Applications for Externalized Control Planes

INVENTING A NEW MOUSE TRAP

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A Device That Moves Bits

They come in a lot of shapes and sizes. But actually all pretty much the same thing?

Control Plane
- Builds Forwarding Table
  Protocols
  STP
  IGP
  EGP

Data Plane
- Moves Bits
- Intercepts Control Packets
- Handles Exceptions

OK.. No.. not really

Packet Switching Thingy

Control

External Control Example: Static Route

Forwarding Plane

Lookup Table
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

Packets in/out

But.. How can we automate services here?

*OSPF Hello
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

OLD WAY

NEW WAY

SDN LOGICALLY CENTRALIZES THE CONTROL PLANE
A New Forwarding Plane

Abstraction Layer

The New Network Applications

Controller

New Magical Forwarding Device

Packets In/out

Minimal Configuration Required

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?

- **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**
  - You Want Features?
  - We write some Bugs
  - Regression..

  - 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…*

* Note Magical things subject to standard roadmap disclaimers*

But these are pretty.. ho hum.. right?
Application Categorization…

MAKING SOME SENSE OF DOMAINS

A New mouse trap.. Packet Domains

- Router apps
- Switch apps
- Session apps
- Forwarding Plane

Orchestration Application Domains

- Orchestration
- Systems
- Forwarding Plane
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…
Openflow Routers

HERE IS WHERE IT GETS INTERESTING

This guy Speaks my language!

He’s a router.. Lets trust him

Routing protocol

Apps

Routing protocol
Openflow Switches and Routers “next step”

OVS in Compute Nodes

Overlay Managers
  IP Tunnels
Underlay Managers
Evolving space
Openflow Load Balancer

Many Papers..

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

IDS LOAD BALANCER & SCIENCE DMZ (Indiana University SClpass)

LOAD BALANCING IN SOFTWARE DEFINED MOBILE NETWORKS (University of Oulu)

OpenFlow Based Load Balancing (University of Washington)

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

Scaling concerns
Flow Scale
Controller Scale

Design and Implementation of Dynamic load balancer on OpenFlow enabled SDN (CMR Institute of Technology)
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

Controller / Application

Well a little beyond basic Openflow

Network

Monitor Fabric

Packet Analysis
Software Defined Something

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

Access

Controller

Application

Fabric

Compute Control

Compute Resources

vBNG

vCPE
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

• 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 google research...
Thanks!