SDN-NGenIA: A Software Defined Next Generation Integrated Architecture for HEP and Data Intensive Science

Entering a New Era of Challenges as we Move to Exascale Data and Computing

- The largest science datasets today, from the LHC program are 300 petabytes
- Exabyte data sets are on the horizon, by the end of Run2 in 2018
- These datasets will grow by 100X, to the ~50-100 Exabyte range, during the HL LHC era from 2025
- The reliance on high performance networks will continue to grow as many Exabytes of data are distributed, processed and analyzed at hundreds of sites around the world
- As the needs of other fields continue to grow, HEP will face increasingly stiff competition for the use of large but limited network resources.

Vision: Next Gen Integrated Systems for Exascale Science: Synergy → a Major Opportunity

Exploit the Synergy among:
1. Global operations and workflow management systems developed by HEP programs, being geared to work with increasingly diverse and elastic resources to respond to peak demands
   - Enabled by distributed operations and security infrastructures
   - Riding on high capacity (but mostly still-passive) networks
2. Deeply programmable, agile software-defined networks (SDN)
3. Machine Learning, modeling and simulation, and game theory methods
   - Extract key variables; optimize; move to real-time self-optimizing workflows

- The Watershed: A new ecosystem with ECFs as focal points in the global workflow; meeting otherwise daunting CPU needs.

SDN in SDN-NGenIA and SENSE
Building on Caltech/ESNet/FNAL Experience

Vision: Distributed environments where resources can be deployed flexibly to meet the demands
SDN is a natural path to this vision: separating the functions that control the flow of network traffic, from the switching infrastructure that forwards the traffic itself through open deeply programmable controllers.

With many benefits:
- Replacing stovepiped vendor HW/SW solutions by open platform-independent software services
- Virtualizing services and networks lowering cost and energy, with greater simplicity
- Enabling new methods and architectures
- A major direction of Research networks + Industry
- Still emerging and maturing

OVS: Managing Site Interactions Locally, with Regional and Wide Area Networks

- Provides SDN-orchestrated configuration for data flows all the way to the end-host, which can be orchestrated from the local/campus SDN controller or brought down from the Regional/WAN controller
- Provides QoS and traffic shaping right at the end-point of a data transfer
  - QoS via OVS is protocol agnostic: one can use TCP (GridFTP, FDT) or UDP
  - Helps to achieve better throughput by moderating and stabilizing data flows; e.g. in cases where the upstream switches have limited buffer memory
  - Under the hood, OVS uses the TC (Traffic Control) part of iproute2 to configure and control the Linux kernel network scheduler
- Monitoring is done with standard sFlow and/or NetFlow protocols
  - www.openswitch.org

OVS is included in the standard Linux releases

Consistent Network Operations in ODL

Y. Richard Yang

Site-resident: Site Agent, Site OpenDaylight Controllers
Network-resident: Abstraction (ALTO RSA) and Control (ALTO SPECE)
SciTools: Orchestrator/Scheduling systems

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