



Responding to the demands of big data scientific instruments through the development of an international software defined exchange point (SDX)

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# The Phenomenon

- New scientific instruments are being developed in the southern hemisphere that will increase the need for large, real-time data transfers among scientists throughout the world:
  - The Large Synoptic Survey Telescope (LSST) being built in Chile
    - Will produce 6.4 GB images that must be transferred to the U.S. in 5 seconds
  - The Square Kilometer Array (SKA) in South Africa
    - Will transmit approximately 160Gbps of data from each radio dish to a central processor

# SKA network requirements

- SKA uses four network types:
  - Science Data
    - Transport of thousands of Gigabits of data per second
    - High-throughput network transport
  - Sync and Timing
    - Requires low latency, high priority, and low bandwidth
    - Low bandwidth requirements
  - Non-science data
    - Carries ‘live’ observation critical data; testing, diagnostic and commissioning data;
    - All other monitor and control information
    - General purpose communications traffic (e.g. IP telephony)
    - High-throughput network transport
  - External Connections
    - Multiple 100G connections
    - High-throughput network transport

# Limitations of traditional networks

- Traditional networks are based on destination MAC or IP addresses
  - Sub-optimal resource utilization
  - Forwarding based on other fields implies complex operation
- Some R&E networks can accommodate big data requirements:
  - Multiple paths with multiple 100G links
  - Dynamic provisioning, Bandwidth reservation, Network programmability, etc.
- But R&E networks are interconnected through Academic Exchange Points:
  - Almost no support for programmability
  - Manual provisioning of circuits and services (QoS profiles, for instance)
  - Data-intensive end-to-end applications may require all networks in the path to support QoS and Programmability
    - Including the Academic Exchange Points
- Software Defined Exchanges offer a potential solution

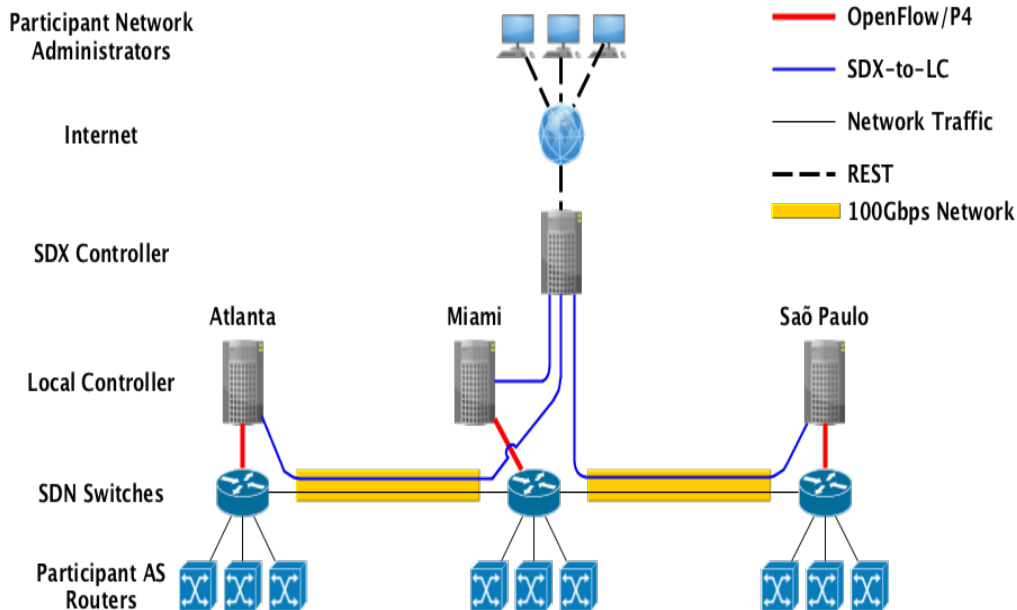
# SDX

- A Software Defined eXchange (SDX) introduces Software Defined Networking (SDN) technologies into Academic Exchange Points to optimize
  - Resource sharing and allocation
  - Inter-domain R&E network programmability
  - End-to-End QoS coordination and enforcement
- Policies based on packet header field:
  - Match TCP or UDP source and destination ports
  - Match source and destination IP address or
  - Match source and destination MAC addresses
- Policies based on external data:
  - Collect information from other systems, such as
    - network monitoring systems, user databases, DNS or NTP server
  - Match parameters, such as network latency, bandwidth, user name, domain name, date and time

# SDX Applications

- To augment BGP policies in an Academic Exchange Point:
  - Application-specific peering
  - Inbound traffic engineering
  - Wide-area load balancing
  - Redirection through middle boxes
- Data Domain:
  - Data-on-demand
  - Data preprocessing
  - High-quality media transmission over long-distance networks.

# AtlanticWave-SDX Project



- NSF project to build a distributed international SDX controller
- Led by FIU and Georgia Tech universities
- Collaborating partners ANSP and RNP in Brazil
- Initially, three SDX sites (São Paulo, Miami, and Atlanta)
  - Fortaleza a potential future site
- Thousands of KM of fiber between each location
- Split controller design
  - Central controller for interacting with users
  - Local controllers at each location

# APIs for Different Audiences

- Administrators

```
{"l2tunnel":  
  {  
    "starttime": "2016-10-12T23:20:50",  
    "endtime": "2016-10-13T23:20:50",  
    "srcswitch": "atl-switch",  
    "dstswitch": "mia-switch",  
    "srcport": 5,  
    "dstport": 7,  
    "srcvlan": 1492,  
    "dstvlan": 1789,  
    "bandwidth": 1  
  }  
}
```

- Domain scientists

```
{"dtntunnel":  
  {  
    "quantity": "7TB",  
    "deadline": "2016-10-30T23:59:59",  
    "srcdtn": "gt-dtn",  
    "dstdtn": "fiu-dtn"  
  }  
}
```



# Web Interface



Topology

Requests

About Us

sdonovan

## Request a Pipe

Users can request for a pipe based on their requirements and role

[Network Engineers](#) [Scientists](#)

Enter the start date:

Enter the start time:

Enter the end date:

Enter the end time:

Preview

Submit

Enter the desired bandwidth:

Enter the physical port number at source:

Enter the physical port number at destination:

Enter the source VLAN:

Enter the destination VLAN:

Select source:

Select destination:

## Meet the Team

# Conclusion

- SDX could be used to address users' requirements for compute, storage and networking resource sharing
- SDX goal is to provide inter-domain SDN capabilities in Academic Exchange Points
- SDX has the potential to provide end-to-end inter-domain programmability and QoS
- With SDX, SKA and LSST can achieve their goals of
  - high bandwidth availability
  - low latency and high priority over existing R&E interconnected networks