TOMORROW starts here.
ESP - Evolved Services Platform
“Mozart”

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That was L2 Overlay.

Wait… Let’s leave the DC world for now. How about the WAN? The Internet?

How well does L2 scale? Can I have L3 Overlay, please?
The answer is vPE.

*BGP-based IP VPN based on MPLS VPN technology scales great and is massively deployed.*
The Data Center

DC Interconnect (e.g.: ASR 9000)
Building an Overlay
Connecting VMs to VPNs (normal PE-CE relationship)
DCI
• Devices: Physical, Virtual

• Domain: DC, WAN

• WAN: VRF Interconnect,

![Diagram of DCI network with VRF interconnect, GRE, and MPLS-VPN connections.]

**Table: Data Structure**

<table>
<thead>
<tr>
<th>IGP Label 10</th>
<th>BGP VPN Label</th>
<th>IP Payload</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPN Label pop/push</td>
<td>IP look up in VRF</td>
<td>VPN Label pop/push</td>
</tr>
</tbody>
</table>

**IPv4 Header**

- GRE Header

**IPv Payload**

- IP Payload

**Diagram Notes:**

- VRF1
- VRF2
- GRE
- WAN MPLS-VPN
- DC
- VRF interconnect
- MPLS-VPN connections
- VSOC Network Ctrl
- MP-BGP
- RESTConf
- VM: 20.0.0.1
- VM: 21.0.0.1
- Server1
- Server2
- App VM
- VRF Label pop/push

**Network Details:**

- 0.0.0.0/0 NH=10.0.0.1, VPN Label, GRE
- 21.0.0.1/32 NH=11.0.0.3, VPN Label=100, GRE

**Devices:**

- Physical, Virtual

**Domain:**

- DC, WAN

**WAN:**

- VRF Interconnect,
Cisco Evolved Services Platform - Mozart
Functional Architecture

- Applications
  - Portal/Service Catalog
  - SP OSS
    - REST API

- Cross Domain Orchestrator
  - VNF
  - DC Network
  - Cloud
  - WAN
  - Mobility
  - Enterprise/CPE
  - 3rd Party Orch/Mgmt.

- Domain Orch./Mgmt.
  - OpenStack
    - (Compute and Storage Manager)
  - Open Daylight

- Infrastructure Controllers
  - Cisco or 3rd Party

- Infrastructure
  - Virtual
  - Physical
  - Evolved Programmable Network

- System Management
  - High Availability
Cisco “NFV Solution” 1.0
Expanded Architecture View

Prime Service Catalogue

Prime Fulfillment

SP OSS
SP’s Existing Portal/Catalogue

vSOC

VNF Manager
- Service Lifecycle Management
- Service Provisioning

Virtual Topology Manager
- DCI Routing
- Service Routing
- Address Mgmt.

OpenStack
(Compute and Storage Manager)

OpenStack/Jcloud API

MP-BGP

RESTCONF/YANG

DCI (ASR9k)
vPE-F

System Management
High Availability

VNF Library (sample list)
- CSR1kv
- ASAv
- QvPC SI
- QvPC DI
- 3rd Party vNF

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vPE Data Plane: vPE-F (Forwarder)

* **vPE SDN-driven forwarding in the server**

- Light weight software forwarding plane
- Provides highly optimized forwarding in x86 environment
- Runs inside a VM in each server
- Contains a unique forwarding context per tenant
- Provides per-tenant L3, L2 and PBR forwarding
- Support for IPv4, IPv6 address families
- Provides multiple tunnel encaps (MPLS-over-GRE, L2TPv3 P2P L2 transport, VXLAN in future)
- Provides DHCP relay function
- Programmed by vSOC using YangAPI (tenancy and service chaining)
ESP – Forwarder design

Mozart Forwarding Element (vPE-f) VM

- Proxy ARP
- DHCP Relay

- Tenant2 Context
- Tenant1 Context

- DPDK Drivers
- MPLS-over-GRE/VXLAN/L2TPv3 Traffic

- vPE Control Agent

- Mozart Forwarding DP

- VM2, IP2, MAC2
- VM3, IP3, MAC3

- Thin driver for ESXi and KVM

- Host - Linux or EXSi

- Traffic

- Industry’s first user space forwarder
- Multi-threaded, 10G in single core
- ISSU, Fault Isolated
- Highly Portable
- 64-bit, endian clean
- High performance vector packet processing

- DPDK Drivers

- Mozart Forwarding Element (vPE-f) VM
vPE-F Technology – Vector Path Processing (VPP)

- vPE-forwarder is based on Cisco’s VPP technology

- What is Vector Packet Processing?
  - Highly optimized packet processor for general-purpose CPU’s
  - Very fast
    - Constructs super frames of packets and processes them in one shot - exploits temporal locality of application flows. Benefits from I-cache, D-cache hits.
    - Direct PCI pass-through allows send/receive packets with zero operating system overhead
    - near line rate processing on 10G interfaces
  - 64-bit, multi-threaded
  - Portable
  - VPP is a user space process - fault protected & easy upgrades
  - Multi-tenant forwarding contexts for IPv4 and IPv6
  - Shipping on several Cisco products (ASR 9000, CGSE, CSR1000v)
What is the Intel DPDK and what it is Not

- Intel DPDK – Intel’s Data Plane Development Kit
  - Intel’s Framework for fast packet processing ecosystem
  - Operates in Linux user space
  - Framework provides a set of libraries that enable a general abstraction layer for:
    - Packet buffers
    - System memory allocation / de-allocation
    - Ethernet Poll Mode Driver API (virtual & physical)
    - Longest Prefix Match & Hash Algorithms
    - Traffic Meter & Hierarchical Scheduler
    - Time reference

- The DPDK is not a protocol stack!

- VPP engine use: DPDK as NIC driver
IPSE - Interface to a Packet Switching Element

- Forwarding plane data models published in IETF draft

- Defines programming interface to a packet forwarding plane
  - Defines an open, standards based data model for the data plane
  - Usable by a controller to define forwarding behaviors to achieve a function

- Any forwarding plane can support this data model and be usable from a Mozart controller
  - Currently implemented in the Mozart VPP
  - Usable on regular ASIC and microcode driven forwarding engines too
  - (eg. TORs, DCI)
ASIC or CPU? Real PE or vPE? SDN or NfV?

**CRS:**
- 2004: 130nm NPU, 40Gbps (~11W/Gbps)
- 2010: 65nm NPU, 140Gbps (~5W/Gbps)
- 2013: 40nm NPU, 400Gbps (~2W/Gbps)
- 2015: 20nm...

**ASR9000:**
- 2009: 90nm NPU, 120Gbps per slot
- 2011: 55nm NPU, 360Gbps per slot
- 2014: 28nm NPU, 800Gbps per slot
- ...

**Virtual:Physical (CPU:ASIC) real estate ratio ~15:1**

**Legend:**
- No Traffic Mgmt
- Basic QoS
- Hierarchical QoS

**CPU Core (x86) Feature Processing Performance**

- 1 Feature: IP Forwarding
- 2 Features: IP Forwarding, MPLS Label
- 3 Features: IP Forwarding, MPLS Label, Netflow
- … ‘N’ Features

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ESP - BUILDER SCREENSHOT: DESIGNING A SERVICE
Summary: Components of Cisco vPE Solution

- **vSOC**: Virtual Systems Operations Center (vSOC) Extensible Service Orchestrator

- **vPEF**: Virtual PE Forwarder (vPEF) – Light weight forwarding element per Server

- **NfV Services**: vASA, CSR 1000 for NAT and DPI & RaaS,

- **DC WAN Gateway**: ASR9k, Nexus 7k - Physical PE (DC WAN Gateway)
Prosíme, ohodnoťte tuto přednášku

Děkujeme