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

SEAN DONOVAN — GEORGIA TECH

RUSS CLARK — GEORGIA TECH/SOX

JERONIMO BEZERRA — FIU

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TWO QUESTIONS

What do domain scientists need to do?

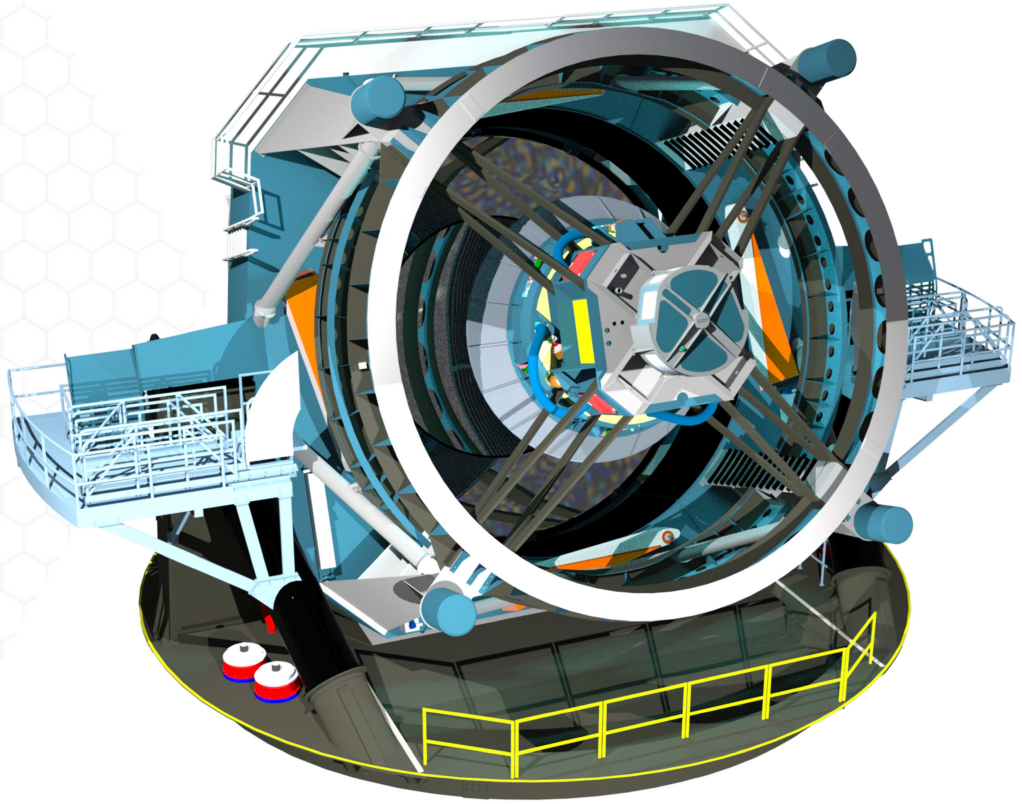
- Move bulk data
- Move streams of data
- Connect instruments with data processing
- Share resources

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



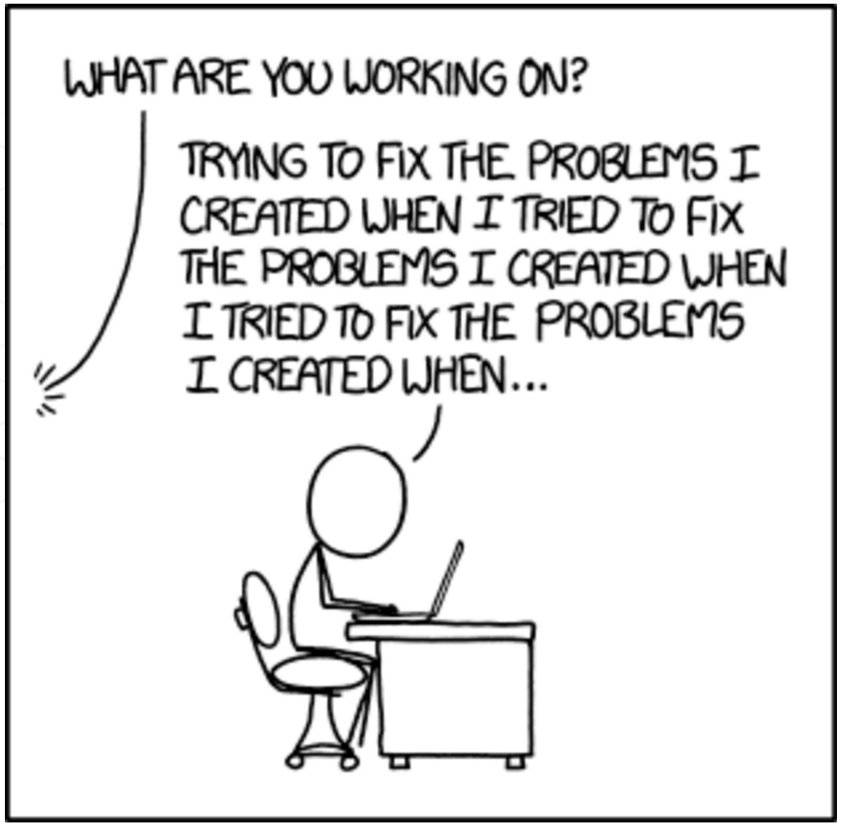
SETTING UP A NETWORK CONNECTION AS DOMAIN SCIENTIST

- 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:

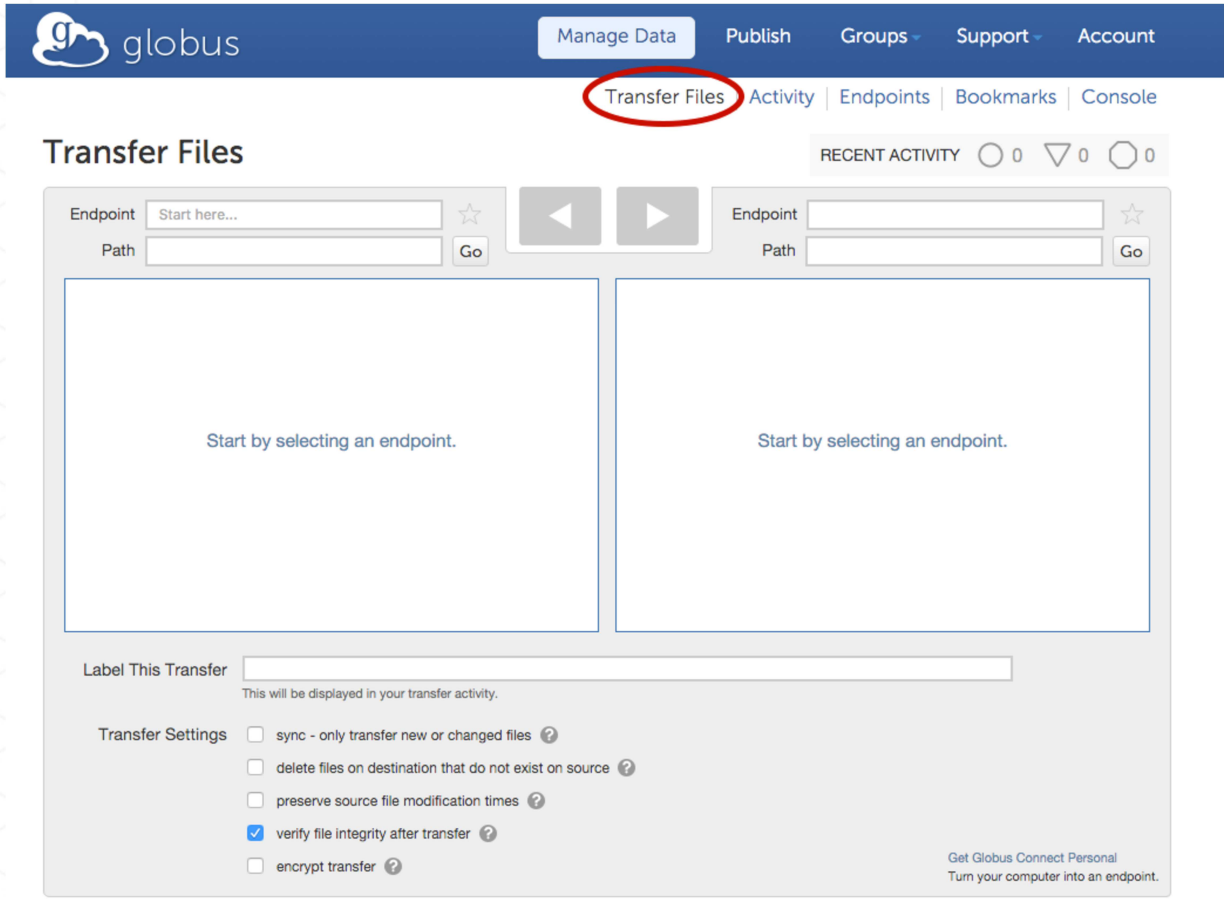
- Automated provisioning
- A method for the domain scientists to access the automated system to create own paths

Madness:

- Multi-domain issues abound
- Current process is in place for a number of reasons

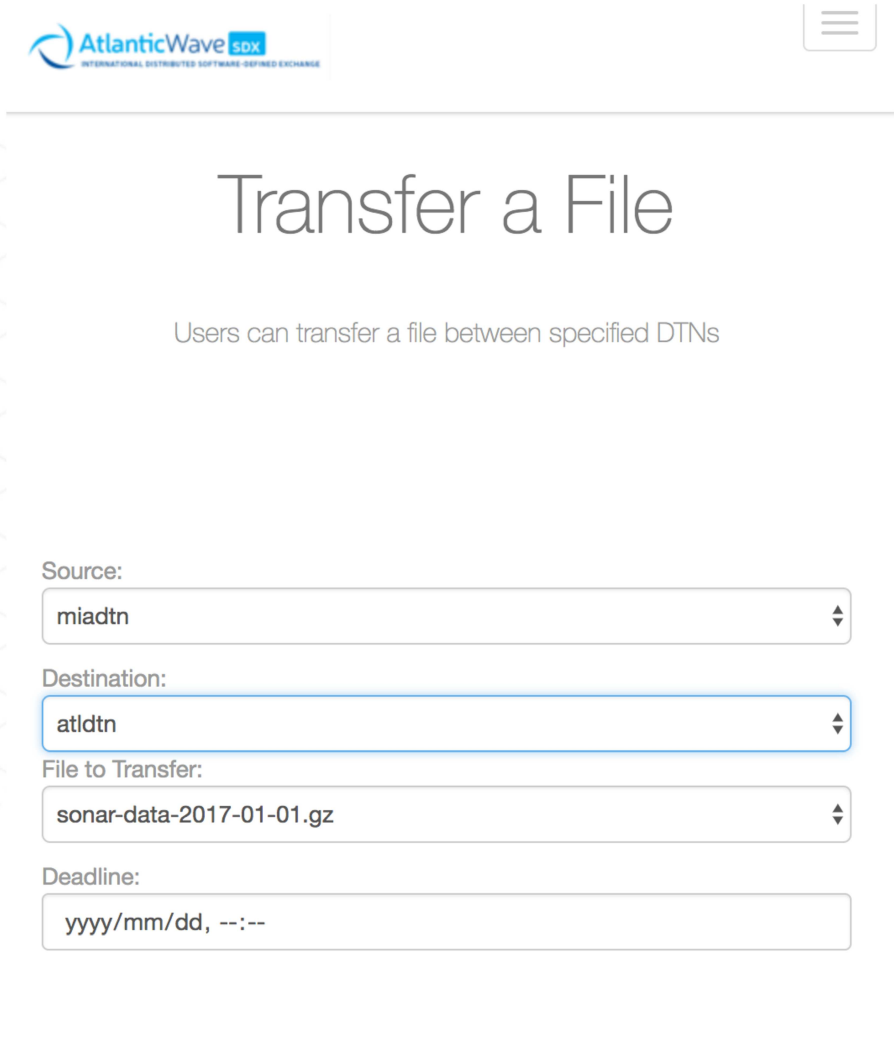
WHAT COULD POSSIBLY GO WRONG?

- 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



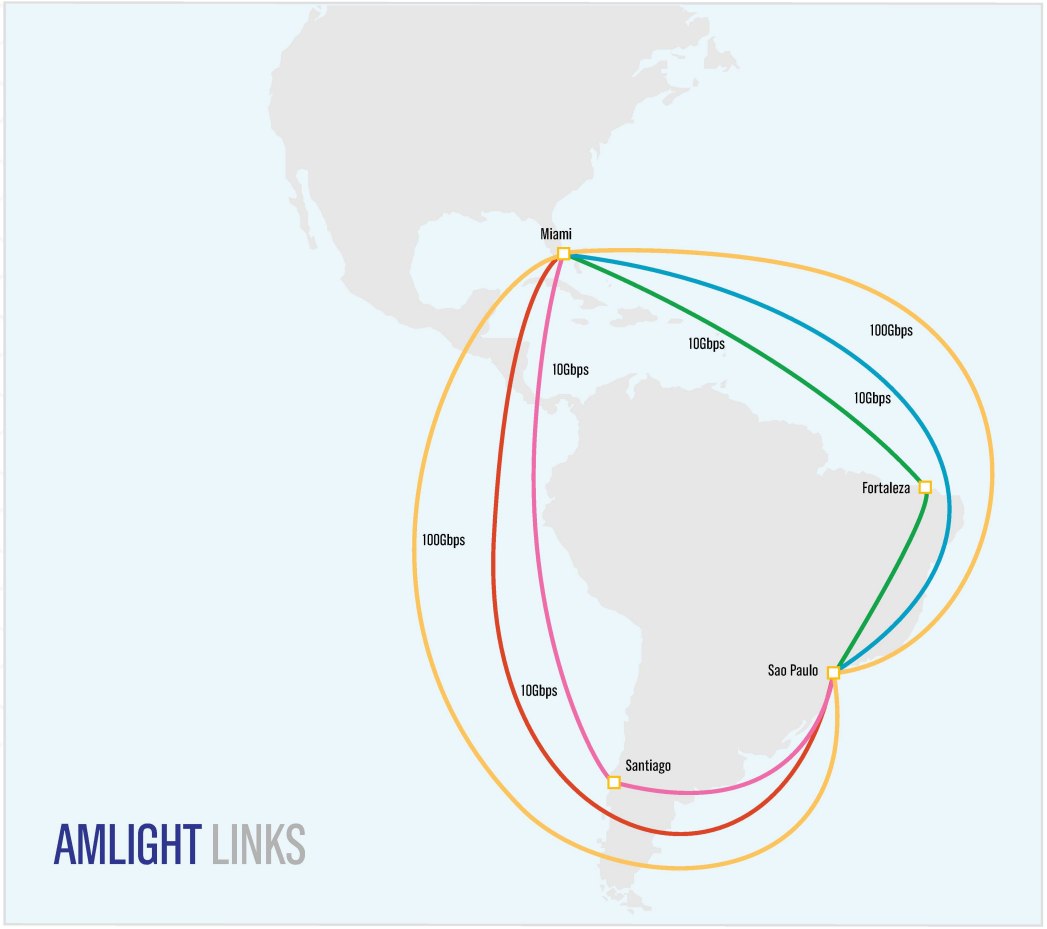
OUR PROPOSED SOLUTION

- 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.



ATLANTICWAVE/SDX OVERVIEW

- 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

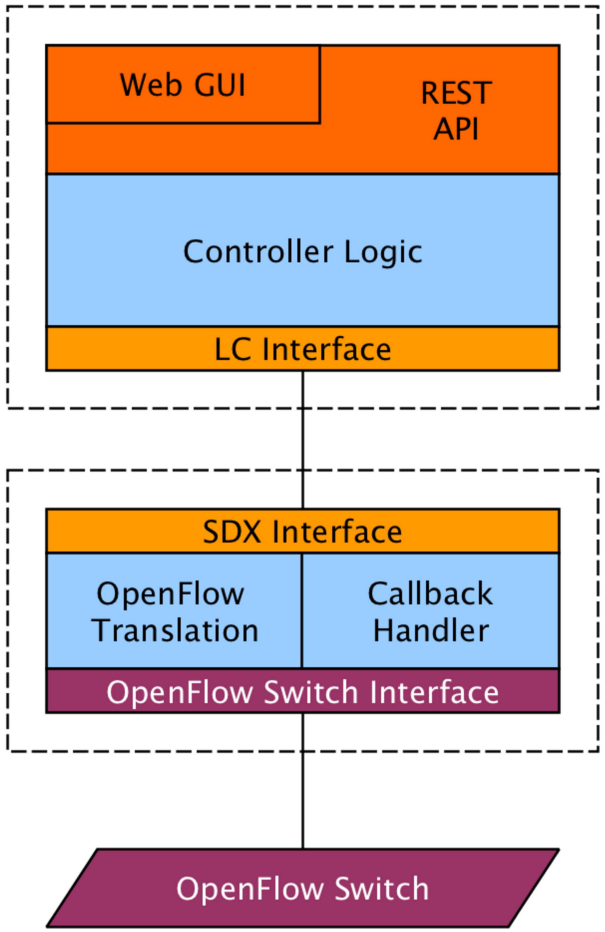


USE CASES WE'RE CONSIDERING

- 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?

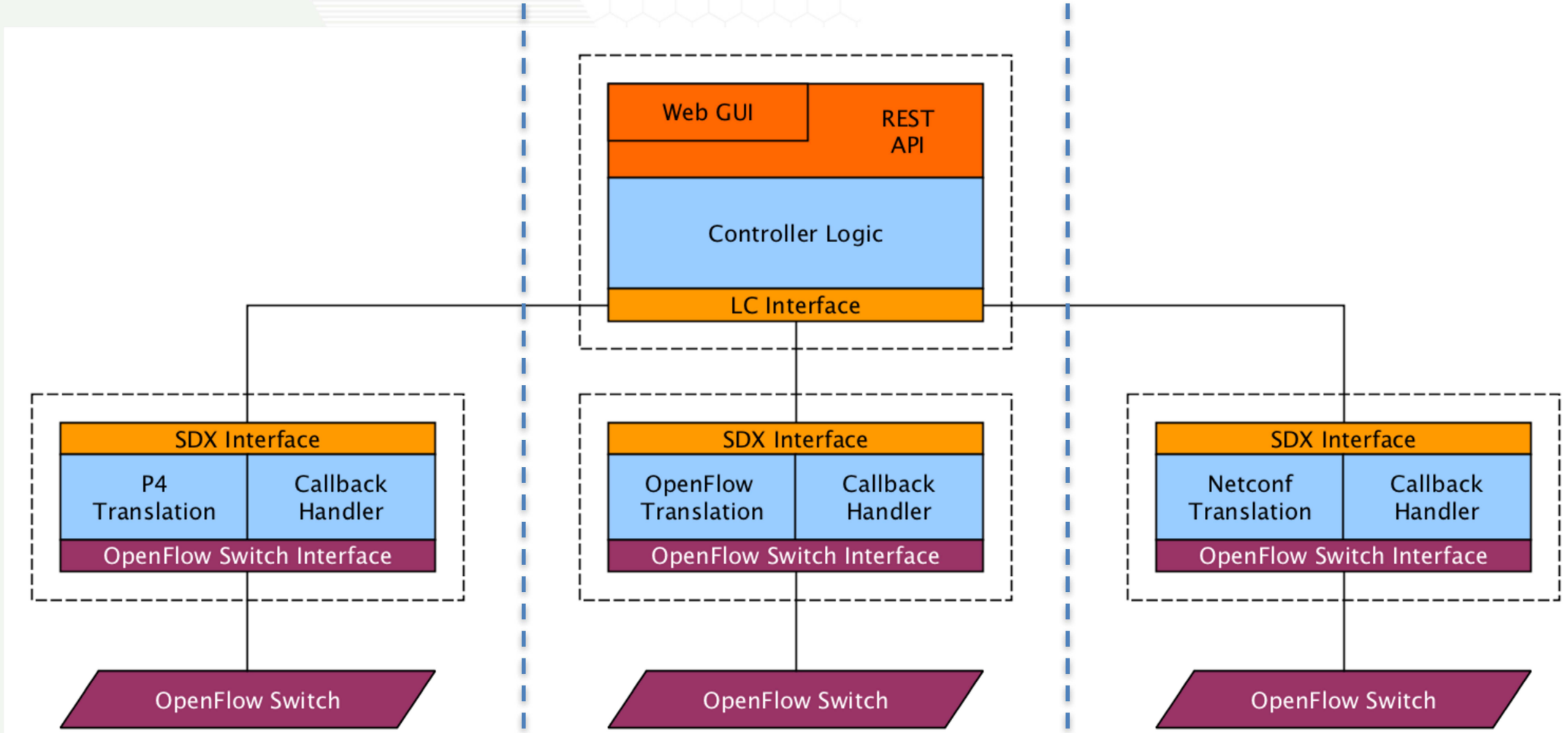
ATLANTICWAVE/SDX ARCHITECTURE



SDX Controller

Local Controller

ATLANTICWAVE/SDX ARCHITECTURE



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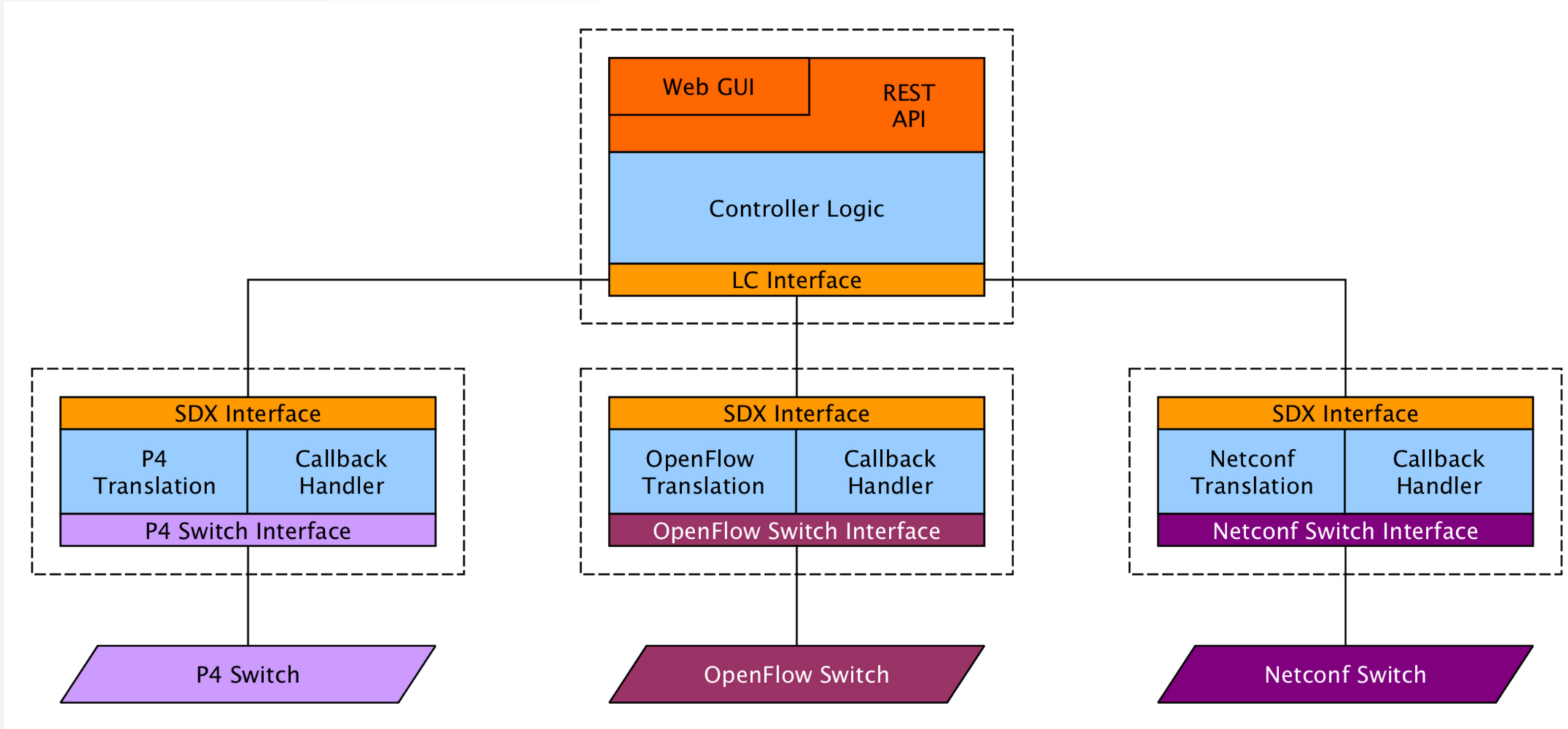


SDX CONTROLLER

- 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

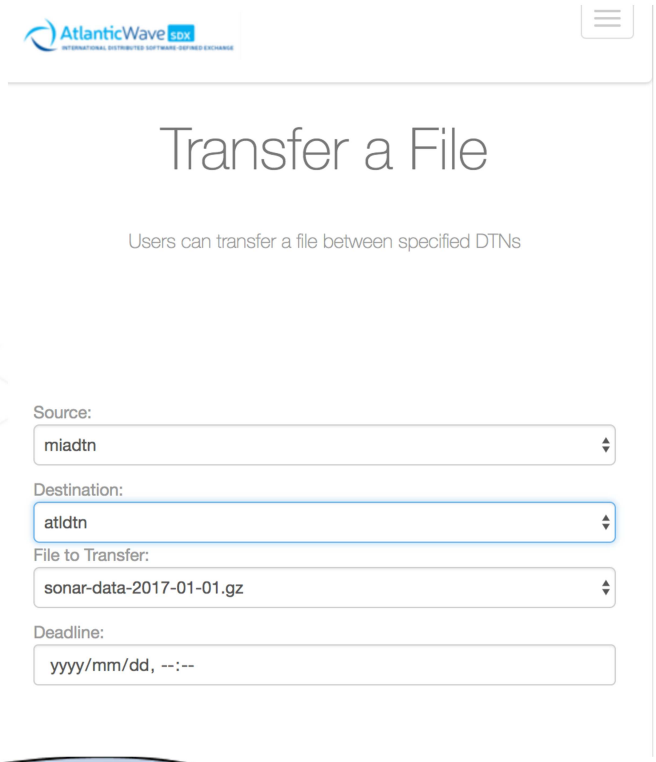
LOCAL CONTROLLER

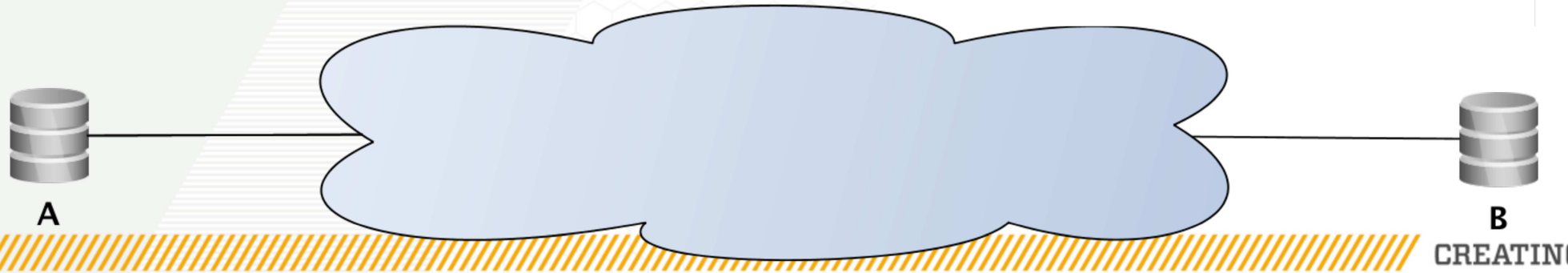
- Mid-level Input
  - E.g., VLAN 635 port 1 to VLAN 879 port 3
- Translates to what switch can handle
  - OpenFlow 1.3 or OF 1.3 + Corsa-specific REST, in our case
  - Could be swapped for some other protocol
    - E.g., Netconf, NSI, P4, Cisco/Juniper/etc. APIs
- Rules
  - match(inport:1, VLAN:635) action(modify(VLAN=879), fwd(3))
  - match(inport:3, VLAN:879) action(modify(VLAN=635), fwd(3))

HOW DOES THIS ALL FIT TOGETHER?

Scientist wants to transfer a file from server A to server B across the network

Uses a file transfer interface





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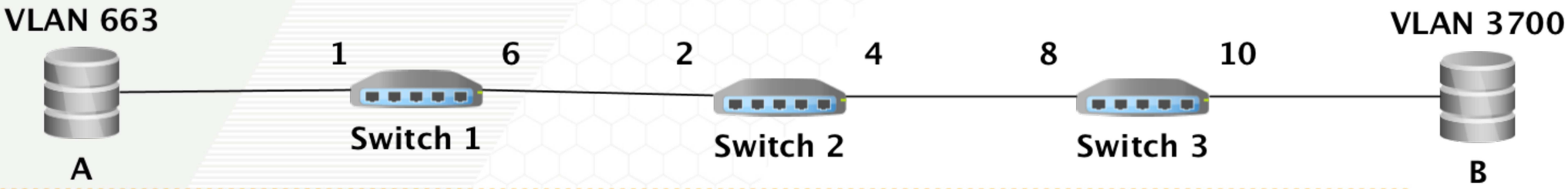
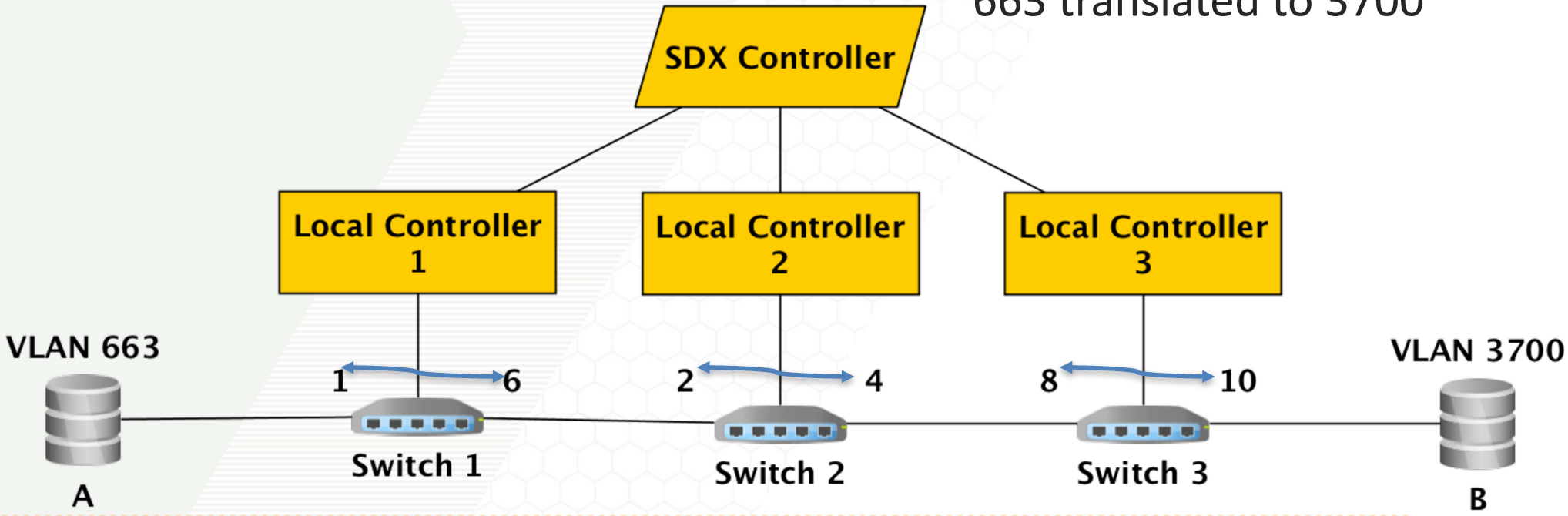


HOW DOES THIS ALL FIT TOGETHER?

SDX Controller translates to per-LC rules

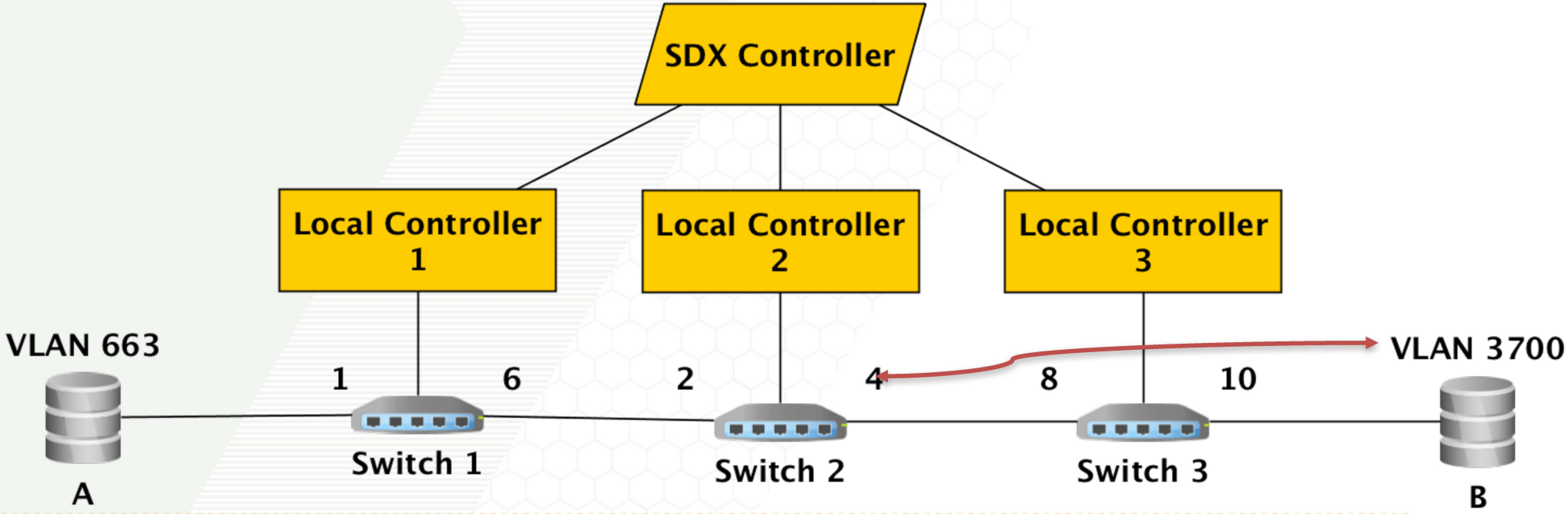
1. Connect ports 1 and 6 on VLAN 663
2. Connect ports 2 and 4 on VLAN 663
3. Connect ports 8 and 10 on VLAN 663 translated to 3700



HOW DOES THIS ALL FIT TOGETHER?

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)



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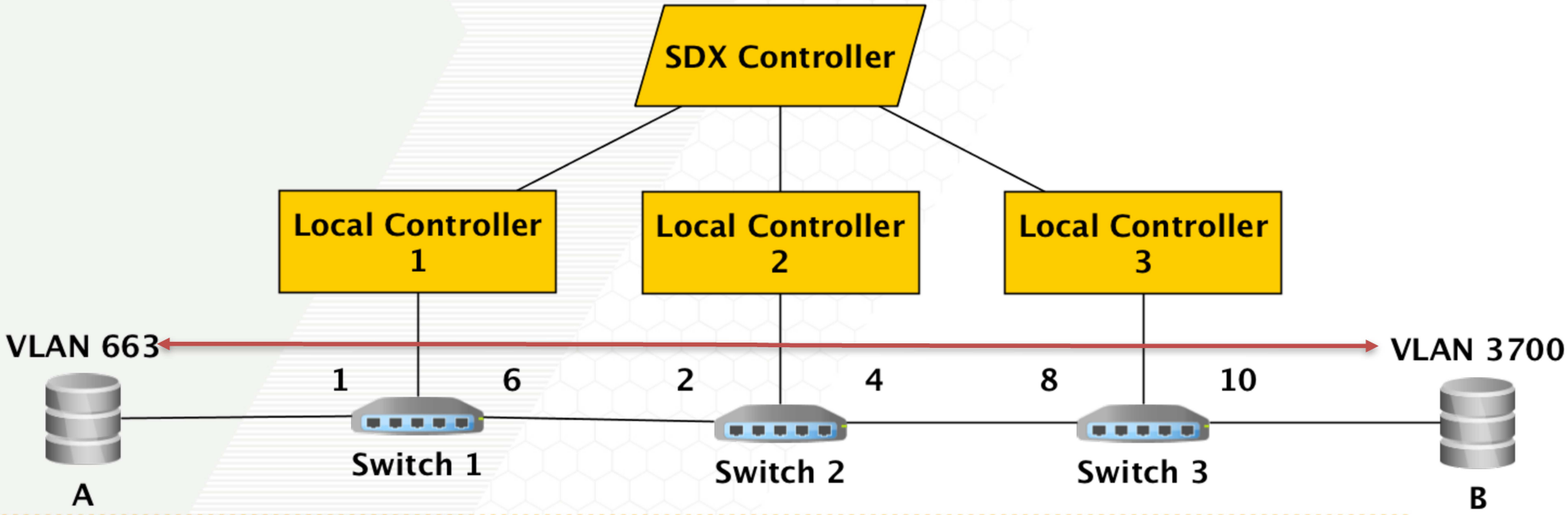


NOT JUST L2 POINT-TO-POINT

- Multipoint VLANs
- Semi-Arbitrary rules
- REST API
  - For programmatic control

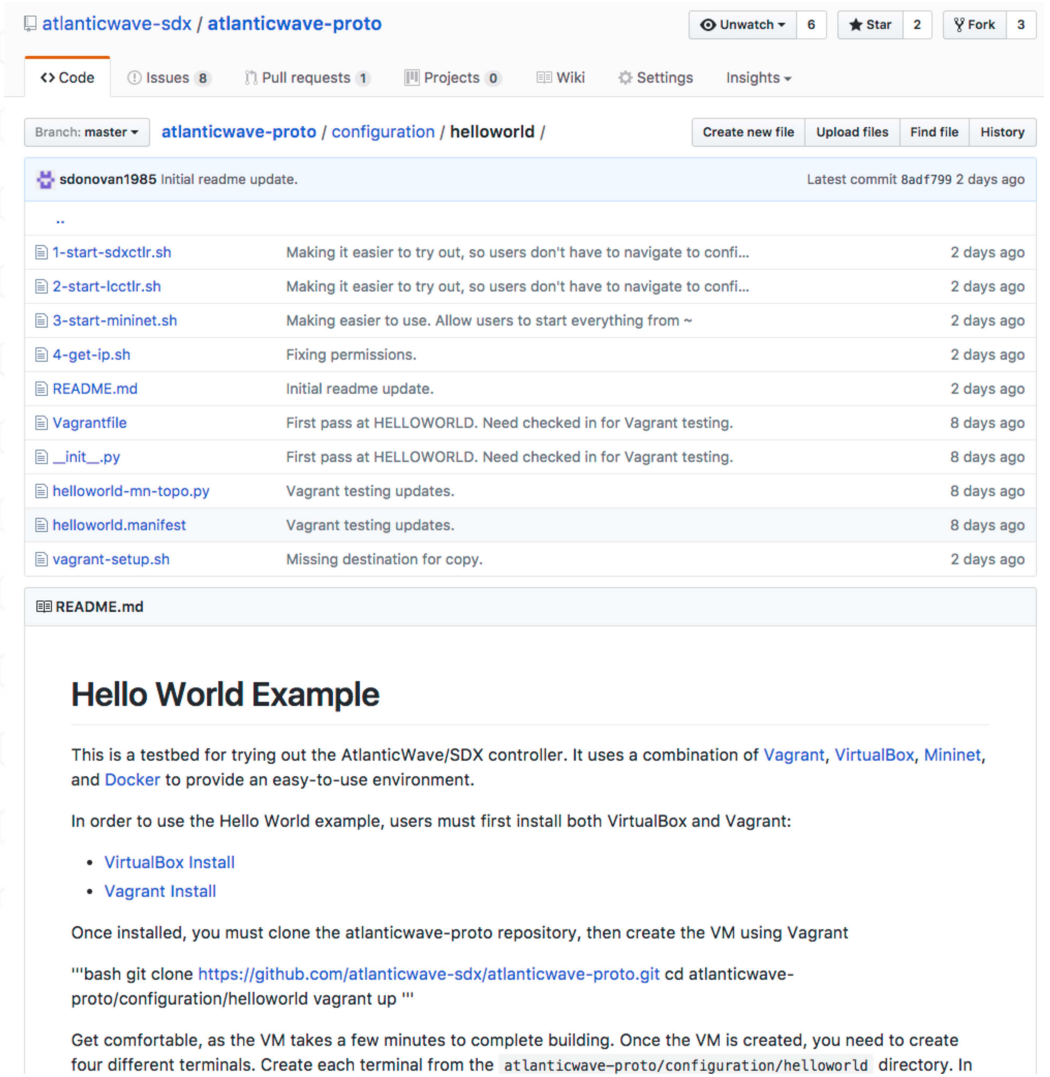
```
{"l2multipoint":{
    "starttime":"1985-04-12T23:20:50",
    "endtime":"1985-04-12T23:20:50+0400",
    "endpoints": [ {"switch":"mia-switch", "port":5, "vlan":286},
                   {"switch":"atl-switch", "port":3, "vlan":1856},
                   {"switch":"gru-switch", "port":4, "vlan":3332} ],
    "bandwidth":1000}}
```

FUTURE WORK

- 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

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QUESTIONS?

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CONTACT

Sean Donovan sdonovan@gatech.edu

Russ Clark russ.clark@gatech.edu

Jeronimo Bezerra jbezerra@fiu.edu

http://www.atlanticwave-sdx.net/
https://github.com/atlanticwave-sdx/

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BACKUP

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JOAQUIN CHUNG'S THESIS WORK