SDN is dead. Long live SDX!

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Some signs

• Google trend for SDN shows decreasing interest in search
• ONS no longer pulls 1500+ people
• "You've probably realized that SDN became as meaningless as Cloud in the recent years, and all we're left with is a plethora of vendors engaged in SDN-washing their products” – Ivan Pepelnjak of ipSpace.net
• Bruce Davie (Nicira/VMware) gave a talk in ’14 that OpenFlow is dead
I personally knew it when I got this email.

Balachander Krishnamurthy  10 June, 2015 at 5:03 PM
To: Marco Canini  Cc: Balachander Krishnamurthy
Resent-From: Marco Canini

can u please send me pointers to 4 best papers to read on any aspect of measurement and SDNs/virtual infrastructure?

thanks
bala
FINAL MISSION COMPLETE!
KEEP CALM AND CARRY RESEARCH
What’s an SDX?

• Refer to Nick’s previous keynote 😊
Conventional IXPs

- AS A Router
- AS B Router
- AS C Router
- Route Server
- BGP Session
- Switching Fabric

IXP
SDX = SDN + IXP
Several projects in the area

• Google's Cardigan project in New Zealand

• SDX at Princeton
  • [http://sdx.cs.princeton.edu](http://sdx.cs.princeton.edu)

• ENDEAVOUR project in the EU, in collaboration with DE-CIX
  • [https://www.h2020-endeavour.eu](https://www.h2020-endeavour.eu)
iSDX [NSDI’16]

A’s Router

- Input Table
  - match srcmac, VMAC
  - match dstmac
- Inbound Table
  - match dstmac
- Output Table
  - match dstmac
  - write dstmac, output packet

IXP Fabric

- Steering Rules
- Forwarding Rules

Fabric Manager

A’s Controller

- A’s Outbound Rules

IXP Controller

C’s Controller

- C’s Inbound Rules

A’s Outbound Rules

C’s Inbound Rules

C1’s Router

C2’s Router
Work done so far is "plumbing"

• More deployments and testbeds

• Effectively communicate research advances with network operators
  • Do we sell them what they want?

• Stay conscious of the incentives and business aspects at play
• We found evidence of inbound TE being performed at a large IXP in EU
• SDX can make is easier to perform inbound TE; do ISPs care though?
A Fail Example

• "My inbound TE problem is Google's outbound TE problem; I don't need to solve it if Google already has got some clever algorithm to load balance traffic they send me”

• What about retaining control over your own network?

• Can you really trust Google to do the right thing for other networks?
Takeaways

• We need to see more deployments and testbeds in this area

• SDXes are inherently inter-domain
  → pose more challenges than SDI destined for a single organization
Interlude

OH INTERNET

YOU UNDERSTAND ME
What is next?

Vision of this workshop:

• “Concept of SDXes will enable large-scale interconnection of SDIs, owned and operated by many different organizations, to provide logically isolated "on demand" global scale infrastructure on an end-to-end basis, with enhanced flexibility and security for new applications.”

• How do we get there?
Challenges and problems are future SDXes

• Security
• User privacy
• Business confidentiality
• Reliability & robustness
• QoE
• Marketplace
• Platform
Marketplace

- Setting up peering on-demand
- Optimizing routing and providing end-to-end guarantees
- 3rd party providers of virtualized network functions
Platform

• How should we design SDXes if we think about their global impact?
  • Smart grid, transportation, cities
  • Secure Internet elections
  • Greener environment
  • Universal Internet access

• SDXes for resource fluidity
• Crowd-sourced SDXes
• SDX vaults
Conclusion

• SDXes are happening and there are many research opportunities
• Fundamental research
  • Formal foundations for reasoning about SDXes
  • Hard statements regarding their properties
• Applied, interdisciplinary work
  • System prototyping, deployment, testbed operation
  • Use cases and long term vision about the potential impact of SDXes