How to Bring Calm to an Otherwise Too Exciting Networking World

Google™

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Networks Today Are Very Exciting

Networking State of the Art

- I am on the edge of my seat when:
  - A link fails
  - I perform a switch software upgrade
  - Multiple applications try to share the same network
  - I add a new customer to an existing network
  - I try to expand my network fabric
  - I set security/isolation policy
  - I migrate a virtual machine
  - I need performance isolation
  - I define a new traffic engineering policy
  - I introduce a product from a new vendor

Networking Reality for the Masses

- I am on the edge of my seat when:
  - A link fails
  - I perform a switch software upgrade
- I pray to my favorite deity when:
  - Multiple applications try to share the same network
  - I add a new customer to an existing network
- I don't even bother trying to:
  - Expand my network fabric
  - Set a security/isolation policy
  - Migrate a virtual machine
  - Enforce performance isolation
  - Use traffic engineering
  - Introduce a product from a new vendor

What We're Left With

- Overriding philosophy: if we don't touch the network, maybe it won't break

- Fundamental *under-investment* in network
  - Unbalanced systems*
  - Millions of $$ of compute and storage systematically under-utilized because network can't keep them fed

- A network that gets in my way rather than enables computation and data storage

* See "TritonSort: A Balanced Large-Scale Sorting System", Alexander Rasmussen, George Porter, Michael Conley, Harsha V. Madhyastha, Radhika Niranjan Mysore, Alexander Pucher, and Amin Vahdat, Proceedings of the 8th ACM/USENIX Symposium on Networked Systems Design and Implementation, March 2011.

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Companies would pay a lot of money for a network that adds to their ROI on their compute/storage infrastructure

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What We Should be Working Toward in Networking

How to Get There From Here

- The driving philosophy behind networking has been:
  - Approximate the global optimum based on local view of events
  - Network fabrics are just a collection of individual boxes, each acting autonomously
- Full decentralization is beautiful and pure but also impossible to get right

How to Get There From Here

● Leverage all of the progress made over the past 30 years in other disciplines of computer systems
  ○ Distributed systems for fault tolerance, scale, and logically centralized control for global optimum*
  ○ High-level Programming Languages to specify network-wide intent
  ○ Correctness proofs to enforce invariants
  ○ Extensible databases to maintain network schema
  ○ Staged, coordinated fabric-wide upgrades for hitless reconfiguration

* One starting point: Sanjay Ghemawat, Howard Gobioff, Shun-Tak Leung, "The Google File System." Proceedings of ACM SOSP, October 2003

How to Get There From Here
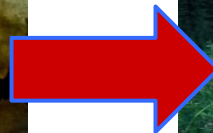
OpenFlow and Software Defined Networking

Word of caution: techtonic re-imaginings will mean a few steps back before moving forward