FROM NETWORK ADMINISTRATOR TO DOMAIN SCIENTIST: CHALLENGES WITH CREATING USABLE HIGH SPEED NETWORKS

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CREATING THE NEXT®
TWO QUESTIONS

What do domain scientists need to do?
- Move bulk data
- Move streams of data
- Connect instruments with data processing
- Share resources

What do domain scientists know about networks?
- Assume nothing
- Bandwidth (Mbps/Gbps), VLANs, regional networks, research networks may be a foreign concepts
USE CASE:
ASTRONOMERS WANT DATA FROM TELESCOPES

• Two possible types of data
  • Bulk data from previous night’s viewing
  • Streamed data from instruments

• Need to get data from source to destination
  • Bulk transfers are simple
  • Streamed data should use dedicated path between instrument and processing center
• Call up local IT people
  • Shuffled to the right person, eventually

• Local network admin needs details
  • Bulk transfers? Streaming data? How much? How fast? What timeframes?

• Local network admin needs to talk to destination network admin and network provider(s)
  • To set up path/VLANs/everything else

• Half a dozen or so emails or phone calls
• Days to weeks to set up a connection
IT’S SETUP, RIGHT?

• Usual Process
  • Setup
  • Test
  • Fix
  • Retest

• Issues
  • Slow process – takes days-to-weeks
  • Fraught with issues – fat fingering is common
  • Too many cooks in the kitchen
  • Involves one or two people per network
HOW DO WE IMPROVE THIS?

Method:
• Automated provisioning
• A method for the domain scientists to access the automated system to create own paths

Madness:
• Multi-domain issues abound
• Current process is in place for a number of reasons
WHAT COULD POSSIBLY GO WRONG?

• Domain scientists are not knowledgeable of network terminology
  • Globus is a good example on how to simplify for non-specialists

• Network Operators don’t trust users
  • Justifiably!
  • Process is about Approval
OUR PROPOSED SOLUTION

• Portal for domain scientists
• Simple endpoints
• Submit a request
• Administrators (endpoints and network(s)) approve
  • Automatically or manually
• Integration with transfer applications
  • Globus, GridFTP, etc.
• Inter-domain SDN controller for wide-area, high speed science networks
• We’ve talked about it before
• Adaptable for multiple situations
  • Including self-service case we’re describing
  • Used by not-quite-PhD Joaquin Chung for his thesis
USE CASES WE’RE CONSIDERING

- Astronomer use case
- Network Operator
  - “Advanced options”
- Commercial Operator
  - How to handle per-use costs?
- Multi-domain
  - How to handle different management and authorization levels
- Compute integration
  - Compute resources as a part of the SDX

- What other use cases should we be looking at?
  - Is there a particular type of user that we should be talking to?
SDX Controller

Local Controller
ATLANTICWAVE/SDX ARCHITECTURE

- Web GUI
- REST API
- Controller Logic
- LC Interface

SDX Interface
- P4 Translation
- Callback Handler
- P4 Switch Interface

SDX Interface
- OpenFlow Translation
- Callback Handler
- OpenFlow Switch Interface

SDX Interface
- Netconf Translation
- Callback Handler
- Netconf Switch Interface

P4 Switch

OpenFlow Switch

Netconf Switch
• High Level inputs
  • From users
  • L2 Connection: 2 endpoints, start and stop times, bandwidth required
• Create an L2 tunnel between VLAN 635 on port 7 on ATL switch to VLAN 879 on port 3 on BOS switch between 0000 and 1600 tomorrow with 1gbps reserved

• Mid-level output
  • Not OpenFlow
  • Per-LC rules
• Per LC:
  • ATL: VLAN 635 port 7 to port 12
  • WAS: VLAN 635 port 4 to port 2
  • BAL: VLAN 635 port 8 to port 30
  • NYC: VLAN 635 port 14 to port 24
  • BOS: VLAN 635 port 1 to VLAN 879 port 3
• **Mid-level Input**
  - E.g., VLAN 635 port 1 to VLAN 879 port 3

• **Translates to what switch can handle**
  - OpenFlow 1.3 or OF 1.3 + Corsa-specific REST, in our case
  - Could be swapped for some other protocol
    - E.g., Netconf, NSI, P4, Cisco/Juniper/etc. APIs

• **Rules**
  - match(inport:1, VLAN:635)
    action(modify(VLAN=879), fwd(3))
  - match(inport:3, VLAN:879)
    action(modify(VLAN=635), fwd(3))
Scientist wants to transfer a file from server A to server B across the network

Uses a file transfer interface
HOW DOES THIS ALL FIT TOGETHER?

VLAN 663

A

Switch 1

1 6

Switch 2

2 4

Switch 3

8 10

VLAN 3700

B
HOW DOES THIS ALL FIT TOGETHER?

SDX Controller translates to per-LC rules

1. Connect ports 1 and 6 on VLAN 663
2. Connect ports 2 and 4 on VLAN 663
3. Connect ports 8 and 10 on VLAN 663 translated to 3700
Each Local Controller translates their rules into OpenFlow rules

- match(inport:8, VLAN:663)
  action(modify VLAN:3700, fwd:6)

- match(inport:10, VLAN:3700)
  action(modify VLAN:663, fwd:6)
Each Local Controller translates their rules into OpenFlow rules.
• Multipoint VLANs
• Semi-Arbitrary rules
• REST API
  • For programmatic control

{"l2multipoint":{
    " starttime": "1985-04-12T23:20:50",
    " endtime": "1985-04-12T23:20:50+0400",
    " endpoints": [ {
        " switch": "mia-switch",
        " port": 5,
        " vlan": 286}, {
        " switch": "atl-switch",
        " port": 3,
        " vlan": 1856}, {
        " switch": "gru-switch",
        " port": 4,
        " vlan": 3332} ],
    " bandwidth": 1000}}
• Integration of compute, not just network

• Due to the uncertainty of big-science funding
  • Where else can this be used?
  • What other use cases are there?
  • Is there a commercial application?

• Pay-per-use science model
  • Complication
  • Can we predict costs?
  • Auctioning resources?
CURRENT STATUS

• Web-based GUI in infancy
  • L2 point-to-point is handled easily here
  • Other functionality is REST API only

• Available for use!
  • Easy-to-deploy VM demo using Vagrant
  • Customizable Docker containers for more than “hello world!” functionality

• Happy to have a Skype/Hangouts call with anyone interested in using the AtlanticWave/SDX controller
CONCLUSIONS

• Domain scientists are network users, but they are not network operators.
• They should be able to get network resources easily.
• Automation of network resources should follow the self-service model used by compute resources today.

• The AtlanticWave/SDX controller is working on being an example network resource allocation mechanism.
• The controller design naturally lends itself to multi-domain situations.
• It can be used as a prototype to build off of.
QUESTIONS?
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http://www.atlanticwave-sdx.net/  
https://github.com/atlanticwave-sdx/  

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JOAQUIN CHUNG’S THESIS WORK

SDX Controller

Telescope Facility

Local Controller

Local network

SDX domain 1

Local Controller

Local network

SDX domain 2

Local Controller

Local network

SDX domain 3

Supercomputer Facility

Network Operator

SDX User Interface

Scientist User

SDX User Interface

Data Workflow Management System

SDX User Interface

Network Service Science Gateway

SDX-to-LC Interface

SDX-to-LC Interface

SDX-to-LC Interface

Interdomain links

SDX-to-LC: SDX to Local Controller

Network Operator

Scientist User

Data Workflow Management System

Network Service Science Gateway

SDX-to-LC Interface

SDX-to-LC Interface

SDX-to-LC Interface

Interdomain links

SDX-to-LC: SDX to Local Controller