SDN is dead. Long live SDX!

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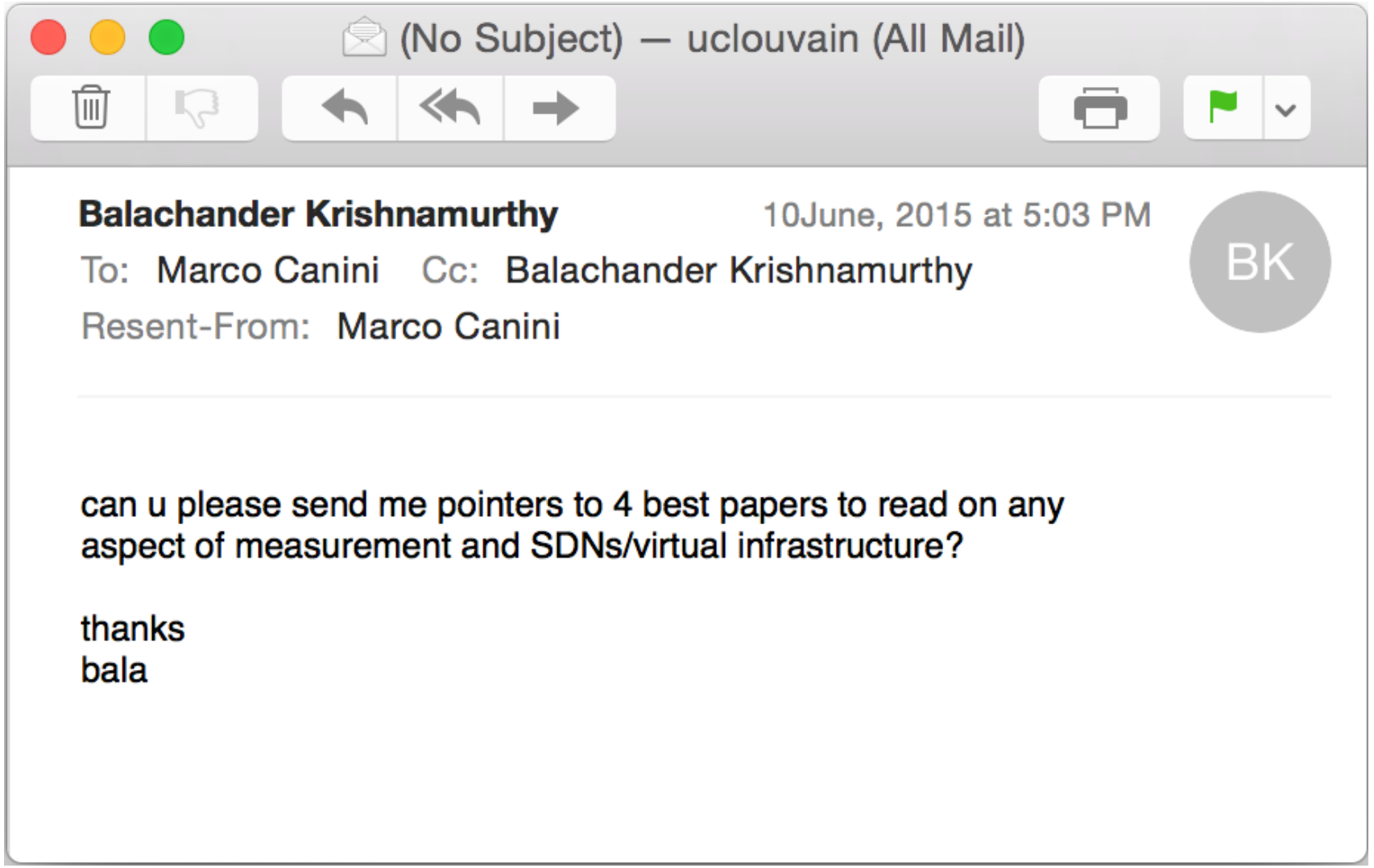
Some signs

- 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



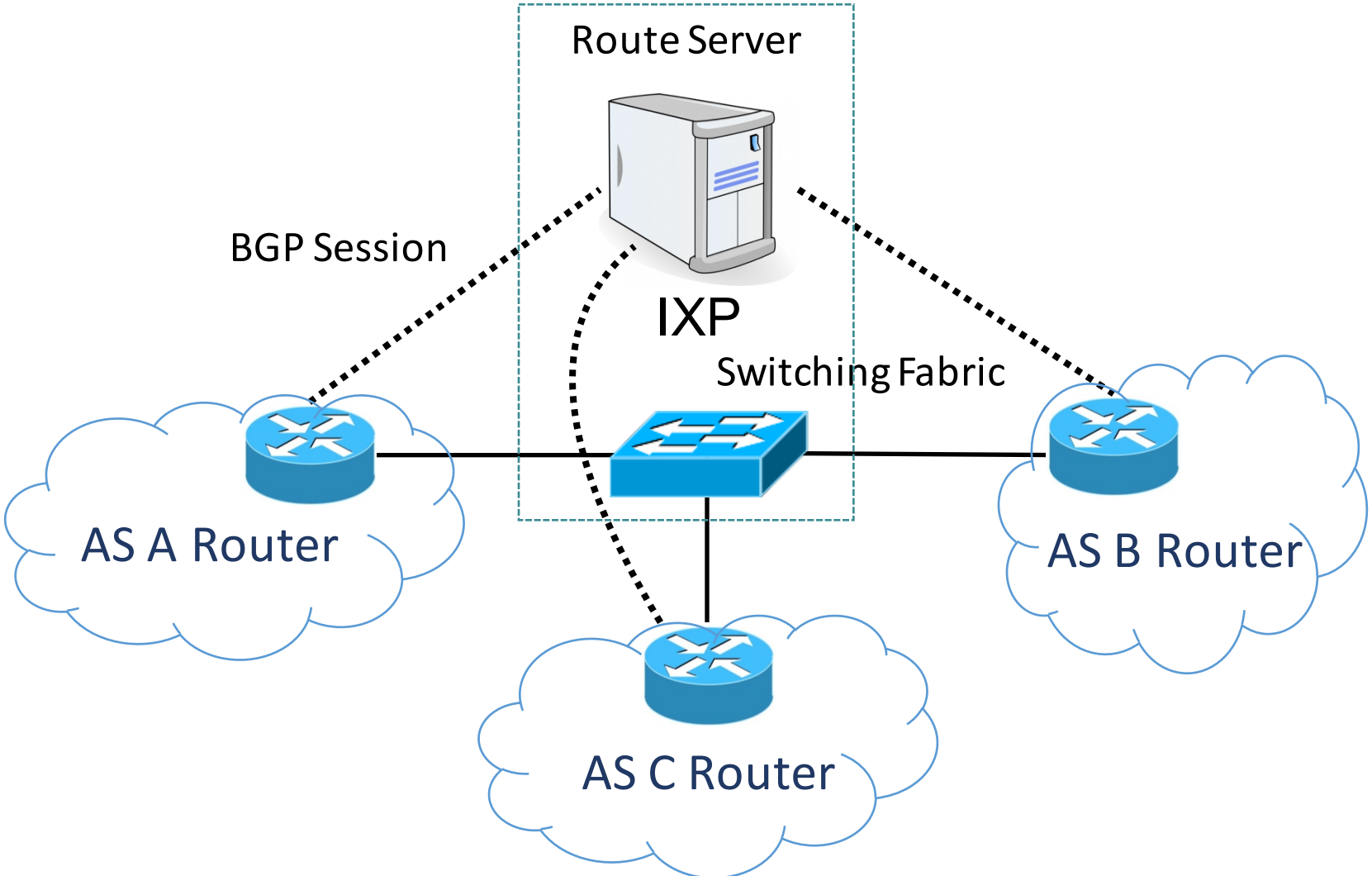

3163240
ARMS BOMB
200 24
PLEASE WAIT
1UP=4
FINAL
MISSION
COMPLETE!


KEEP
CALM
AND
CARRY
RESEARCH

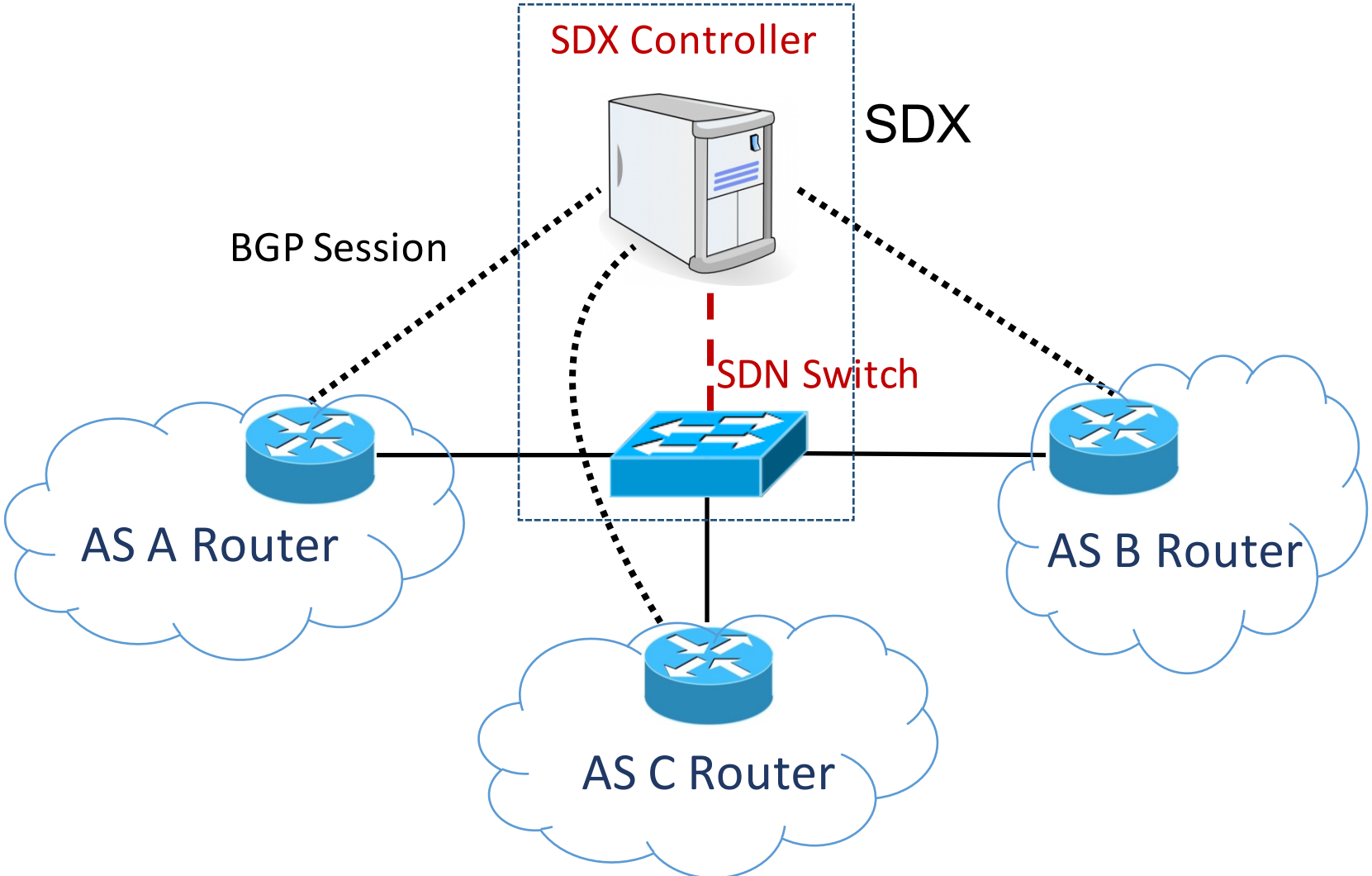
What’s an SDX?

- Refer to Nick’s previous keynote ☺

Conventional IXPs



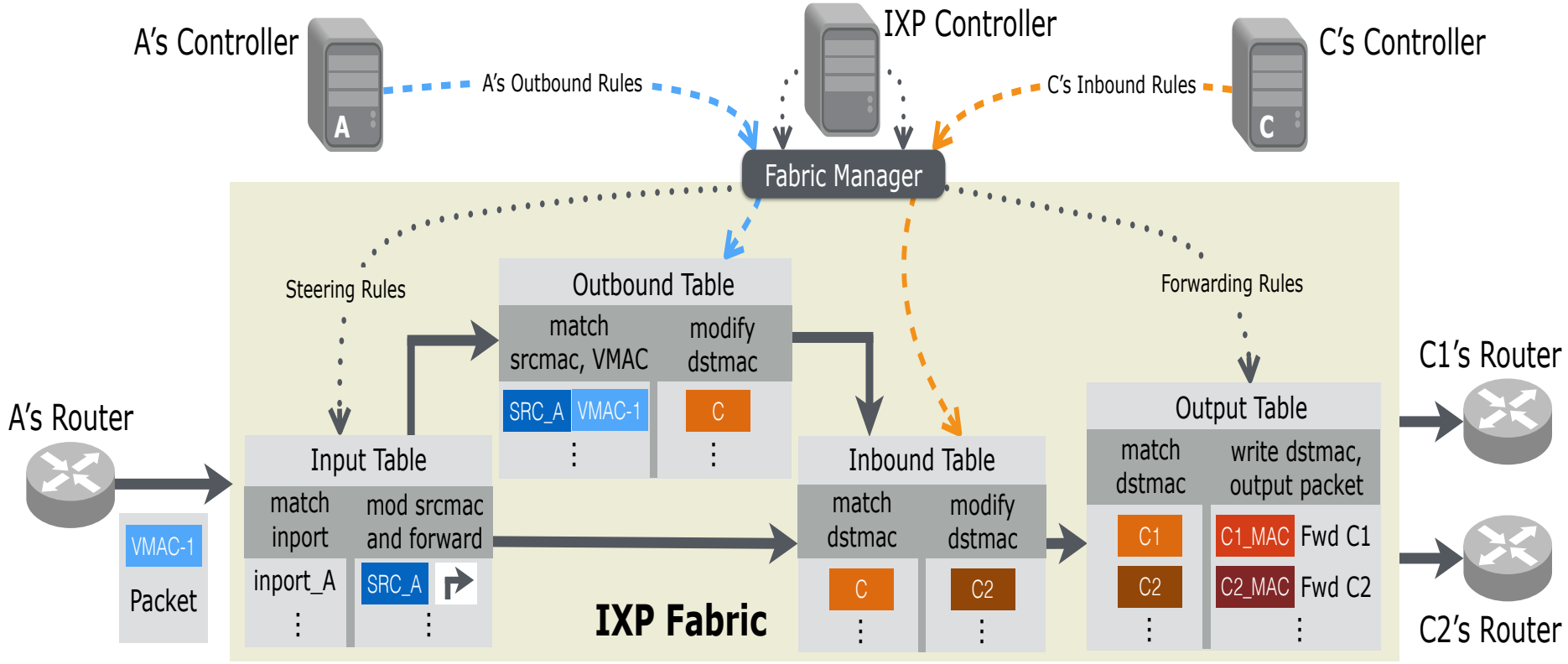
SDX = SDN + IXP


SDX Controller
SDX
BGP Session
SDN Switch
AS A Router
AS B Router
AS C Router

Several projects in the area

- Google's Cardigan project in New Zealand
- SDX at Princeton
  - http://sdx.cs.princeton.edu
- ENDEAVOUR project in the EU, in collaboration with DE-CIX
  - https://www.h2020-endeavour.eu

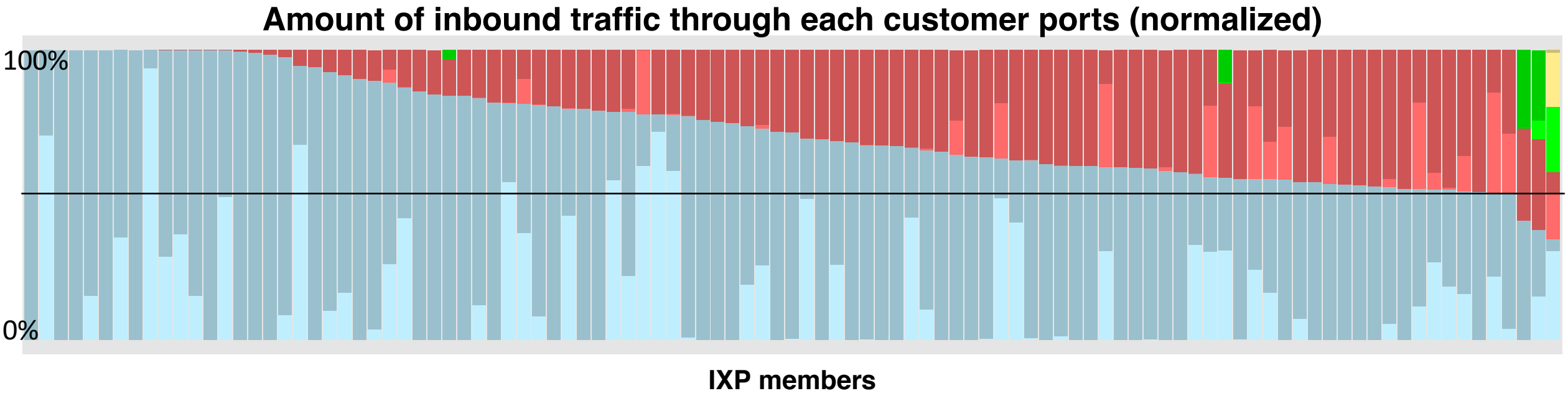
iSDX [NSDI'16]


A's Controller
A
A's Outbound Rules
IXP Controller
C's Inbound Rules
C's Controller
C
Fabric Manager
Steering Rules
Outbound Table
match
srcmac, VMAC
modify
dstmac
SRC_A
VMAC-1
C
Forwarding Rules
A's Router
Input Table
match
inport
mod srcmac
and forward
inport_A
SRC_A
VMAC-1
Packet
IXP Fabric
Inbound Table
match
dstmac
modify
dstmac
C
C2
Output Table
match
dstmac
write dstmac,
output packet
C1
C1_MAC
Fwd C1
C2
C2_MAC
Fwd C2
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

A Win Example



- 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?

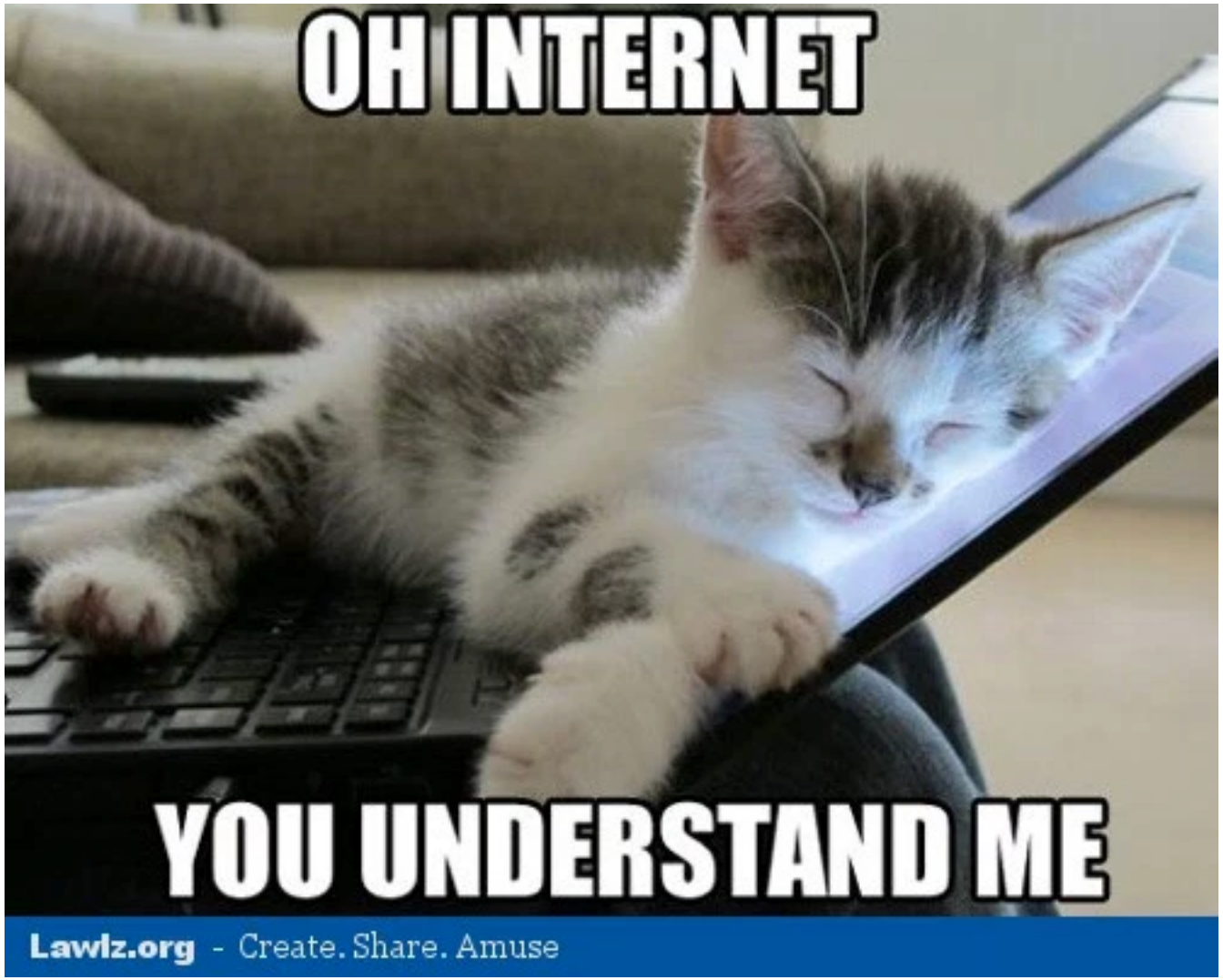
- Can you really trust Google to do the right thing for other networks?

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



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