

Tier 1 Carrier P4 Use Cases: Going Beyond the Packet Pipeline

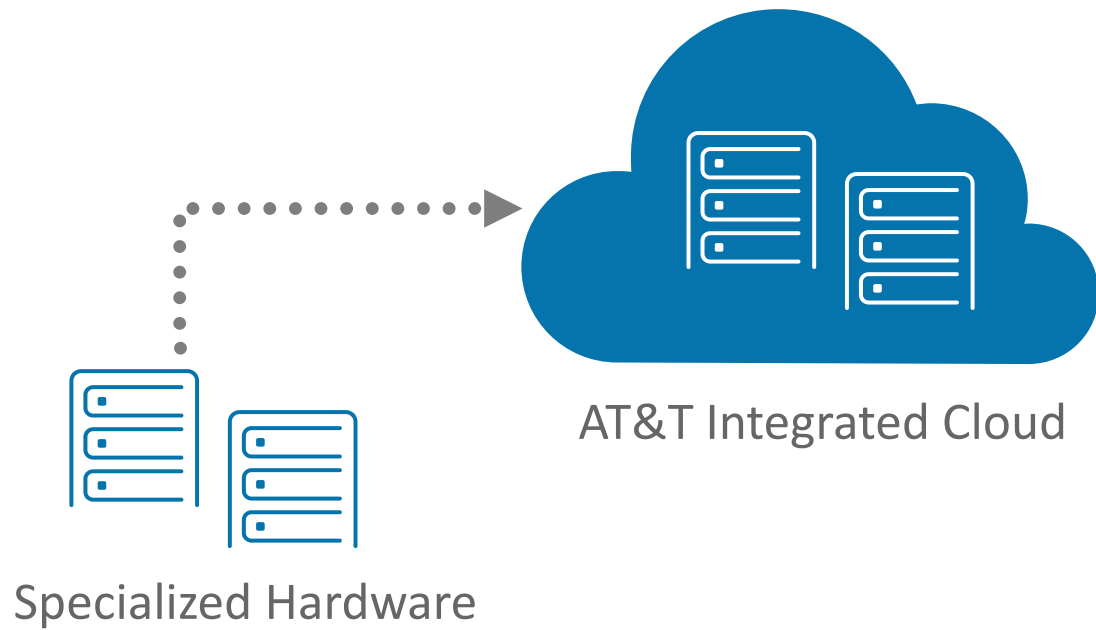
Ken Duell, Ph.D.

AVP Packet Optical Network Development and Engineering

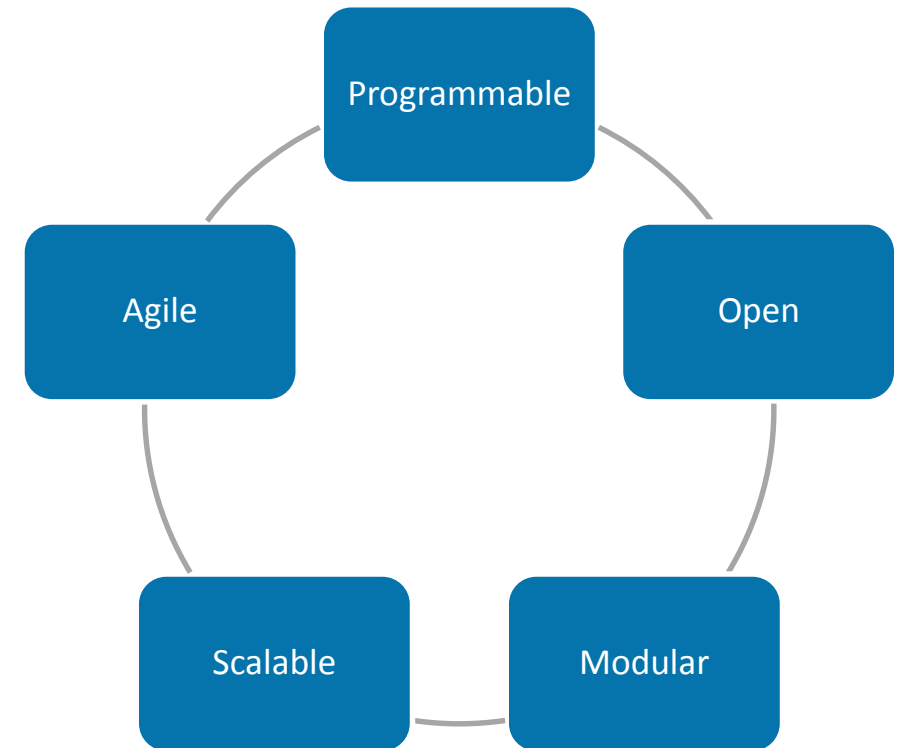
November 18, 2015

Technology Shift

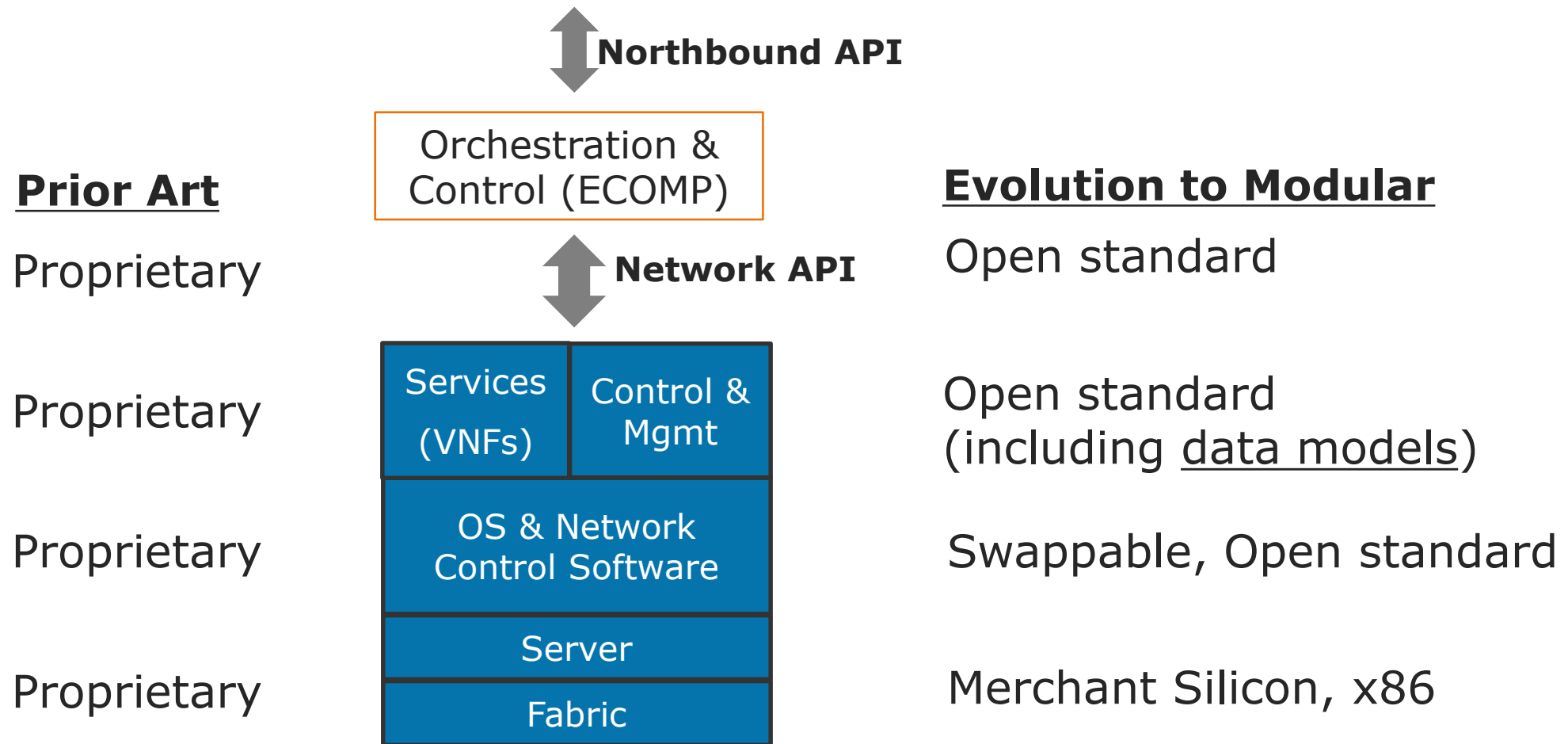
Network Function Virtualization



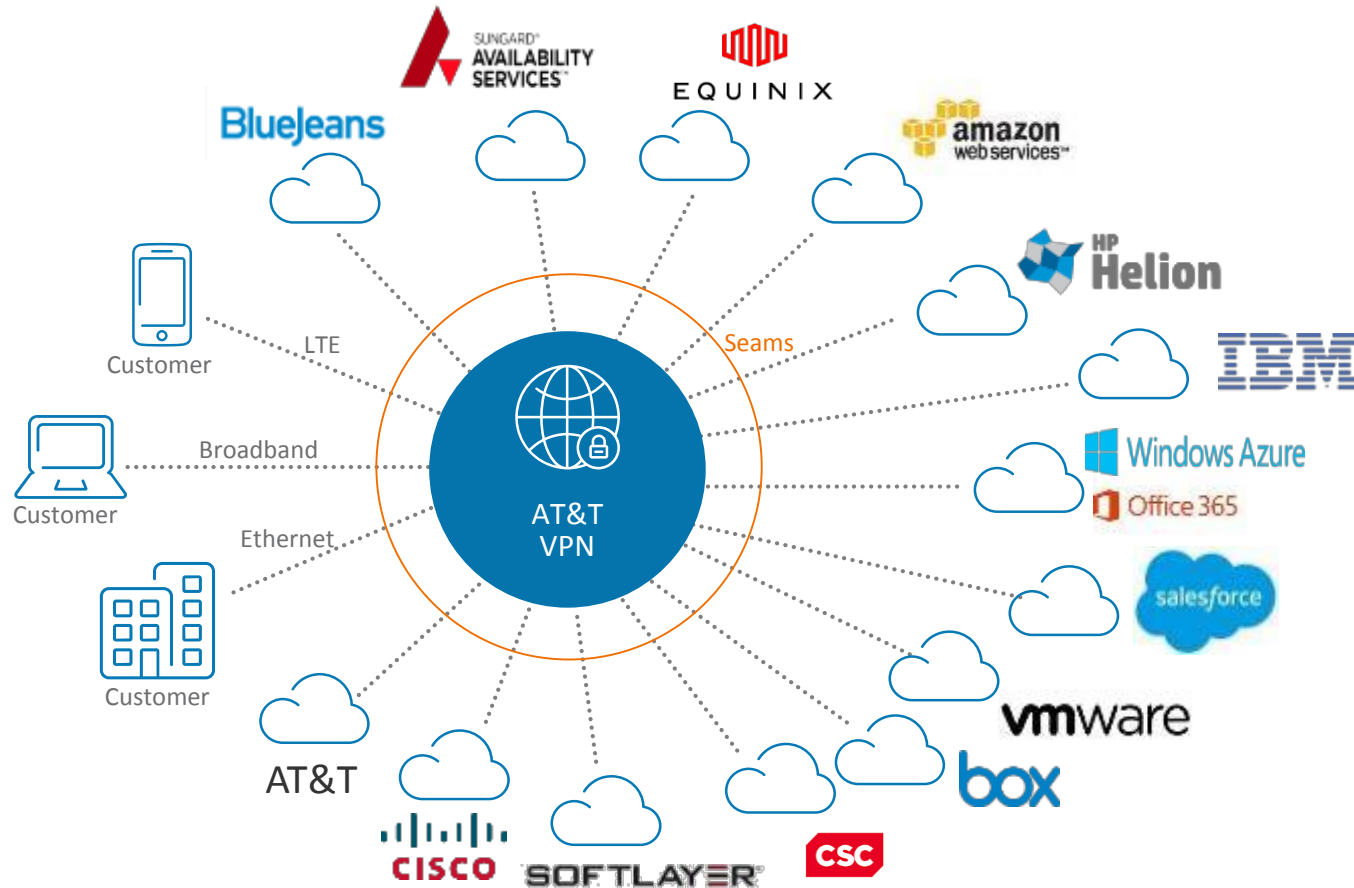
Software Defined Networking



Shift to Disaggregation of Network Elements



AT&T NetBond® Use Cases



Some platforms are currently in deployment stage

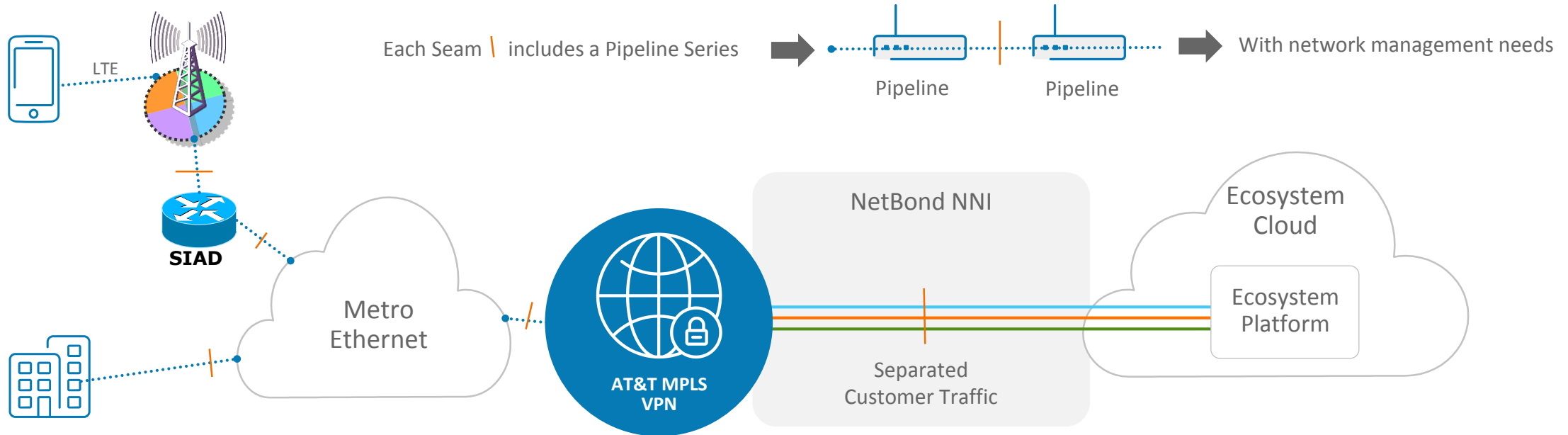
Customers expect seamless

Goal is to make seams invisible between...

- Cloud platforms
- Carrier platforms
- Multiple network element vendors
- Multiple platform technologies



Managing $O(n^2)$ Network Seams



VLAN Mapping

Class of Service

SLA Measurements –
Throughput, Jitter,
Latency, PDR

Telemetry for
Operations

VNF's such as NAT



Example Seam: Multivendor SIAD Class-of-service CLI Configurations

Class of Service Function	Vendor 1	Vendor 2
Port shaping to match Metro Ethernet EVC bandwidth (e.g. 100M EVC)	<pre> port 1/1/8 description "GigE-to-MetroE" Ethernet ... egress-rate 98000 </pre>	<pre> policy-map SIAD_Parent_Policy_Egress_100M description SIAD backhaul egress parent policy v1.0 (rQOS) for Speed 100M class class-default shape average 100000000 100000 service-policy SIAD_Output_Policy_Child_100M </pre>
Define six (6) forwarding classes of service	<pre> network-queue "SIAD-ETH" create description "Revised QOS for Speed 50M-500M" ... fc af create queue 3 fc be create queue 1 fc ef create queue 6 fc h2 create queue 5 fc l1 create queue 4 fc nc create queue 7 </pre>	<pre> class-map match-any qos-group-control match qos-group 6 class-map match-all qos-group-cos1 match qos-group 5 class-map match-all qos-group-cos2v match qos-group 4 class-map match-all qos-group-cos2 match qos-group 3 class-map match-all qos-group-cos3 match qos-group 2 </pre>



Art of the Possible - P4 Community Ask

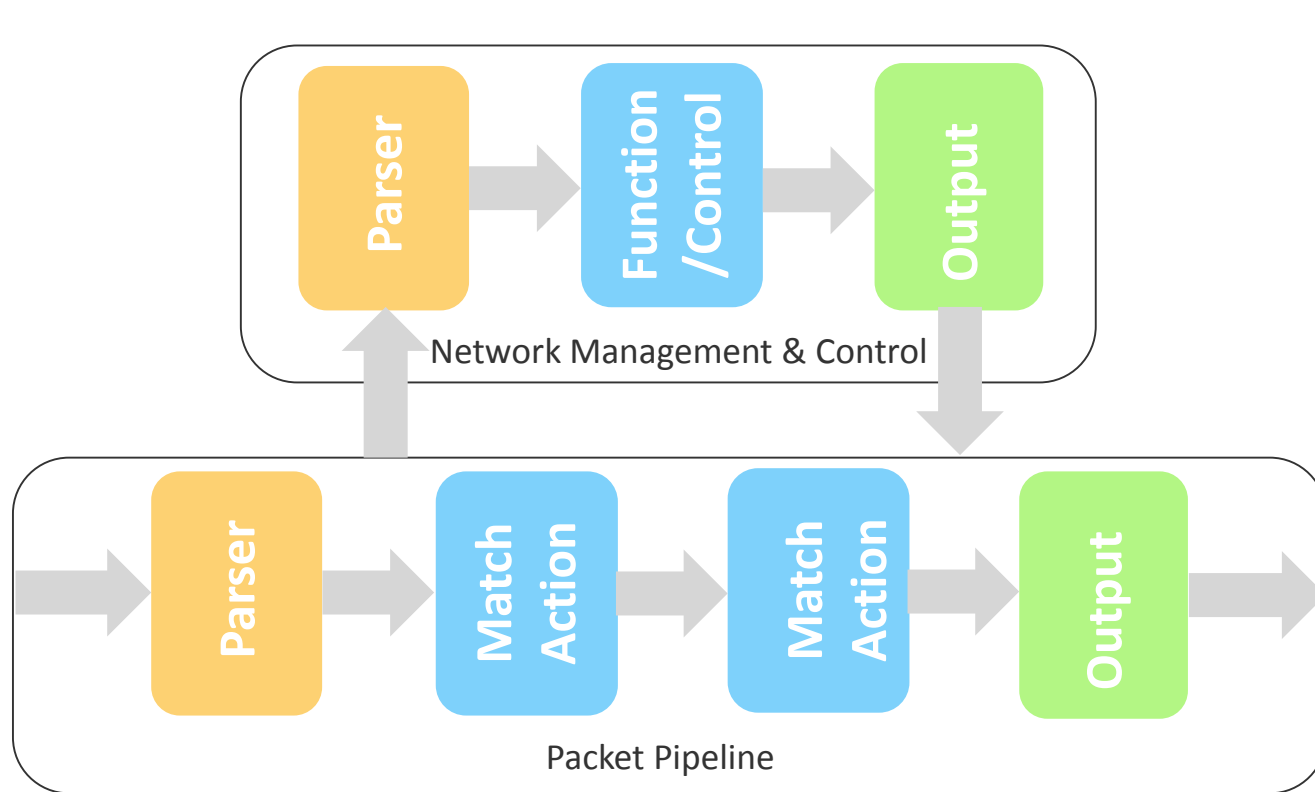
Evolve P4 to be an **unambiguous specification** of a **platforms forwarding and network management behavior** throughout a carriers network

<u>Prior Art</u>	<u>Evolution Examples</u>
Pairwise partner VLAN negotiations and interlock	Exchange ATT_VLAN.p4 & Partner_VLAN.p4
Experimental CoS tweaking of multiple platforms	Provide ATT_COS.p4 to multiple platform suppliers & then show me it works
Regression testing of SLA design with each new platform	Provide ATT_SLA.p4 to multiple platform suppliers & then show me it works
Validation testing of Telemetry across platforms	Compile ATT_Telemetry.p4 to your platform
Supplier NAT requirements interlock	Provide ATT_NAT.p4 supplier

A very powerful construct to simplify a carriers $O(n^2)$ seam management effort

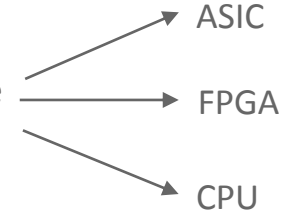


Extending P4 to Network Management and Control



Function /Control

Open
Data Model
& Complete
Portable
.p4 Spec



Multiple
Targets

Function /Control	Use
Time Stamp	TWAMP SLA
Traffic Generator	Throughput Testing
Timer	BFD
Counter	Usage based services
VNF Logic	SDN Control

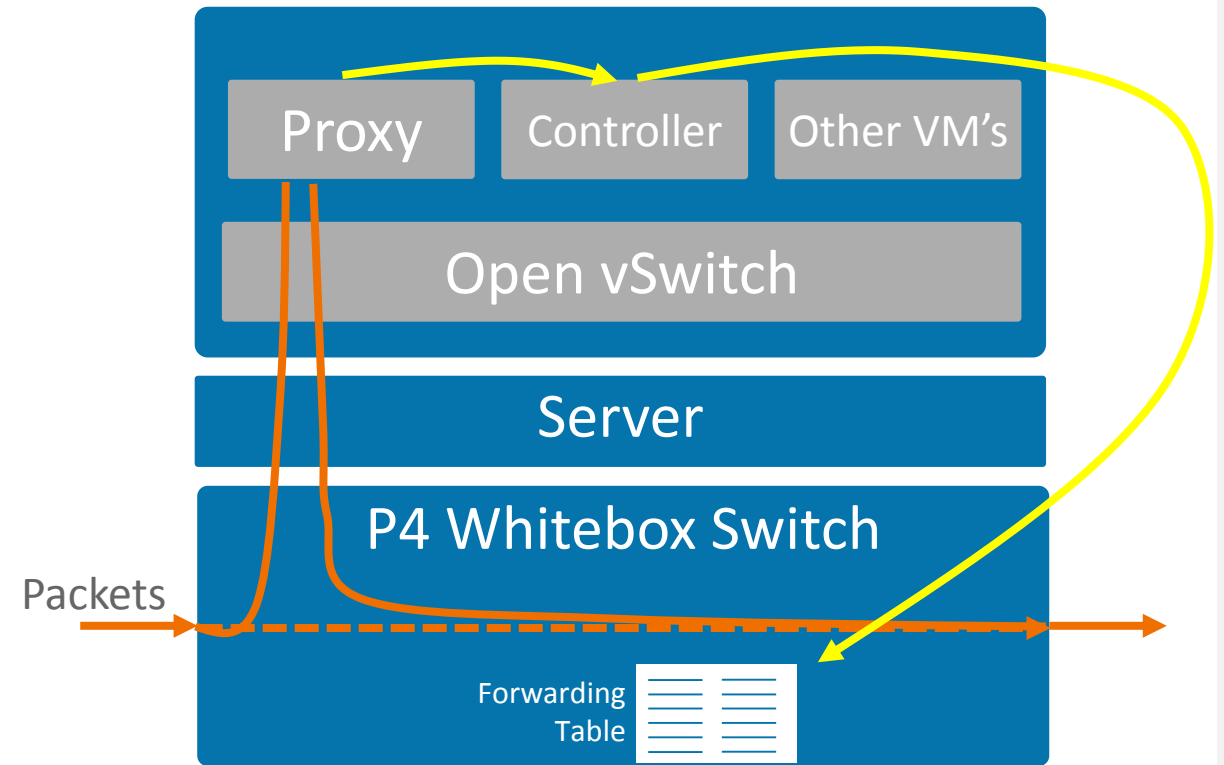


P4 Network Control - Proof of Concept

AT&T Application Development Team in Tel Aviv

- P4 used to dynamically control which packets are passed to the application layer
- Majority of the packets are handled in whitebox switch
- Only the packets requiring application processing will go to application layer
- Increase network efficiency and reduce latency

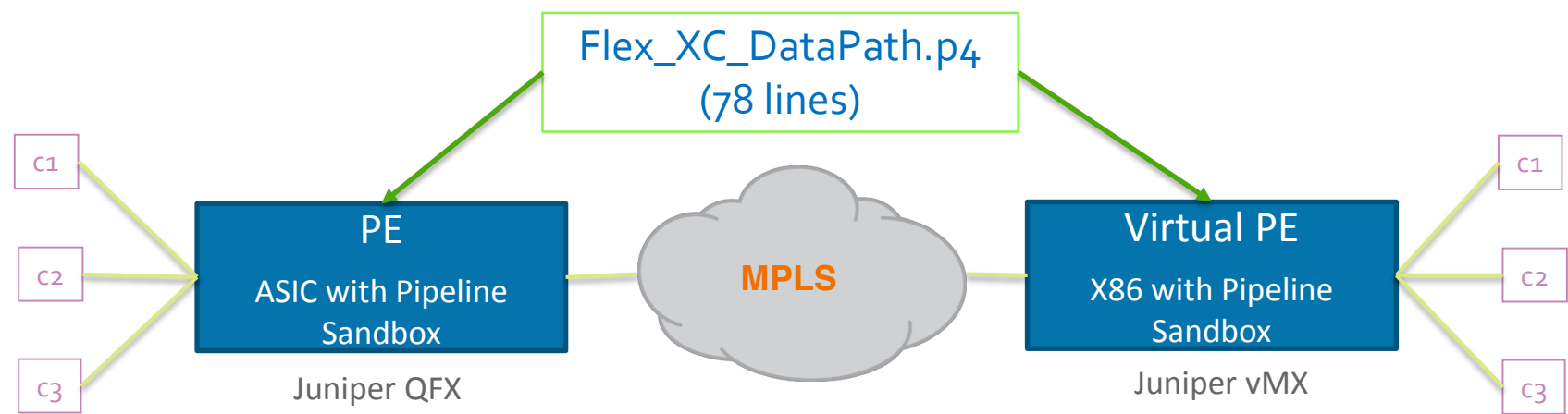
“Taking TCP Splicing down to the switch level”



P4 Flexible Cross Connect Service - Proof of Concept

collaborating with Juniper

VPWS support in EVPN, draft-ietf-bess-evpn-vpws-02.txt, Section 2.4, Oct 15, 2015



Seam Management	P4 for Flexible Cross Connect
Fast requirements interlock	Yes
Single .p4, multiple hardware targets	Yes
Fast standards delivery on multiple platforms	1 month ietf draft to working demo



Proof of Concept Learnings → P4 Evolution

P4 addresses the data path pipeline but carriers need additional capabilities to manage seams

Standardize protocol to pass packet data to the controller

- P4 can clone a packet, but to send to the controller you need to wrap it inside some other protocol

Standardize function/control extensions that can be compiled to multiple hardware targets

- Simplifies a carriers $O(n^2)$ seam management effort

Standardize the protocol between controller and P4 switch used to load data into the Switch tables

- In P4 POC demo we used thrift for loading switch table entries, but just as an example.
- Standardize protocol for loading entries into the switch table to allow a P4 controller to transparently interact with P4 switches from different vendors/targets



