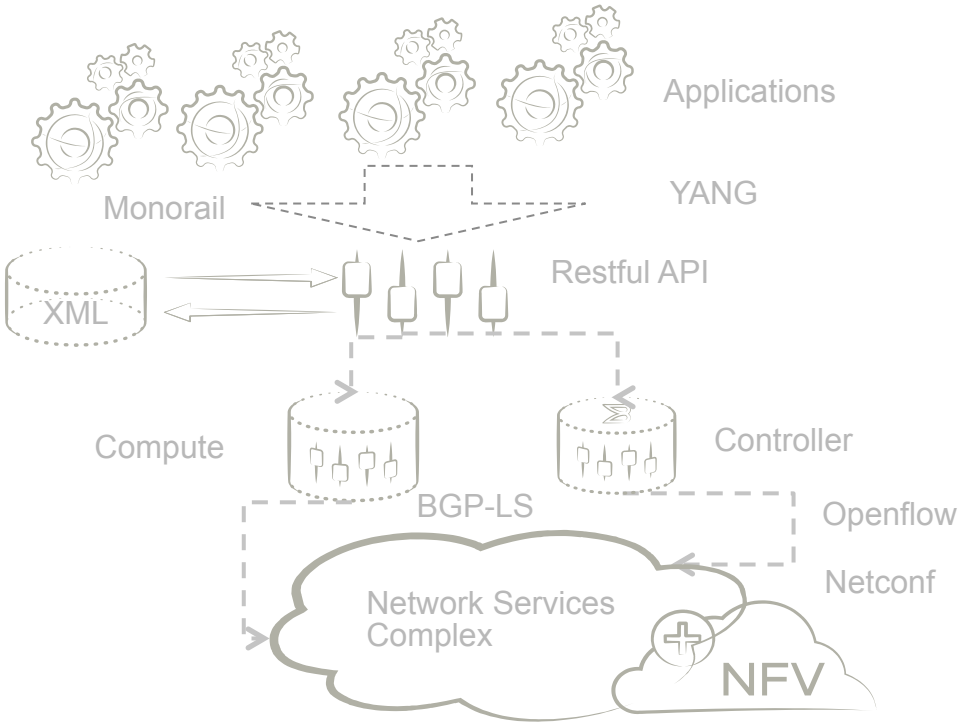
Applications for Externalized Control Planes

INVENTING A NEW MOUSE TRAP



David Lambert

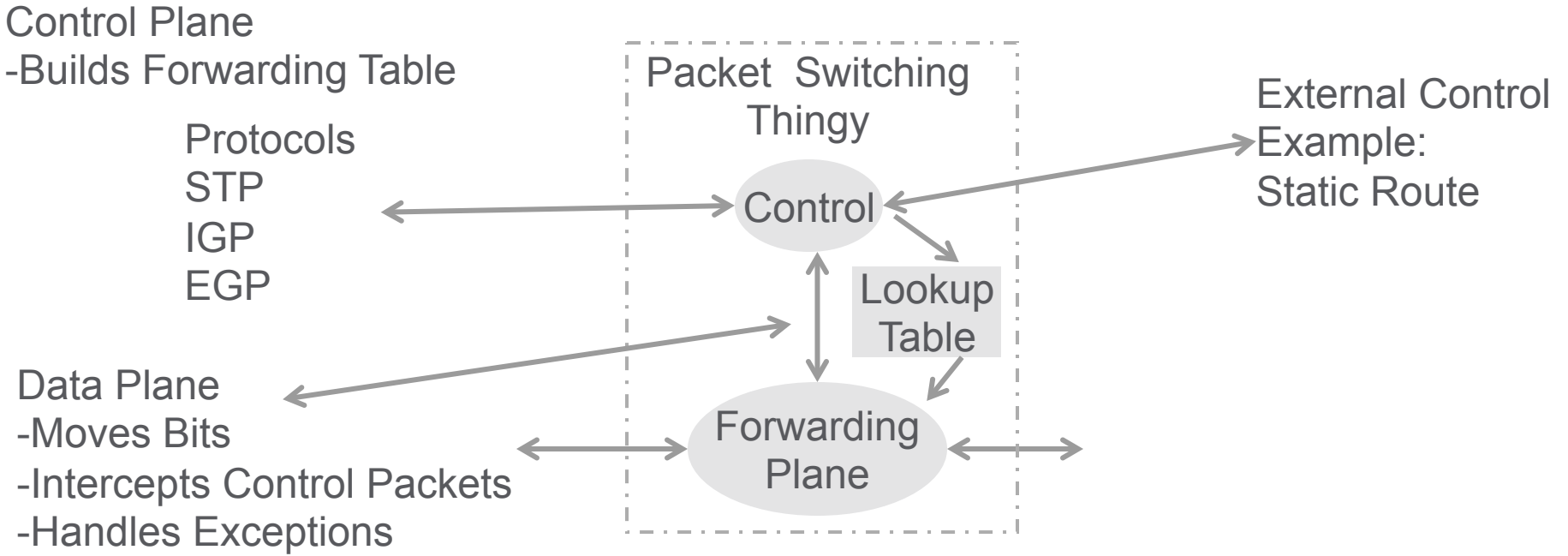
Principal Systems Engineer

BROCADE

August 2015

A Device That Moves Bits

- THEY COME IN A LOT OF SHAPES AND SIZES.. BUT ACTUALLY ALL PRETTY MUCH THE OK.. No.. not really



Captive Control Planes

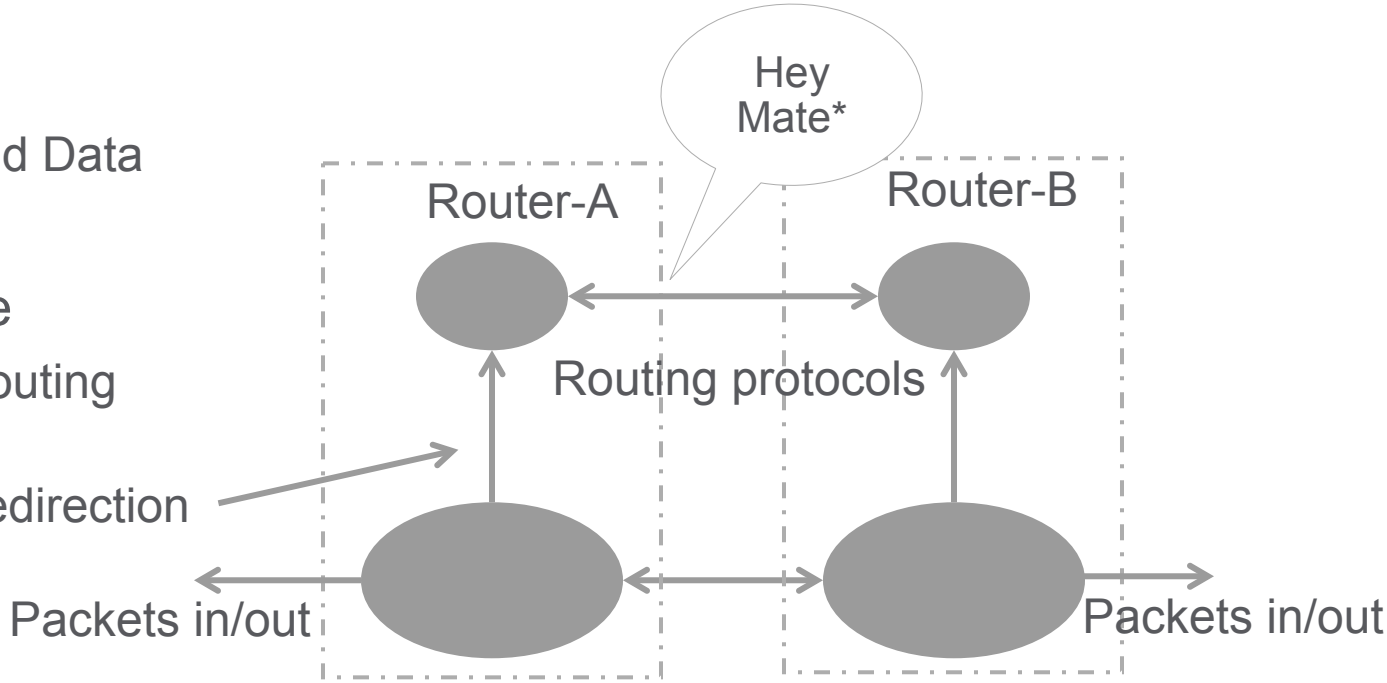
Routers are Happy Speaking With Their Friends

Networking Devices

- Separate Control and Data

Captive control plane

- Shares state via a routing protocol.
- Host traffic redirection



But.. How can we automate services here?

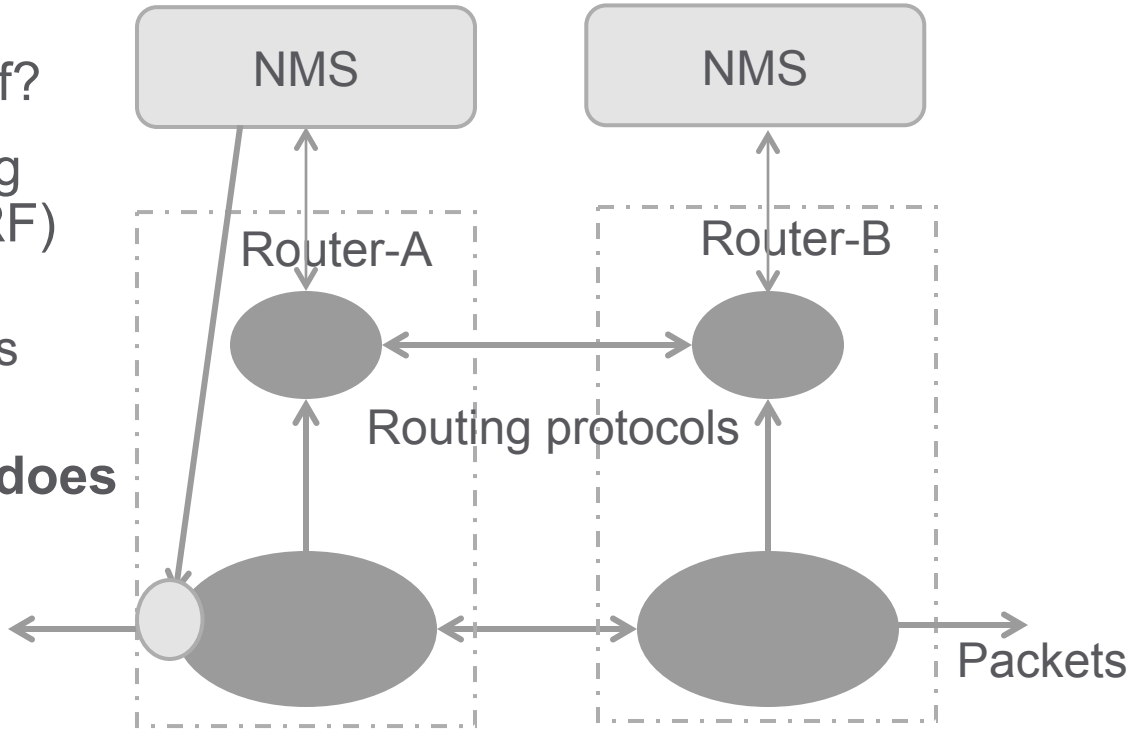
*OSPF Hello

Externalize The Control Plane?

- An NMS is actually an External Controller.. Kind of?
- Can be as simple as adding an ifl (that attaches to a VRF)
  - This will determine “some” action to perform to packets transiting on that interface

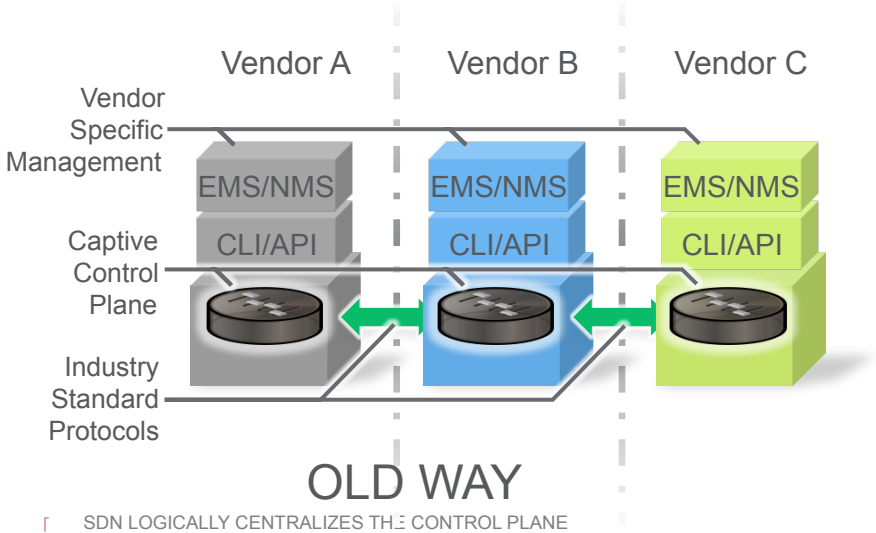
This is what a controller does

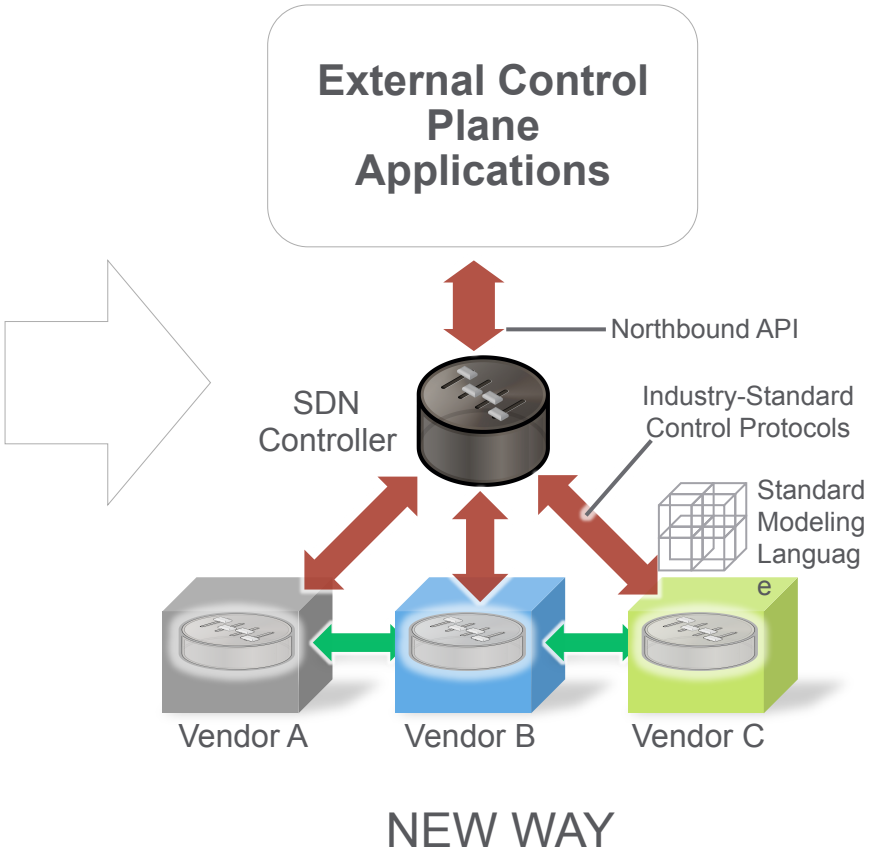
“A network in which the Control Plane is physically separated from the Data Plane”



A New Control Plane

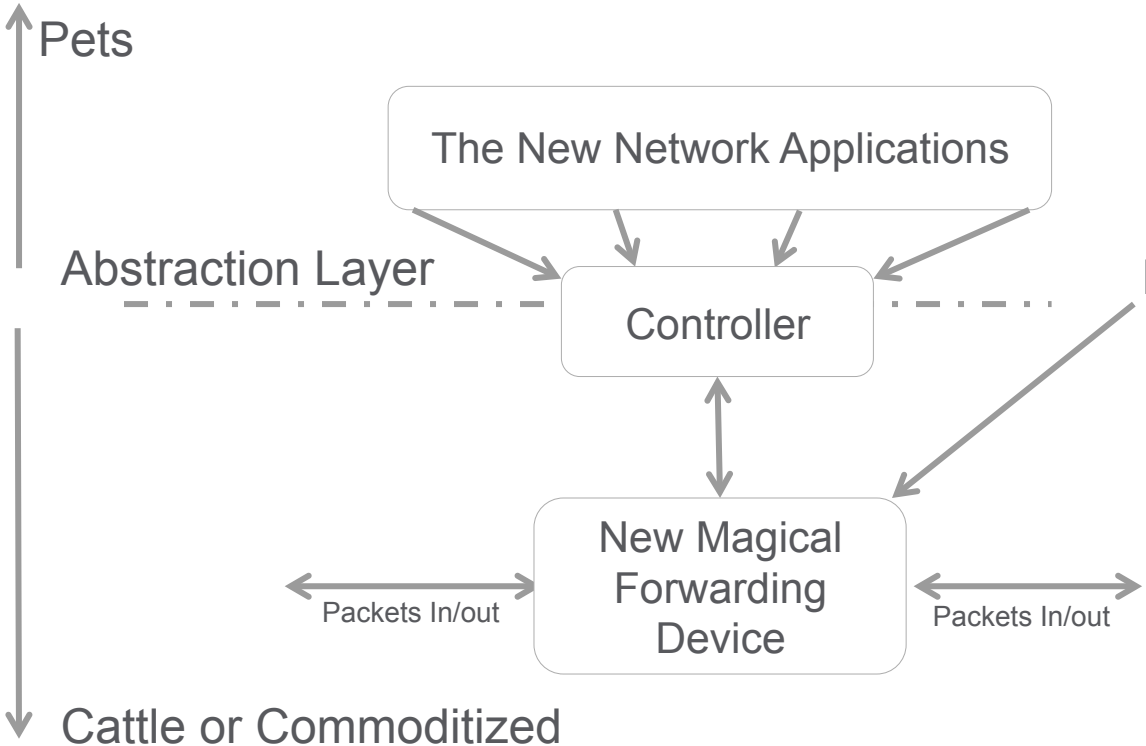
- Logically centralized open control plane, non-vendor specific
- Normalized programming interface
- Standard control protocols and modeling language





SDN LOGICALLY CENTRALIZES THE CONTROL PLANE

A New Forwarding Plane



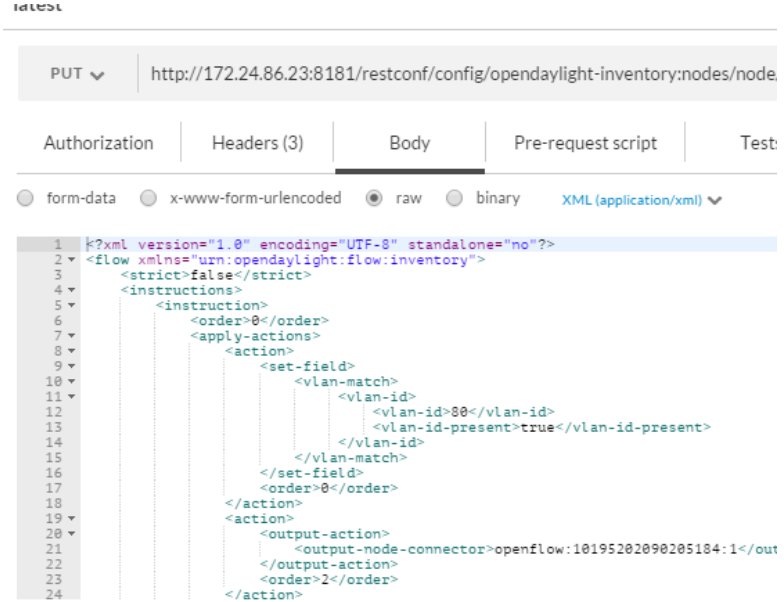
If we ignore control plane (for a second)
The things I care about:

- Forwarding Table Size and Function
- Speeds and Feeds
- Environmental Requirements
  - Power
  - Footprint
  - NEBS

Standardization of the Controller API. What does it give us?

OH GOODY.. AN API FOR THE NETWORK

- Build me some Network?
  - Send it some XML
- Controller South Bound protocols
  - OF, Netconf, BGP…
- How much Network?
  - Well this depends..



But What About The old way?

- **Sure it works**
  - Protocols evolved
    - Switching
    - Routing

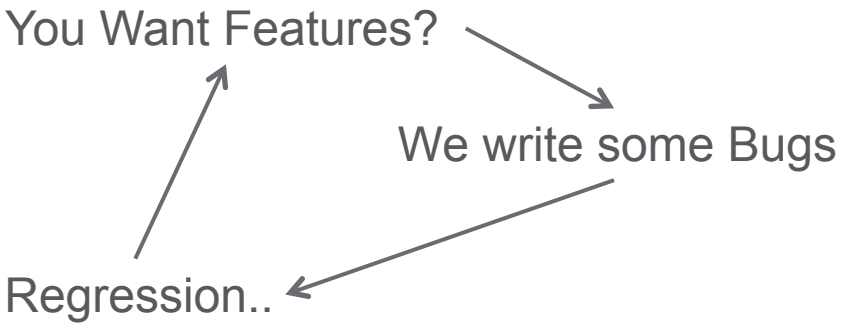
What is the limitation?

Programmability is SLOW

Complex configurations

M2M requirements

- **Why it doesn't**



What is a stable router?

Silicon is awesome?

Early efforts of opening up the forwarding plane

PROPRIETARY SOFTWARE DEVELOPMENT KITS

- SDK's
  - A way to get Vendor X writing to the forwarding plane of vendor Y, exposing bits of the forwarding plane
- Examples
  - You can google it…

- Why did it fail?
  - High cost of entry?
  - Questionable Viability?
  - Who will fund the business case..
    - Limited platforms?
      - Write for vendor A or B?
    - See previous verb on bugs?
  - Did it Fail?
    - There are several examples where it worked.

But the take up is less than the promise of magical unicorns would have us believe..

So what has changed?

A COUPLE THINGS ARE HAPPENING..

- Data Plane is Now Commoditized
  - Openflow
  - YANG
    - Abstract anything

- Control Plane
  - SDN Controllers

    20+ commercially available

    Pick one?

- Viability
  - Vendor Investments
    - Control Plane (Comercial Controllers)
    - Data Plane (WB and Programmability)
    - **Applications!**

SDN Applications

CHOICES AND CATEGORIES

- Box Vendor
  - Traditional Vendors
- Box Replacement
  - WB Switch Vendors

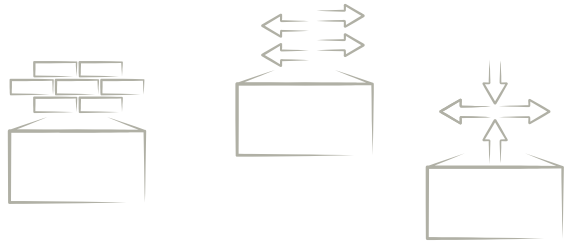
- Independent
  - Orchestration
    - NFV Platforms
  - Applications
    - New Market

- Build your own
  - Open source community
  - Vast resources
    - Join a meetup
    - Join a meetup!
    - Join a meetup!!

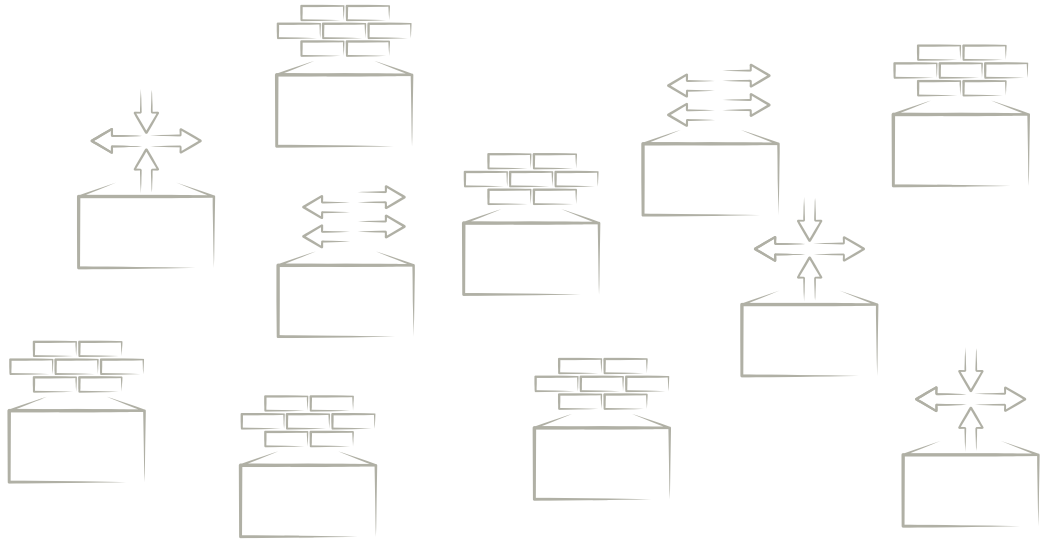
SDNish Applications

BOX CATEGORIES

- Switches
- Routers
- Load Balancers
- Firewalls
- Others.
  - UAC
  - Access networks
  - Core pseudo wire services
  - Magical things…*



But these are pretty.. ho hum.. right?

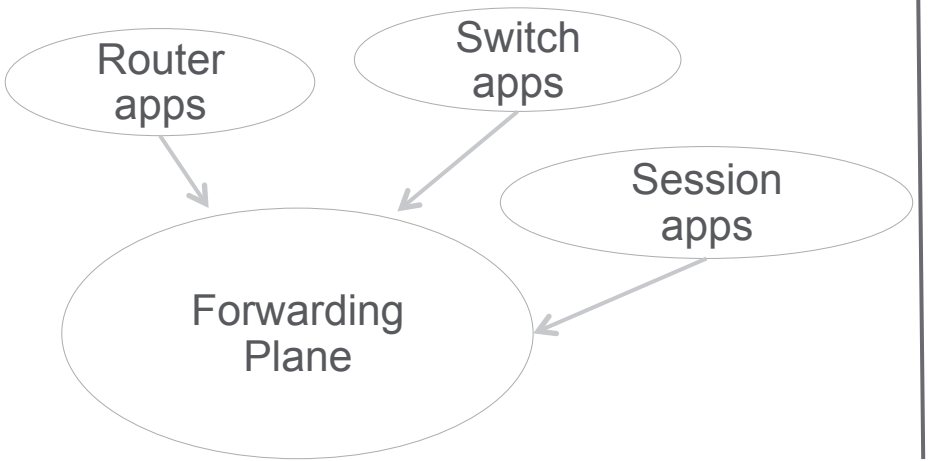


* Note Magical things subject to standard roadmap disclaimers*

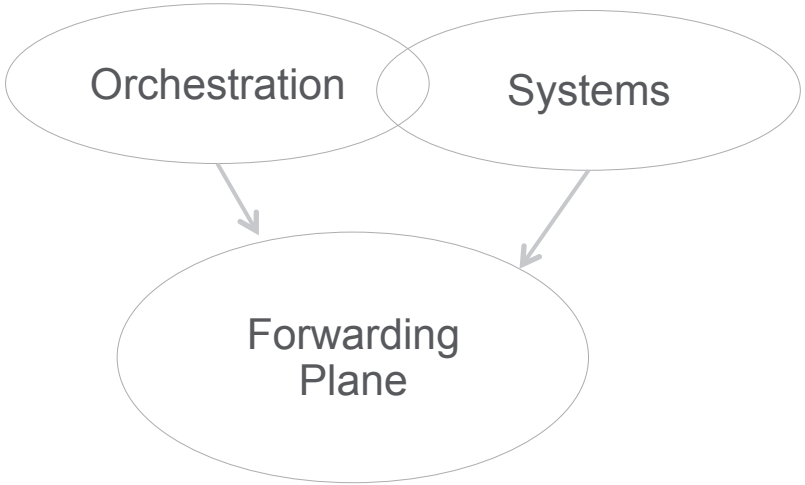
Application Categorization…

- MAKING SOME SENSE OF DOMAINS

A New mouse trap.. Packet Domains



Orchestration Application Domains



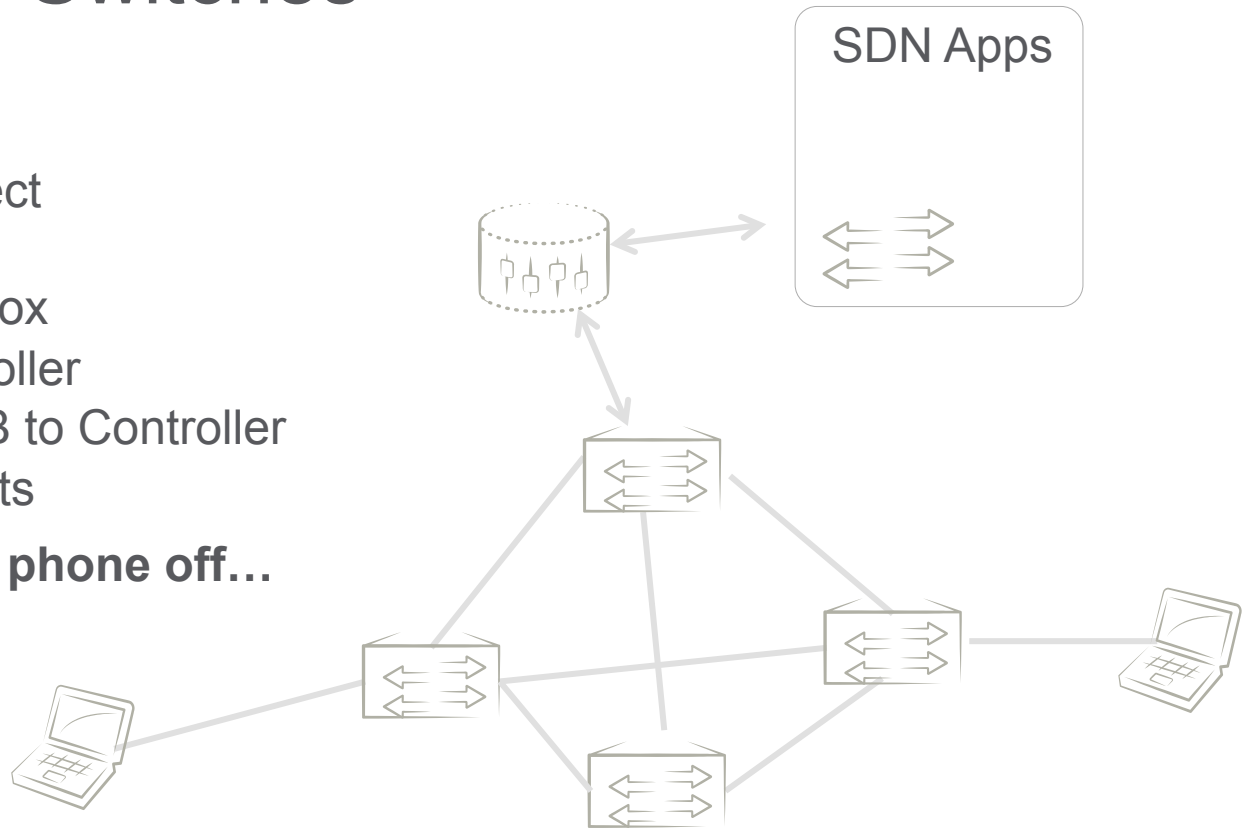
Openflow Switches

WHAT CAN I BUILD TODAY?

ODL L2 Switch Project

Step 1- Buy Whitebox
Step 2- Build Controller
Step 3- Connect WB to Controller
Step 4- Plug in Hosts

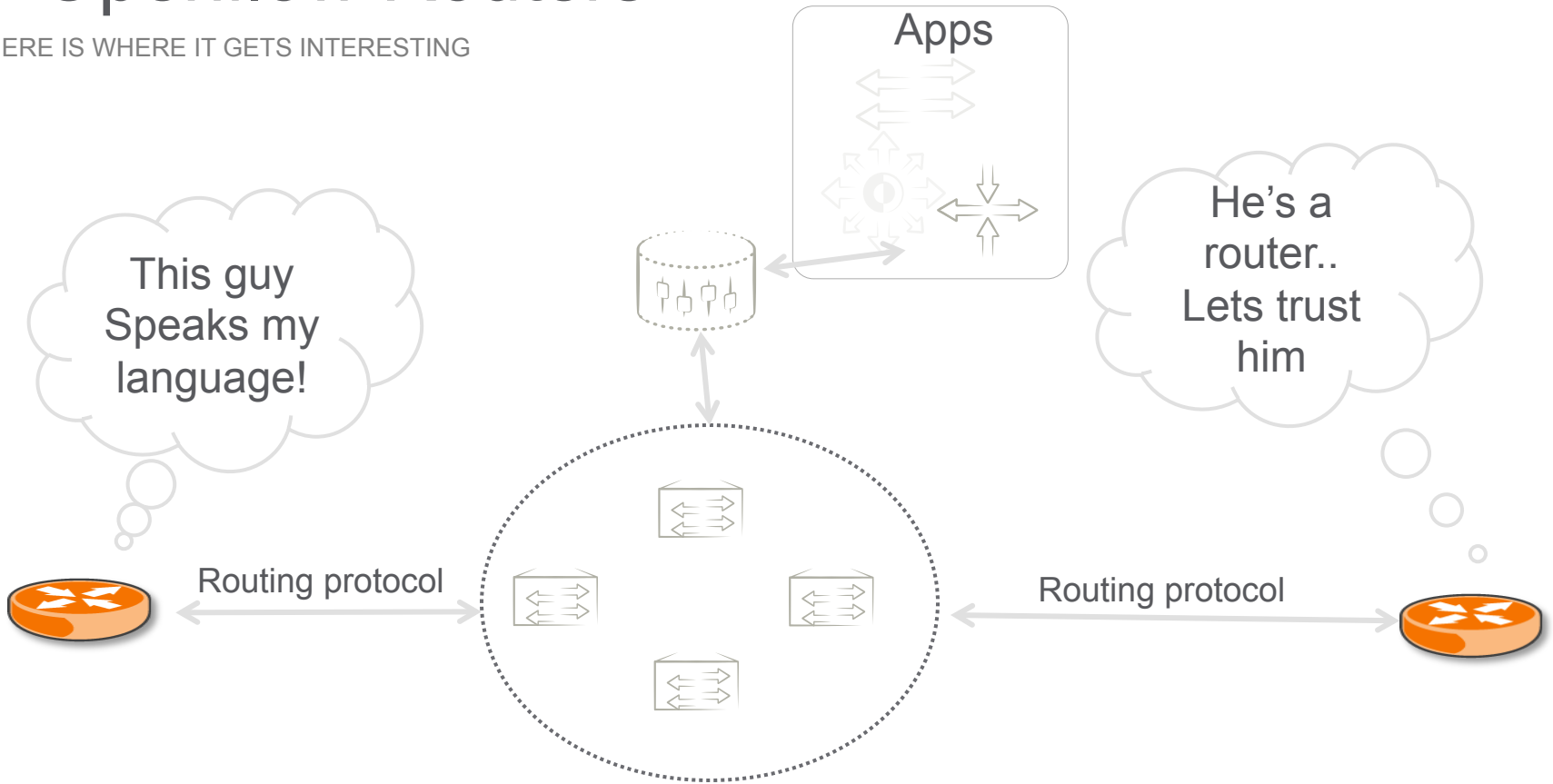
Don’t turn your phone off…



OPEN DAYLIGHT

Openflow Routers

- HERE IS WHERE IT GETS INTERESTING

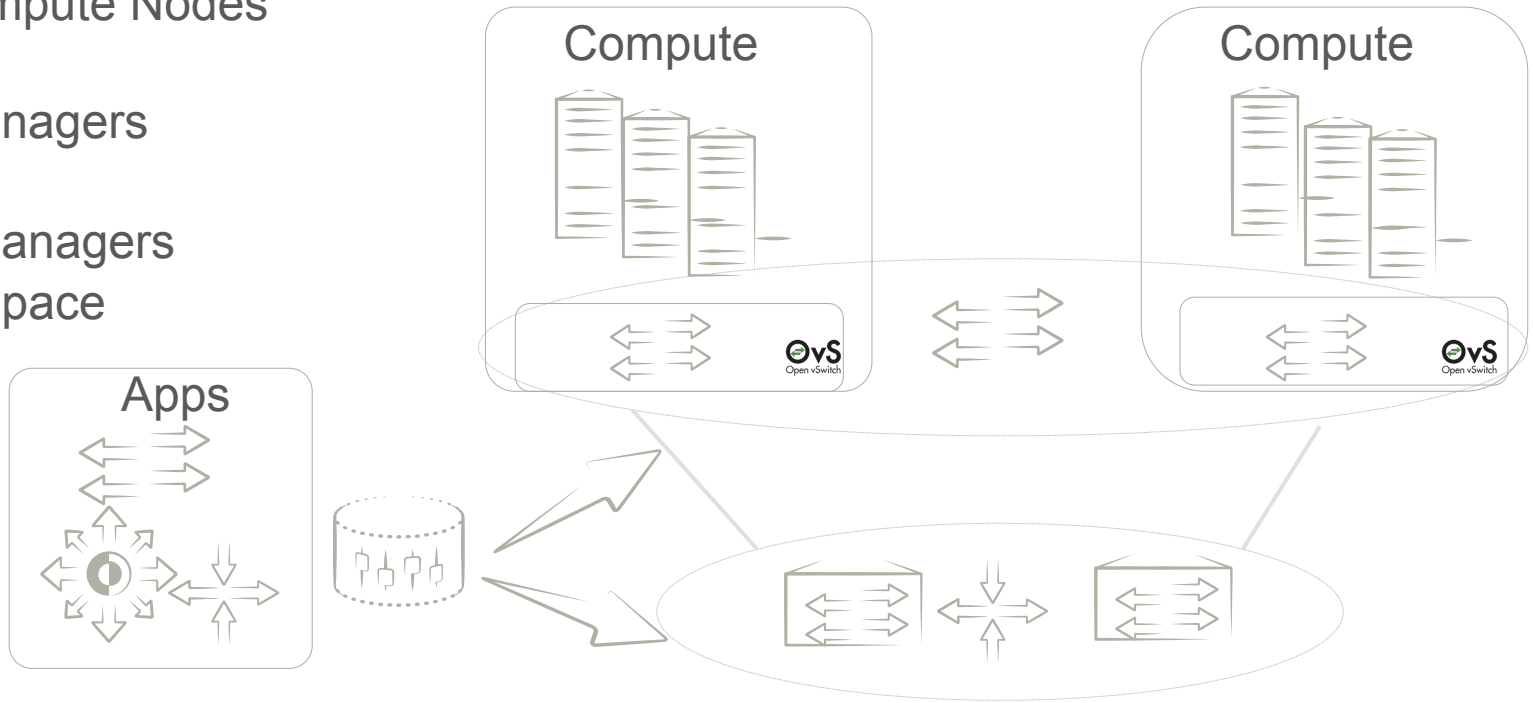


Openflow Switches and Routers “next step”

OVS in Compute Nodes

Overlay Managers
- IP Tunnels

Underlay Managers
- Evolving space



openstack™

OPEN DAYLIGHT

Openflow Load Balancer

Many Papers..

OpenFlow-Based Server Load Balancing Gone Wild (Princeton University)

IDS LOAD BALANCER & SCIENCE DMZ (Indiana University SCIpass)

LOAD BALANCING IN SOFTWAREDEFINED MOBILE NETWORK

OpenFlow Based Load Balancing (University of Washington)

What About Hierarchical Load Balancer?
Scale out existing LB with OF pre load balance?

anfor

Flow enabled SDN (CMR Institute of Technology)

Scaling concerns

Flow Scale
Controller Scale

Openflow Firewall

Some Limitations..

Well um.. Openflow supports only stateless matches.

You can punt a packet to a controller application to learn, but you can really only apply an appropriate openflow match.. Dynamic pinhole based on L1-L4 fields.

Some papers

An Open Flow-based prototype of a SDN-oriented stateful hardware firewall (University of North Dakota)

Future work

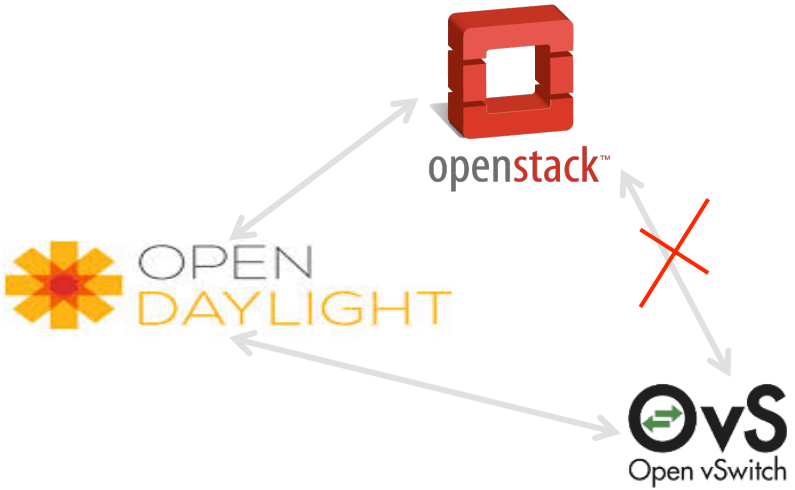
Extending Openflow, MTM with OXM, Reconfigurable Match Tables..

SDNish Applications

APPLICATIONS CATEGORIES

- Orchestration
  - The Usual Suspects
  - Some new players
  - DevOps Teams..
  - ETSI (the MANO VIM part)
  - OPNFV
    - ODL Projects

- Openstack Work
  - Decoupling Neutron agent from OVS



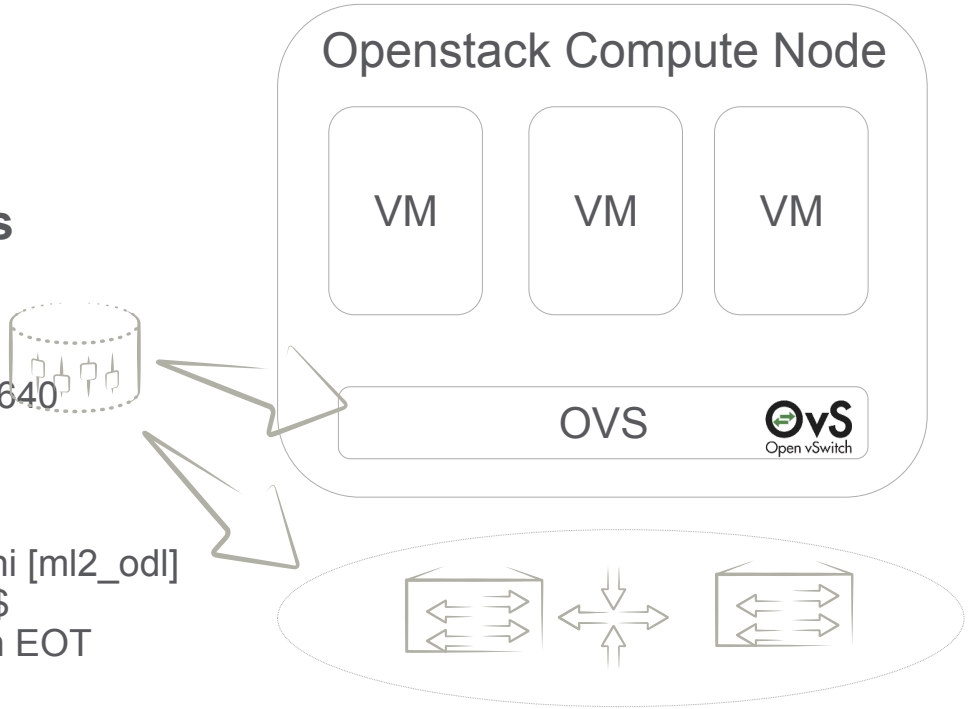
Openstack OpenDaylight Integration

Install ODL ML2 driver
odl-ovsdb-openstack bundle,

Disable Neutron OVS agent on hosts

Point OVS at ODL
ovs-vsctl set-manager tcp:${CONTROL_HOST}:6640

Point Neutron (control node) at ODL
cat <<EOT>> /etc/neutron/plugins/ml2/ml2_conf.ini [ml2_odl]
password = admin username = admin url = http://$
{CONTROL_HOST}:8080/controller/nb/v2/neutron EOT

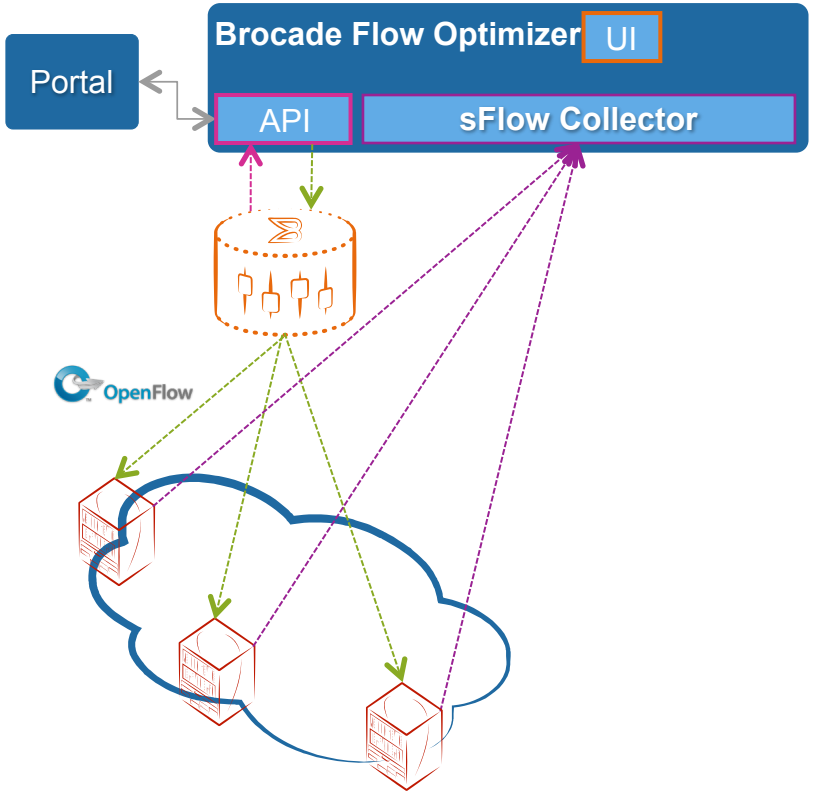


Awaiting that killer Application..

Openflow Flow Optimizer Application

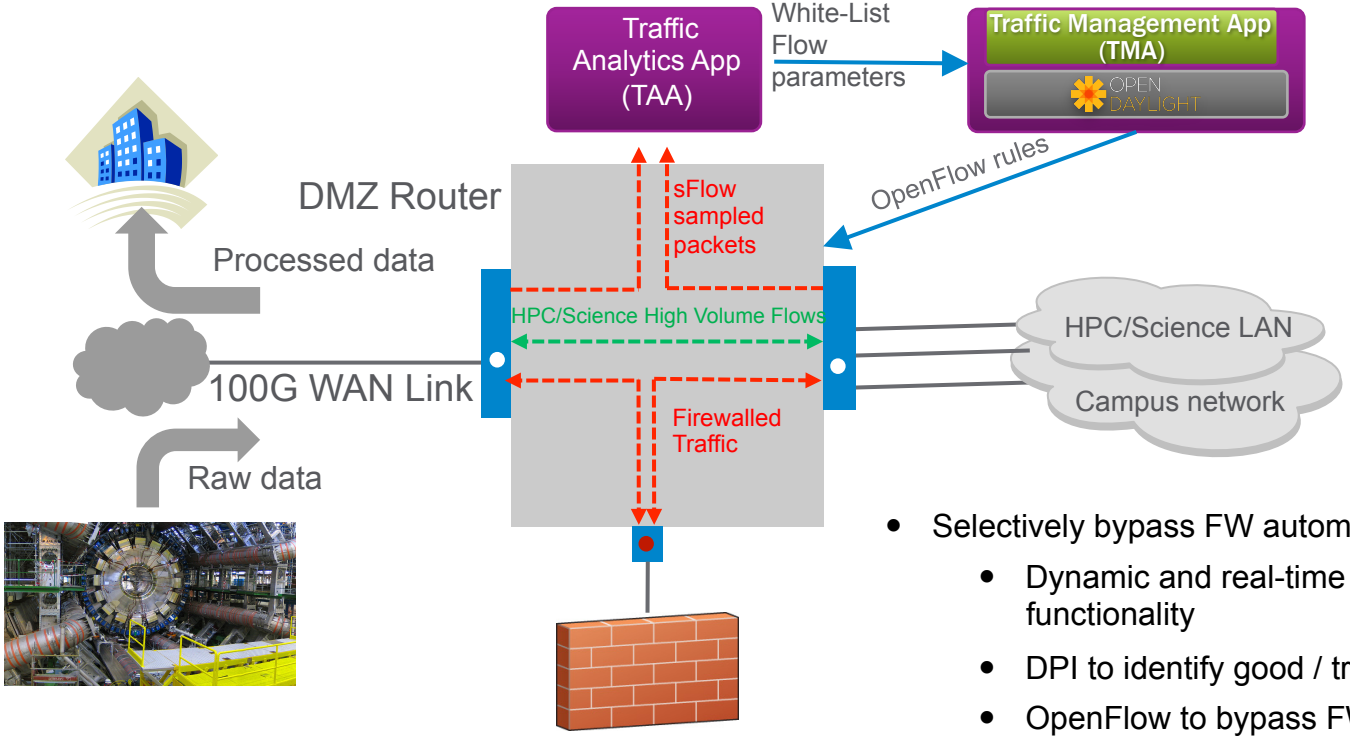
Use Cases

- Volumetric Attack Mitigation
- Flow Metering
- SDN Based Wiretap
- Firewall Bypass
- Botnet Attack Mitigation
- Elephant Flow Management



100G Firewall Bypass Traffic Flow Example

White-List Flow Offload

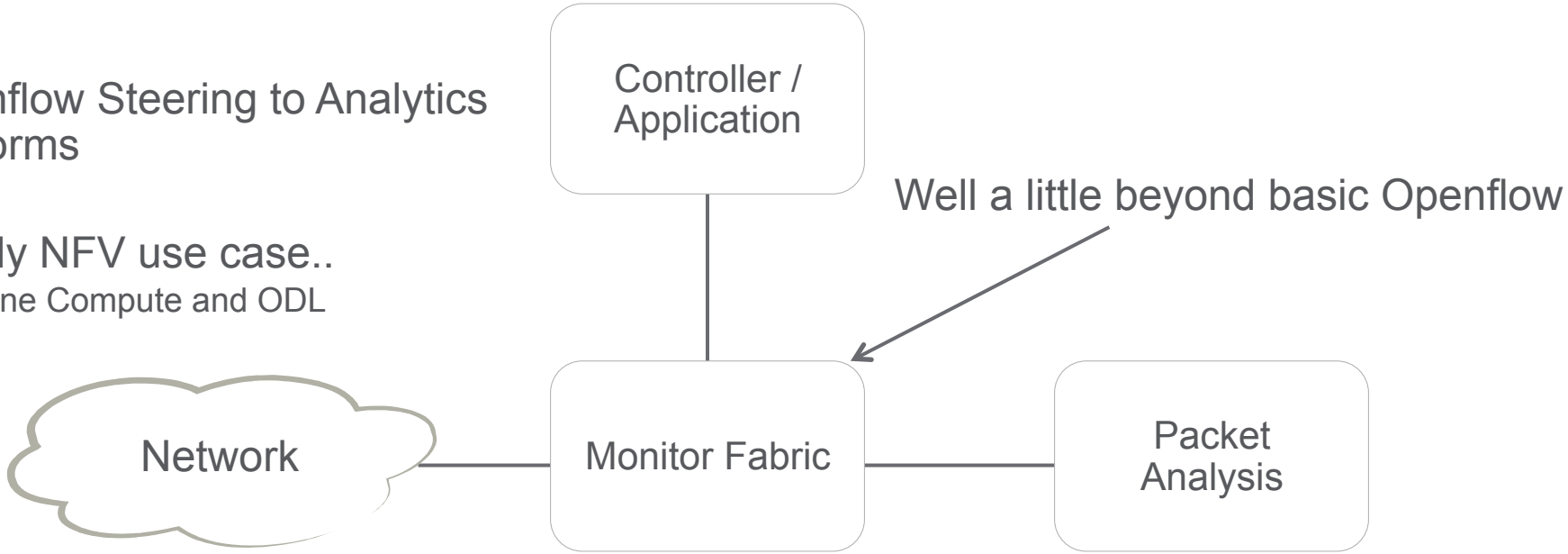


- Selectively bypass FW automatically for trusted users (
  - Dynamic and real-time Firewall service “bypass” functionality
  - DPI to identify good / trusted flows
  - OpenFlow to bypass FW

Software Defined Monitoring SDM

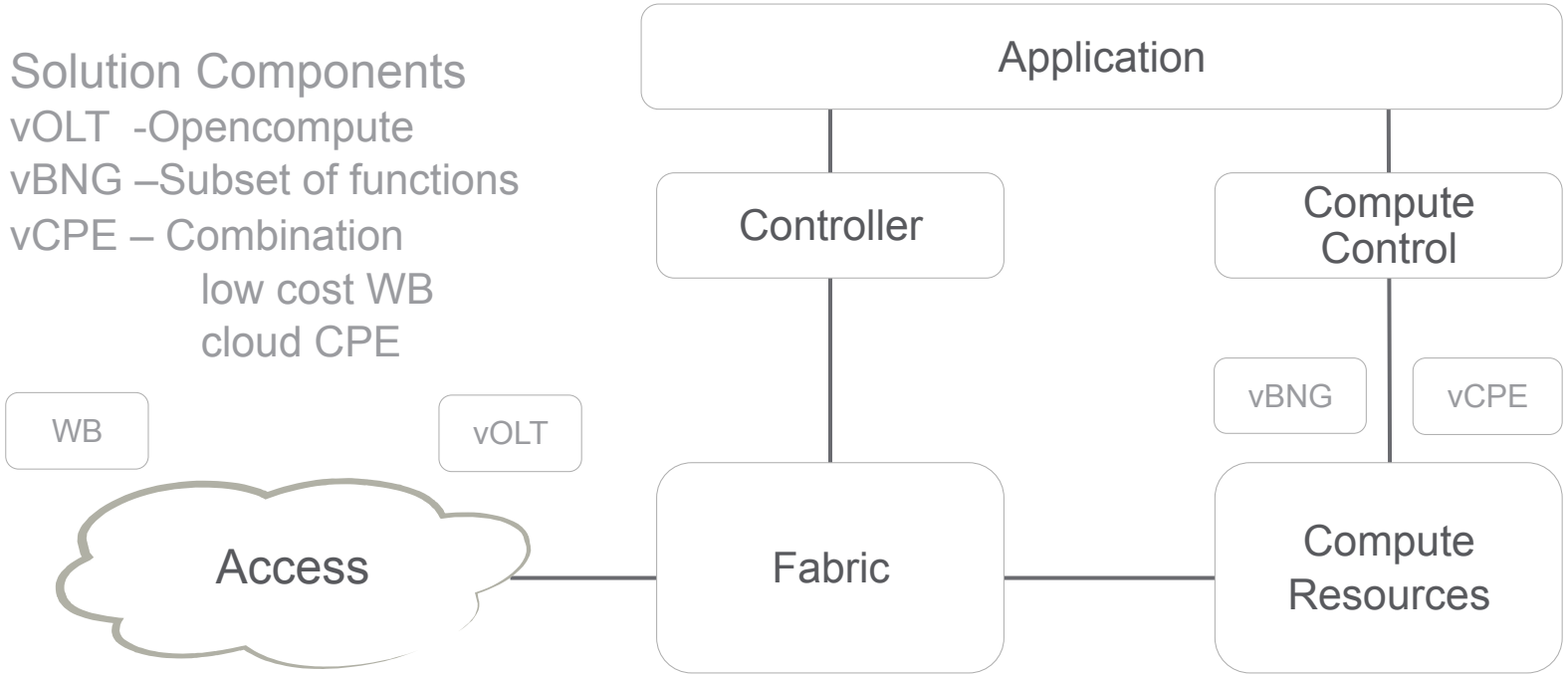
Openflow Steering to Analytics platforms

Ideally NFV use case..
Combine Compute and ODL



Software Defined Something

Solution Components
vOLT -Opencompute
vBNG –Subset of functions
vCPE – Combination
low cost WB
cloud CPE



SDN Applications

A higher level view

Bandwidth Managers
Lots of them, because they are achievable.
Typically WAN solutions (pseudowire services)
Bandwidth Exchange
Bandwidth on Demand
Quality of Service (on demand)

Application Peering Exchanges
Software Defined Internet Exchanges

Service Chaining Applications
Early adopters.. VLAN service stitching, overlay use cases

Technology Choices

Beyond Openflow??

Controller

North Bound API's and Models
Core Projects (who's contributing)
South Bound protocols

Catering for a wide use case criteria

Examples
Service Chaining, {VLAN, VXLAN, NSH (OVSDB MDSAL), IP/MPLS}
SD-WAN (apparently a little more than Openflow required..)

Forwarding Plane

Openflow
OXM
Reconfigurable Match Tables
Netconf
BGP LS CEP
Segment Routing
Hybrid Forwarding
CLI

Build Your Own Application?

DEVELOPER RESOURCES

- Resources
  - RESTCONF
  - https://github.com/BRCDcomm/BVC/wiki/RESTCONF-Developer-Resources
  - Python
  - https://github.com/BRCDcomm/pybvcsamples
  - Ruby
  - https://github.com/brcdcomm/rubybvcsamples
  - Perl
  - https://github.com/brcdcomm/perlbscsamples
- Writing Applications (Because it's fun and it's free)
  - https://www.youtube.com/watch?v=6oV8EFGECFA
  - http://brcdcomm.github.io/BVC/

Actual Market Applications

WITHOUT GETTING ALL VENDOR ON YOU..

- RADWARE
  - DefenseFlow NetFlow and SDN based DDoS Attack Defense
- Elbrys
  - School (Tracking)
  - Store (Metric etc)
  - Office (UAC..)
- HP
  - Lists about 8 applications
- Brocade
  - Growing list of both examples and commercial offerings
- IronSDN
- Alcatel
  - Nuage*
- Big Switch (SDM)
- Arista (SDM)
- NTT
- Fujitsu
- ONOS
  - BGP IP APP
- Midonet
- Sinefa (SDM)
- CYAN
- Ericsson
- Ciena
- NEC

Not an exclusive nor exhaustive list.. a quick qoogle research…

Thanks!