The Many Faces of SDN: An Industry Perspective

Kenneth Duda
CTO / SVP Software
Arista Networks, Inc.

Face 1: SDN is for Experimentation

Today, there is almost no practical way to experiment with new network protocols (e.g., new routing protocols, or alternatives to IP) in sufficiently realistic settings (e.g., at scale carrying real traffic) to gain the confidence needed for their widespread deployment. The result is that most new ideas from the networking research community go untried and untested; hence the commonly held belief that the network infrastructure has "ossified".

McKoewn et al, *OpenFlow: Enabling Innovation in Campus Networks,* ACM SIGCOMM Computer Communication Review, Volume 38 Issue 2, April 2008

Face 1: SDN is for Experimentation

Yes, good scaffolding can be a big help!

Face 1: SDN is for Experimentation

Frustrated by this inability to fiddle with Internet routing in the real world, Stanford computer scientist Nick McKeown and colleagues developed a standard called OpenFlow that essentially opens up the Internet to researchers, allowing them to define data flows using software--a sort of "software-defined networking." ... This software-based access allows computer scientists to inexpensively and easily test new switching and routing protocols.

Kate Greene. *TR10: Software-defined Networking,*
MIT Technology Review, March 2009

Face 1: SDN is for Experimentation

Frustrated by this inability to fiddle with Internet routing in the real world, Stanford computer scientist Nick McKeown and colleagues developed a standard called OpenFlow that essentially opens up the Internet to researchers, allowing them to define data flows using software--a sort of "software-defined networking." ... This software-based access allows computer scientists to inexpensively and easily test new switching and routing protocols.

Kate Greene. *TR10: Software-defined Networking,*
MIT Technology Review, March 2009

Three years pass...

Face 2: Control Plane Extraction

[SDN is] the physical separation of the network control plane from the forwarding plane, where a control plane controls several devices.

ONF website, retrieved 2014-07-01

Face 2: Control Plane Extraction

Software-defined networking (SDN) is a modern approach to networking that eliminates the complex and static nature of legacy distributed network architectures through the use of a standards-based software abstraction between the network control plane and underlying data forwarding plane...

Big Switch Networks website, retrieved 2014-07-01

Face 2: Control Plane Extraction

Vendors offer varying degrees of user programmability on their routers and switches. This can lead to limited functionality for traffic engineering and management, or inconsistent traffic management between equipment from multiple vendors. OpenFlow is designed to provide consistency in traffic management and engineering by making this control function independent of the hardware it's intended to control.

Jim Duffy. *What is OpenFlow and Why is it needed?*, Network World, 2011

Three more years pass...

Challenges

- [OpenFlow] does not fulfill the promise of simplified hardware.
- [OpenFlow] does not provide sufficient flexibility.
- [OpenFlow] unnecessarily couples the host requirements to the network core behavior.

Casado et al, *Fabric: A Retrospective on Evolving SDN*, HotSDN 2012

Challenges

- Flow scalability: millions of flows in real networks
- Fast reconvergence after node or device failure is required
- Controller architecture issues:
  - how to coordinate controllers?
  - how to assign switches to controllers?
  - how do you interconnect the controllers?
  - who controls the controller interconnect?
- Possible to solve all of the above while "eliminating the complex and static nature of legacy distributed network architectures" ?

Yet SDN Motors Along

- Forecasts:
  - IDC (early 2012 forecast): $2B Market in 2016
  - IDC (late 2012 forecast): $3.7B Market in 2016
  - SDNCentral (April 2013): $3.5B in 2015, $35B in 2018
  - MarketsAndMarkets (April 2014): $3.67B in 2019

- In Jim Duffy's *SDN in 2014: More of Everything:*
  - Control-plane data-plane separation *not mentioned;*
  - OpenFlow gets one brief nod!

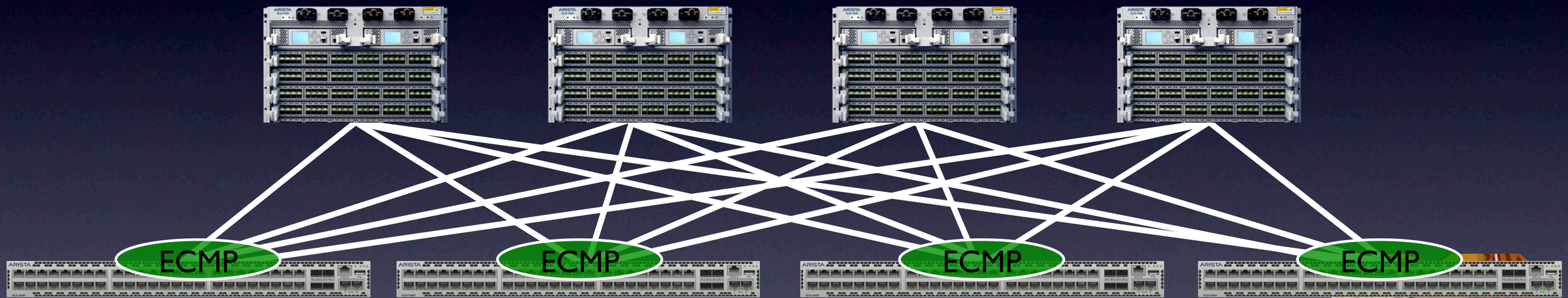
Faces 3..n: All Sorts of Stuff

- Fabrics
- Overlay Networks
- Device Programmability
- Management Automation
- Cloud Orchestration

Face 3: Data Center Fabrics

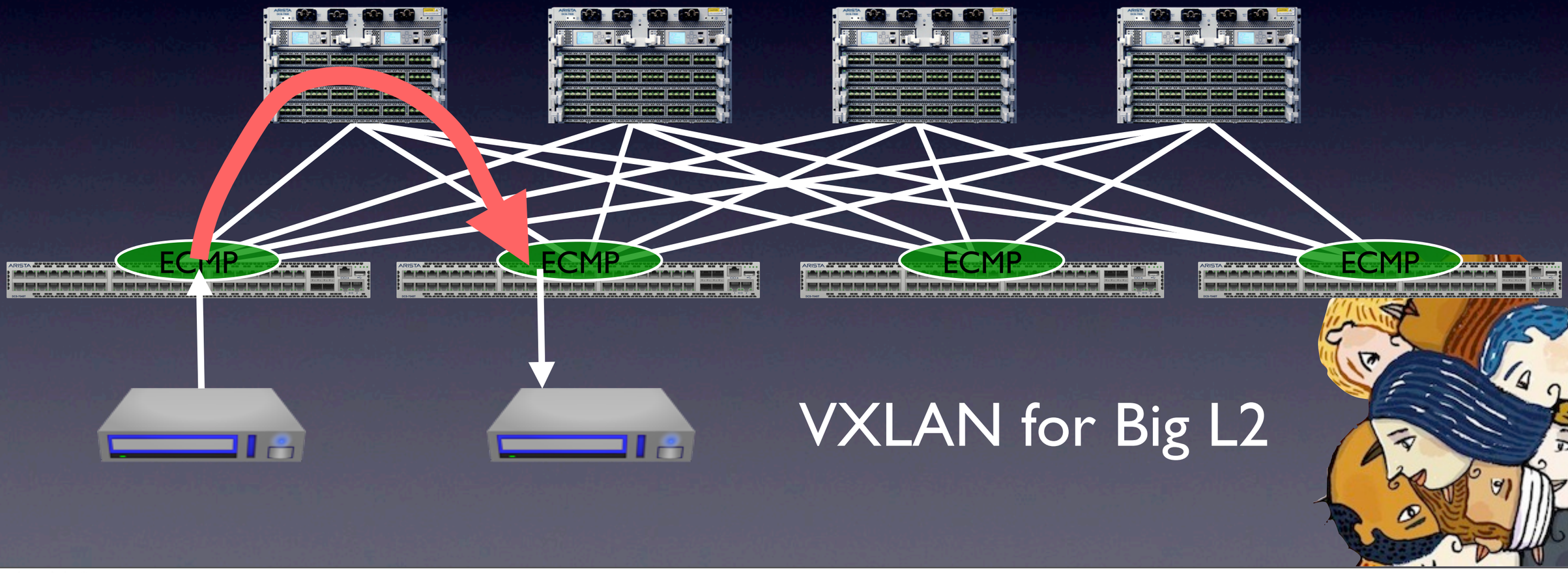
- Solved Problem
- Not PortLand, TRILL, FabricPath, VDX, QFabric, VL2
- Not FC, InfiniBand, MST... these won't go away, but not growing

Face 3: Data Center Fabrics

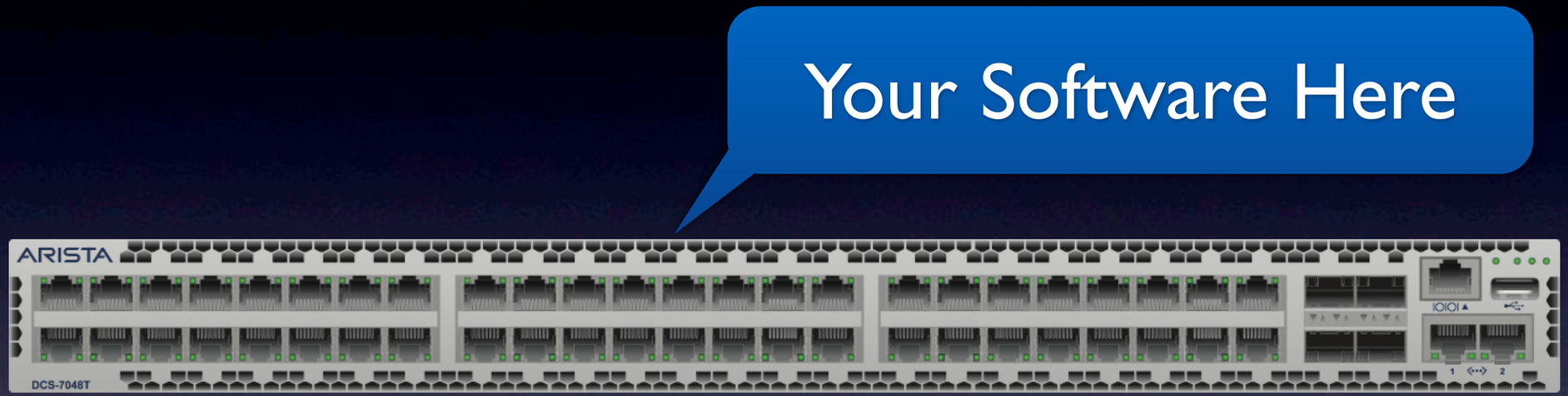


IP BGP ECMP FTW

Face 4: Network Virtualization

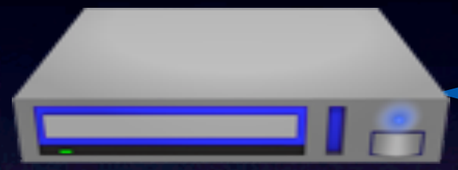


Face 5: Device Programmability



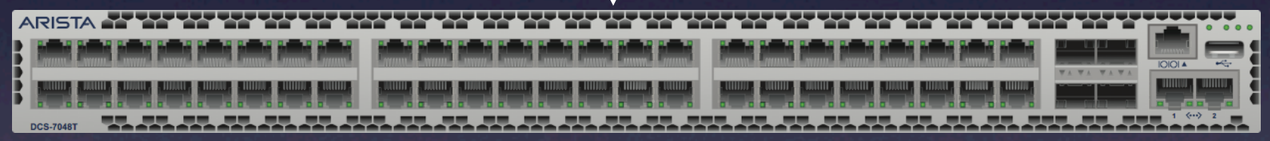
A big deal for a few companies with huge networks

Face 6: Management Automation



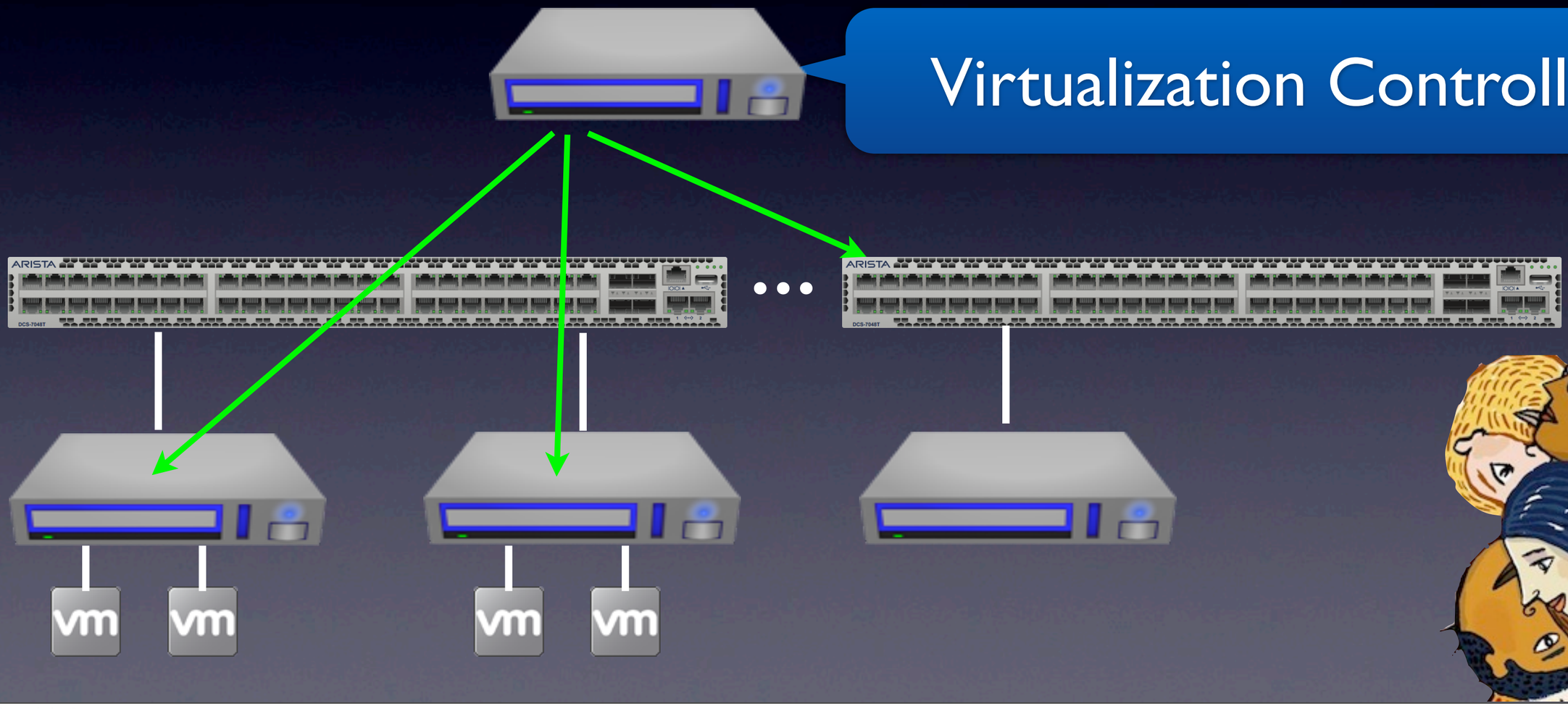
Your Software Here

"Northbound APIs"

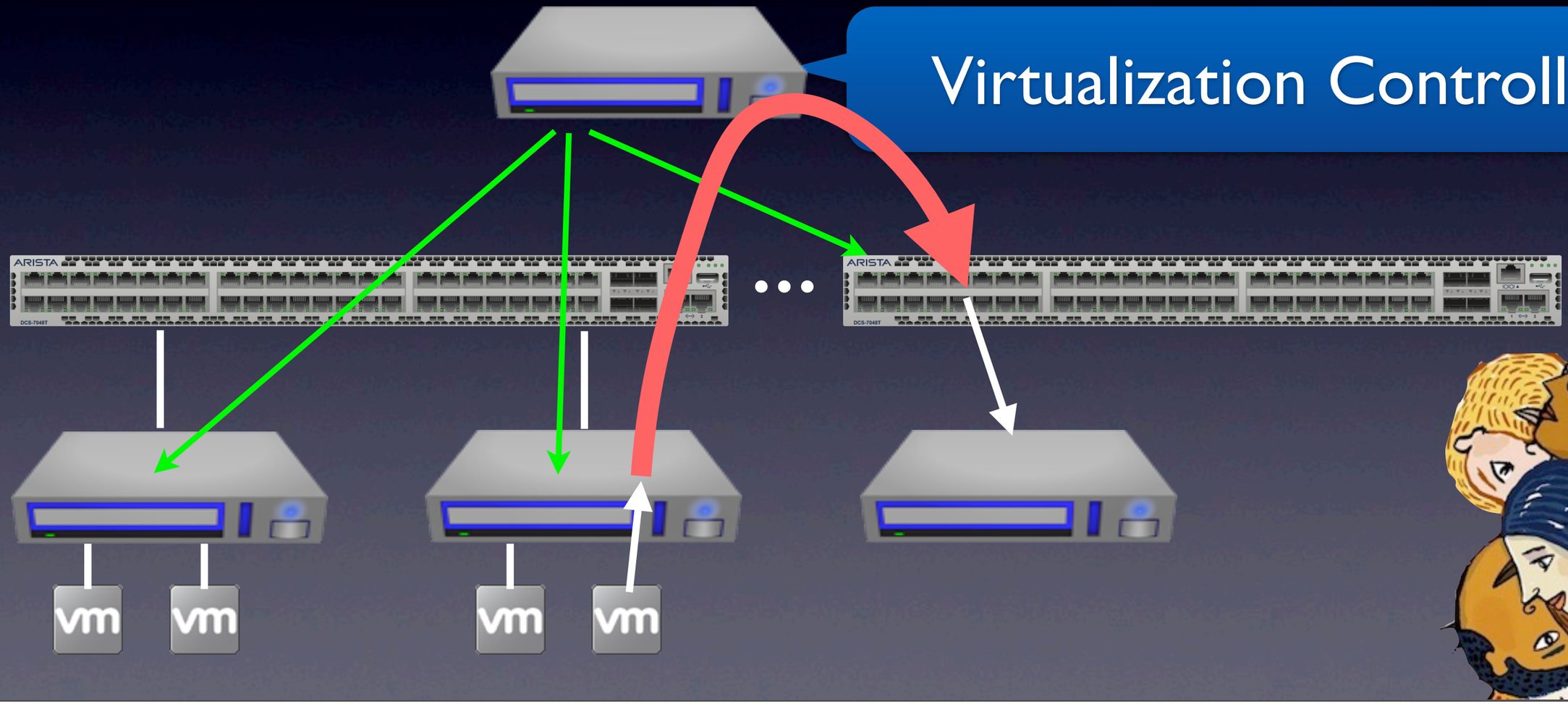


Accessible to anyone who can hack python

Face 7: Virtualization Orchestration



Face 7: Virtualization Orchestration



Conclusions

- OpenFlow is fine for experimentation, and has other use cases, but will not replace traditional forwarding architectures
- Control plane / data plane separation looks undeployable
- Lots of (other) interesting stuff to do under the "SDN" banner