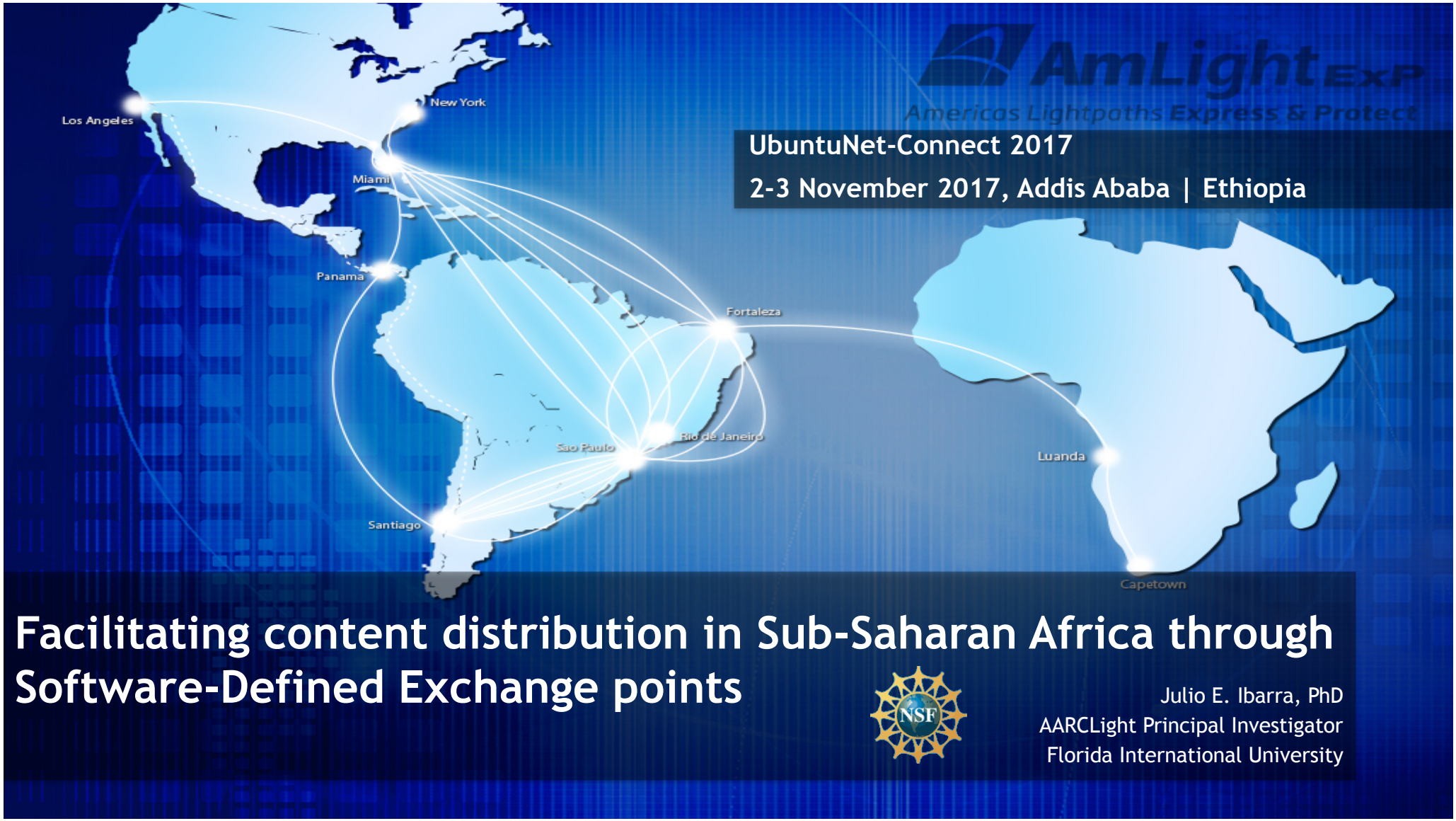


UbuntuNet-Connect 2017

2-3 November 2017, Addis Ababa | Ethiopia

Facilitating content distribution in Sub-Saharan Africa through Software-Defined Exchange points

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Phenomenon in Africa

- Africa is the fastest growing region of the world for international Internet bandwidth
  - Approximately 40-45% growth
  - Approximately 6 Tbps
    - SSA international Internet bandwidth growth approximately 3.2Tbps
  - In comparision, Europe and the U.S. are at 25% growth
- International content provider capacity remains high
  - Europe hosts 81% of international content
  - Latency is a significant issue (100-200ms latency)

Source: Telegeography Spotlight: Data Centers are Coming to Africa

Demand for Content Distribution

- Demand for content distribution within Sub-Saharan Africa is growing
- Intra-African content provider traffic is increasing
  - In 2017, intra-African traffic is 17%, compared to 9% in 2012
    - Content providers (Akamai, Google) have deployed caches
  - Google achieved 80% local traffic exchange in SSA (AfPIF 2017)
  - Microsoft is bringing two new data centers to South Africa. Amazon, Facebook, IBM, and others likely to follow
  - Growth in data center and cloud services is expected to increase traffic exchange within SSA (AfPIF 2017)
- Submarine cable deployments have led to growth in local content distribution
  - International transit in 2017 dropped to 30% from 40%
  - SACS cable: RFS Q3 2018
  - More content from Brazil, USA and the Americas

Role of Internet Exchange Points and Content Distribution

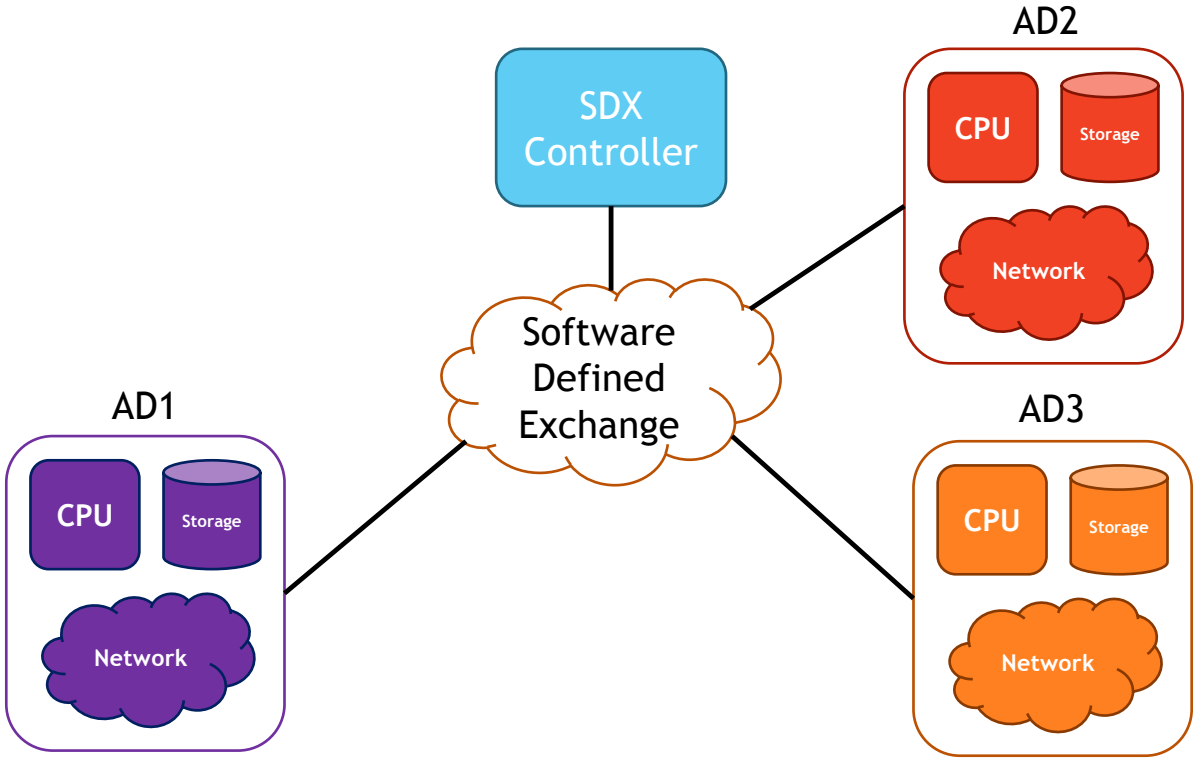
- Internet Exchange Points (IXPs) play a central role by interconnecting many networks
- IXPs facilitate peering and the sharing of content between networks
  - IXPs attract Content Distribution Networks (CDNs), such as Netflix, to increase cache hits
- Likewise, local content at an IXP attracts local networks to peer
  - Content provider caches (Google, Akamai, etc) attract more peers to an IXP

Software-Defined Exchange and Content Distribution

- A Software-Defined Exchange (SDX) facilitates content distribution
  - **Application-specific peering**: Enables two network domains exchange traffic only for certain applications
  - **Inbound traffic engineering**: Using BGP, content providers have little control over how traffic enters their networks
    - Using SDN-enabled switching at an IXP, a content provider has more flexibility to control inbound traffic
  - **Wide-area server load balancing**: Using DNS for server selection, content providers manage complex issues involving DNS cache misses, resulting in latency issues
    - Instead, an SDX can match the chosen hosting location based on any fields in the packet header
  - **Network Programmability**: Provides content distribution networks the capability to
    - Initialize, control, change, and manage network functions dynamically via programmable interfaces

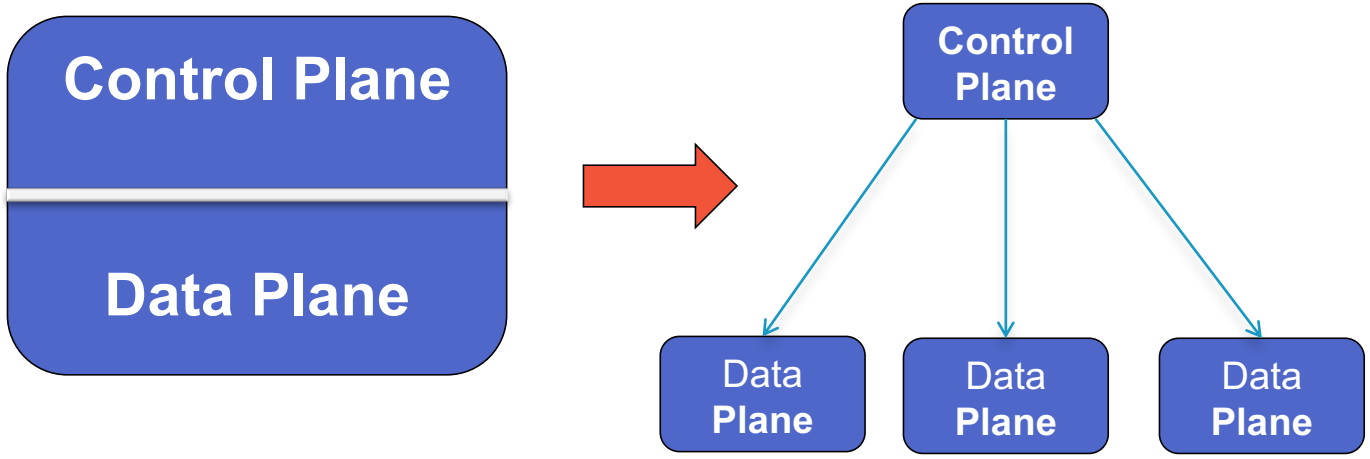
Software-Defined Exchange (SDX) definition

- A SDX is a novel cyberinfrastructure that
  - Facilitates multiple independent Administrative Domains (ADs) to share computing, storage, and networking resources in a programmable way



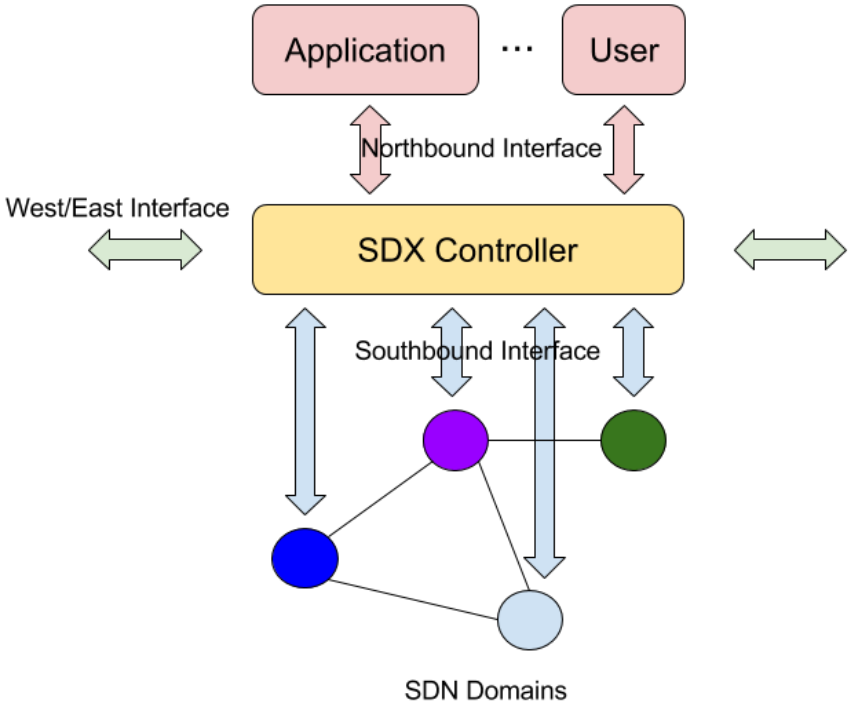
Software-Defined Networking (SDN) – What is it?

- Software Defined Networking (SDN) decouples the control plane from the data plane
- Control Plane decides how to handle the traffic
- Data Plane forwards traffic according to decisions that the control plane makes
- Via an API, an SDN control plane exercises control over the network's data-plane elements (switches, routers, etc.)



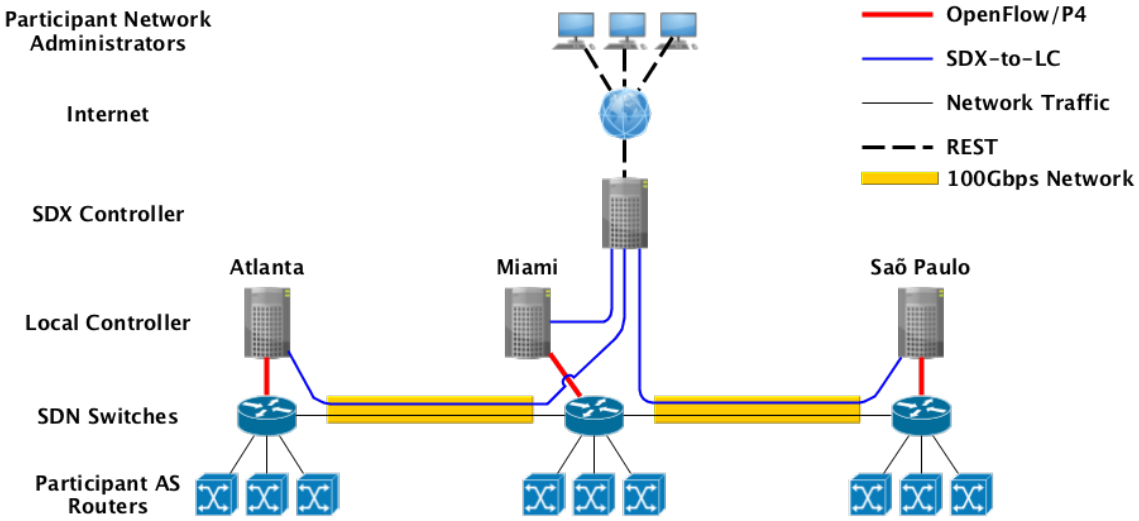
SDX Architecture Interconnecting Independent SDN Domains

- SDX controller interfaces:
  - Applications to SDX controller (e.g., science workflow manager or resource scheduler) → Northbound
  - Controller to SDN participant domains (match SDN northbound interface) → Southbound
  - Between SDX controllers → West/East
- SDX controller functions:
  - Resource management
  - Path computation
  - Resource provisioning



SDX Use Case: Experimenter Accessing Distributed Content

- Content is hosted in several locations
- Using an SDX provided user interface, an experimenter requests desired content
- The SDX will locate the closest content
- Next, the SDX provisions a network path between the content and the experimenter
  - If the path to the closest content is congested, the SDX can negotiate a new path to a more distant repository, but with less congestion
- Upon conclusion of the experiment, the network path is deallocated, and network resources are restored



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THANK YOU!

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AMERICA'S LIGHTPATHS AMLIGHT RESEARCH · EDUCATION COLLABORATION
AMPATH PATHWAY OF THE AMERICAS
AmLight ExP International Distributed Exchange Point
AtlanticWave SDX INTERNATIONAL DISTRIBUTED SOFTWARE-DEFINED EXCHANGE
AARC Light Americas Africa Research & eduCation Lightpaths