THOUGHTS ON SDN IN DATA INTENSIVE SCIENCE APPLICATIONS

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HEP context - for this talk

- LHC experiments now moving 100+ PB per year
- Main driver of R&E network bandwidth utilization over the past decade
- LHC restart in Spring 2015, expect traffic to grow

ATLAS data transfer rates, monthly average

LHCONE VRF

Throughput (MB/s)

Transfer Throughput
2009-01-01 00:00:00 to 2014-02-08 00:00 UTC

Destinations

- CA
- CERN
- DE
- ES
- FR
- IT
- NL
- RU
- TW
- UK
- US
New data movement and access patterns

- Change in Computing Models towards
  - more flexibility (source/destination pairings)
  - more dynamic (popularity based caching)
  - remote access

- Different flow characteristics and patterns
  - Data production
  - Data processing; cached vs remote access

- One constant: **Will remain massively distributed, WAN performance will be key to success!**
Leveraging provider diversity in LHCONE:
- many NRENs, providing multiple paths with multiple

Standard network forwards all packets for a given subnet on the same path
- Multipath configurations not trivial
- Especially when coupled with multiple administrative domains

SDN approach allows to build a flexible yet robust and deterministic forwarding scheme

Similarities with SDX (general) concept
• Provision capacity between OpenFlow switches based on real-time requirements

• Approach in the OLiMPS project: flow management in OpenFlow controller triggers circuit requests to OSCARS controller

• I.e. create a topology optimizing the load distribution in the network

• Future: couple with data transfer application
Another SDN Value Proposition

• Fact: Not all flows/users/application_requirements are the same

• A (the?) key value proposition of SDN in R&D networks:
  – it allows to provide not only differentiated, but tailored services; customized to the particular need of a research community
  – Can be done with minimal amount of effort
    • (once the system is built)

• HEP: Example of a vision could be to differentiate between data production and transfer flows (“elephants”) and analysis data flows in remote access scenarios (“mice”), e.g.
  – “old model”: not the same sites (Tier1/2/3 definition!)
  – “new model”: roles defined on temporal varying requirements
  – not the same capacity and access latency requirements
  – not the same resiliency requirements
How can HEP profit from SDN?

- At the computing sites: Network Virtualization
  - Scalability, flexibility, robustness, security (think ScienceDMZ here)
- In the WAN
  - flexible services
- But also through
  A programmatic interface (TBD) between application and the network
  - Tight integration; direct feedback loop -> reactive system
  - Increased predictability; reduced distribution tails
  - Dynamic workflow optimization
  - Increased efficiency
SDN and Bandwidth on Demand

- BoD aka Dynamic Circuit Networks, aka Lightpaths, aka…

- Is a **form of** Software Defined Networking
  - Circuits are configured by a controller
  - Typically implemented as a (central) Domain Controller

- A proof-of-concept “experiment” is being built by LHCONE
  - in collaboration with GLIF AutoGOLE efforts
  - Interconnect a small number of sites initially
  - Interface into CMS and ATLAS data movement and workflow management

- But really, it will be a first step towards a tight integration between network and applications through broader SDN concepts
Conclusions

• For data intensive science applications, SDN has the potential to enable
  – Better application performance
  – More determinism in workflows
  – Resource optimization

• In order to harness the full potential of SDN, we need
  – a good application-network interface
  – multi-domain capability
  – support in the R&E networks end-to-end
  – coordinated effort between the service providers and the scientists developing their applications
THANK YOU!

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