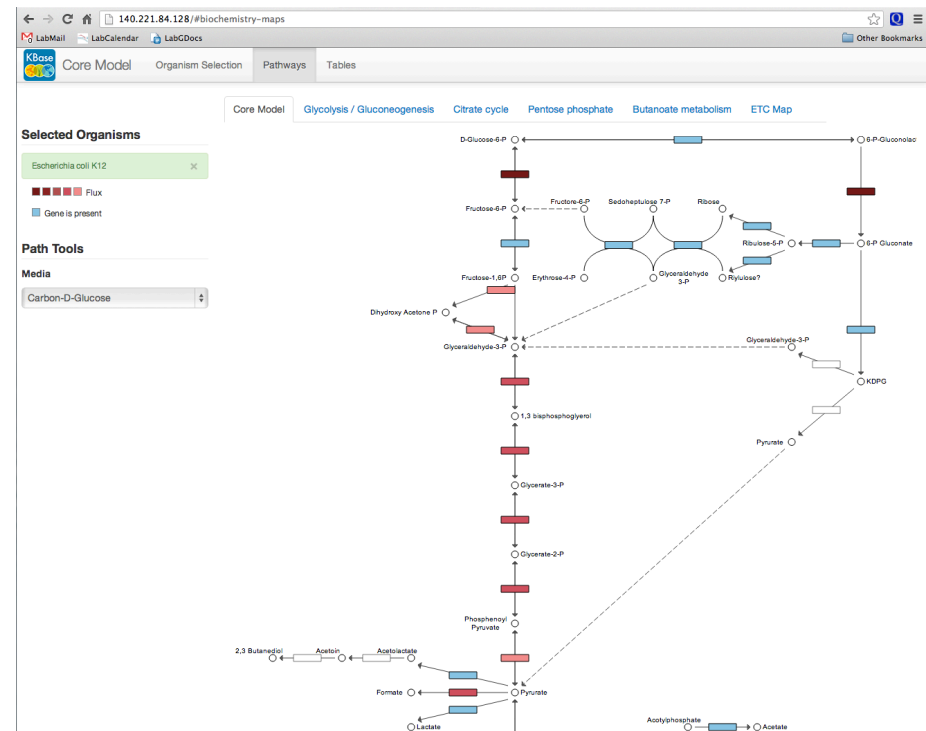
Nick Feamster, Georgia Tech

Network is important component of the larger application picture



Software-Defined Networking should transition to Software-Defined 'Instrument' (SDI)

- Include compute, storage along with network
- Break the networking black box



Standardize APIs and Application 'plugin' processes



Open the SDN app-store

- Leveraging applications within a community will benefit all
- Support both 'open' and 'closed' source
- Will require a set of standard APIs



Manageability goes hand-in-hand with Programmability



Community focus needed to bridge network management and service manageability gap

- no common debugging statistics?
- **What are the 'ping' and 'traceroute' equivalents for SDN?**
 - Simple tools to debug connectivity, and when it does not work.
- **Need a northbound API for debugging, not just for applications**
 - Query network state
 - Interoperable across vendors and controllers

Community is an important element of successful transformation



Community best practices for building SDN networks

- Architecture for the control plane, sizing the control plane etc.

Network Bootstrapping

Education (Unlearning and learning, obsolescence to relevance)

Network virtualization is the killer app, but how does it work?



Managing underlays and overlays – network virtualization

- Techniques not well understood, research topic

Profiles for various applications, so vendors/software developers can build to these profiles (supports the app-store idea)

- Don't know how to make that happen, but a strong desire to have since SDN means so many things

Security, still time to bake it in and do more!



Still a nascent topic, lots of definitions and discussions

Uses of SDN for Security

- Secure updates for applications
- Flexible intrusion detection
- Flexible Reaction/Provisioning

Making SDN secure

- Trust Model
- Correlation of complex network issues
- Policies (AAA, resource management, admission control etc.)
- Consistency model (valid vs invalid network state)



ARDUINO IS AN OPEN-SOURCE ELECTRONICS PROTOTYPING PLATFORM BASED ON FLEXIBLE, EASY-TO-USE HARDWARE AND SOFTWARE. IT'S INTENDED FOR ARTISTS, DESIGNERS, HOBBYISTS AND ANYONE INTERESTED IN CREATING INTERACTIVE OBJECTS OR ENVIRONMENTS.



My inspiration and recommendation:

Draw upon principles of 'Maker Movement' when thinking about SDN

– this could be 'our' DIY project!

- If it can be imagined, it can be made.
- The first step in making a thing, even a non-physical thing, is visualizing it.
- A most effective step in refining/developing a thing is collaborating with others on it.
- Begin with the end in mind.
- Making things always combines form with function.
- **The art of making should be appreciated and celebrated.**

Credit to wikipedia for principles