SDN/OpenFlow: Visão do CPqD

TRANSFORMANDO
EM REALIDADE

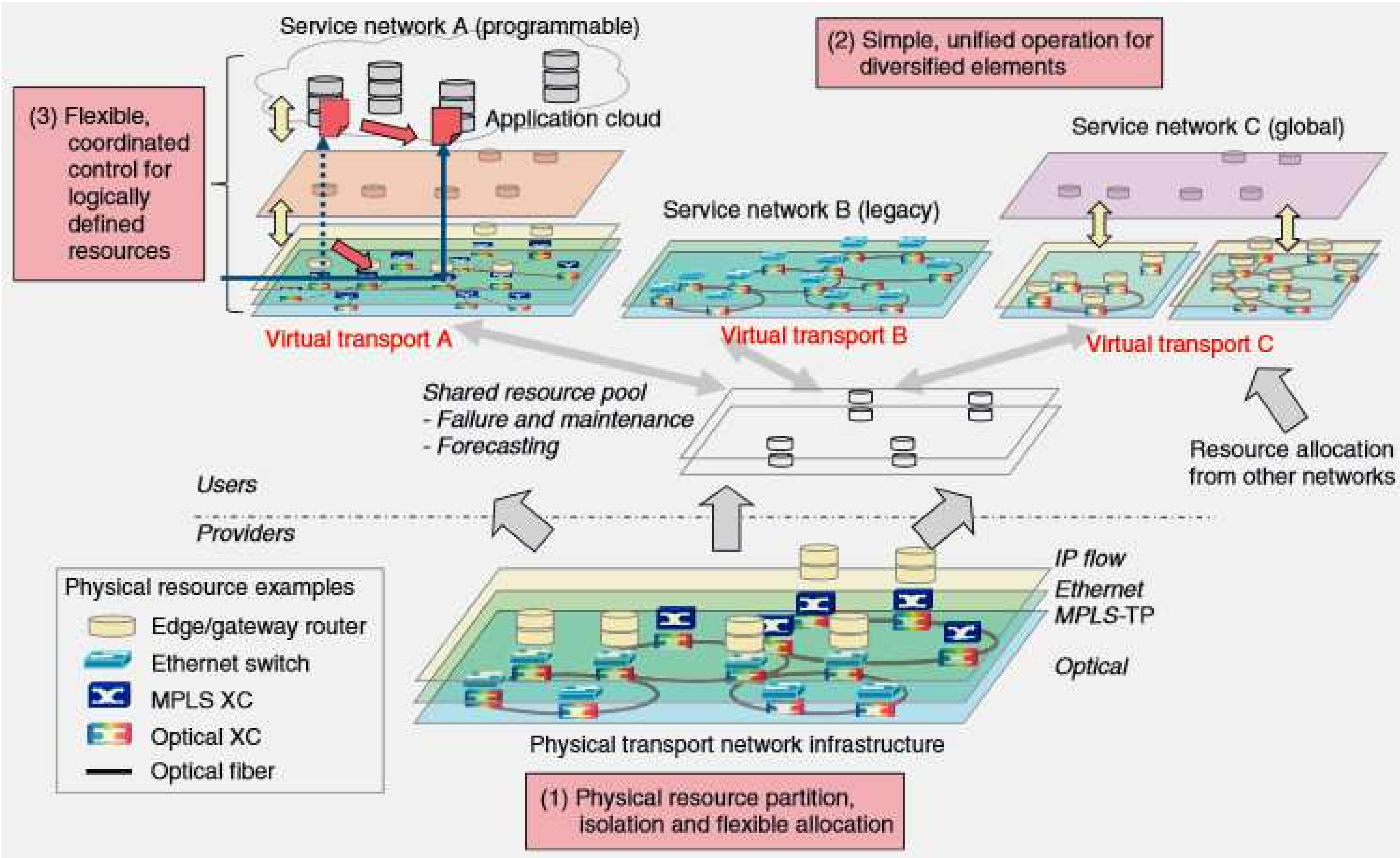
Workshop Datacom de SDN/OpenFlow

Curitiba, PR, 21-22 de Agosto de 2013

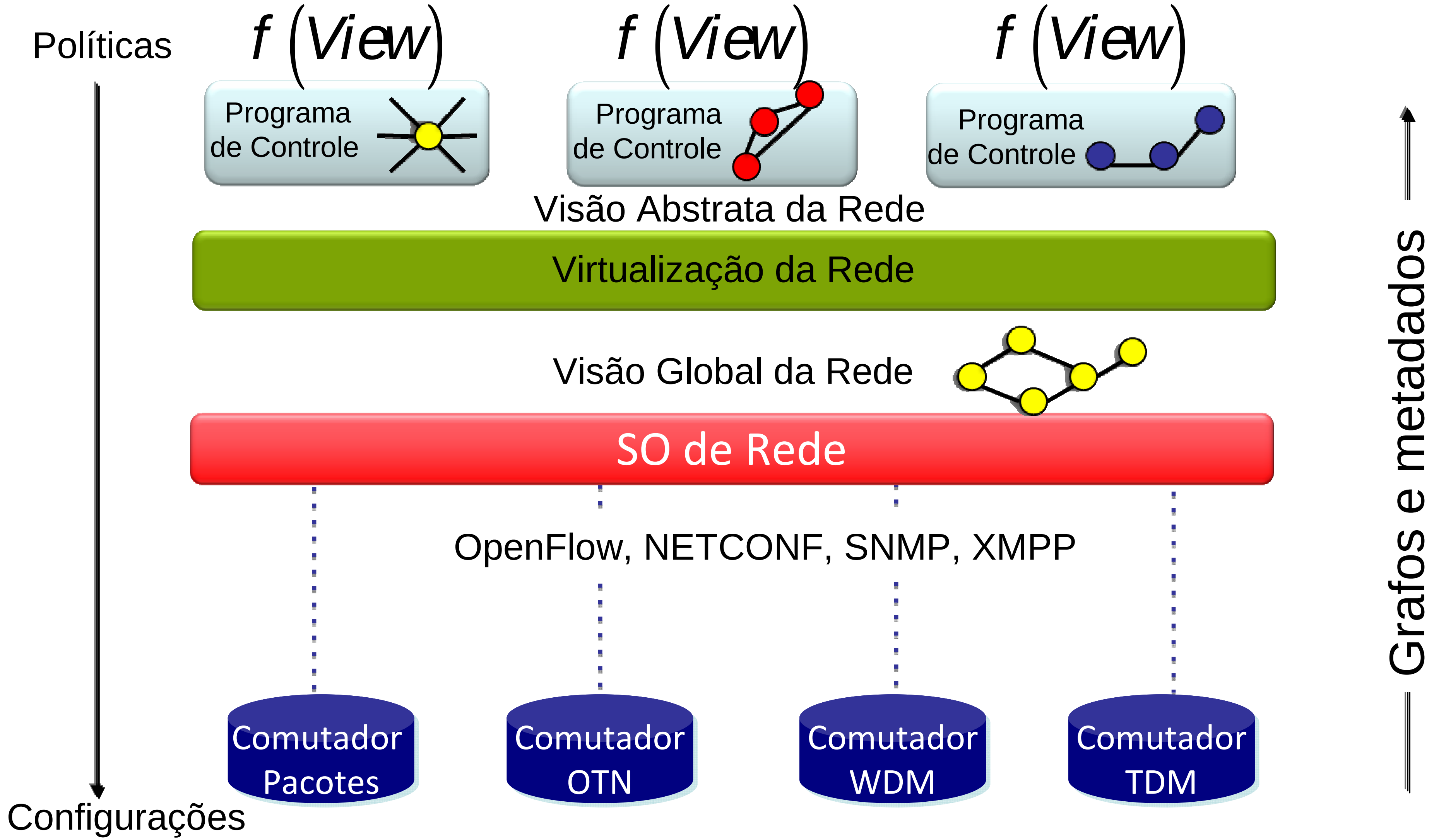
Como enxergamos SDN

- Estamos no início de uma transição irreversível
  - Oportunidades para a indústria nacional
- SDN não é solução para todos os problemas
  - Mas certamente tem apelo em variadas aplicações
- Soluções SDN devem assumir longo período de transição e coexistência com legado
  - Equipamentos híbridos (tradicional/SDN)
  - Redes híbridas: equipamentos tradicionais e equipamentos SDN
  - Soluções que agreguem valor à infraestrutura existente, seja reduzindo custos ou aumentando receitas
  - Algumas exceções (ex.: datacenter de nuvem) podem seguir abordagem SDN 100% OpenFlow
- Oportunidades para a tecnologia nacional em comunicações seguras anti-espionagem

Visão de SDN
Convergências Vertical e Horizontal



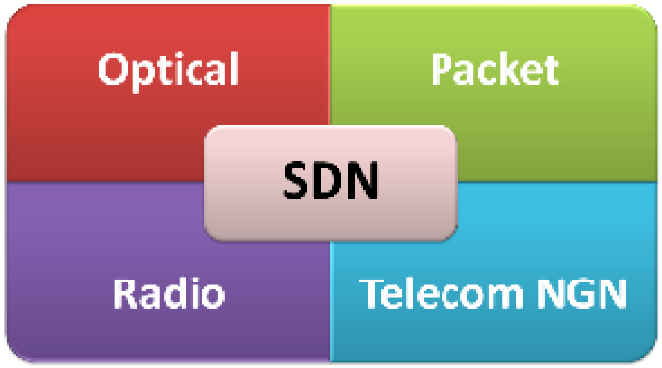
• Visão de SDN: Controlador



Escopo de SDN:
Migração gradual para SDN

Software Defined Optical Transport
- Flexgrid ROADMs and adaptive transponders
- Embracing NETCONF and YANG modeling
- GMPLS emulated services and hybrid models
- Application of cognitive algorithms

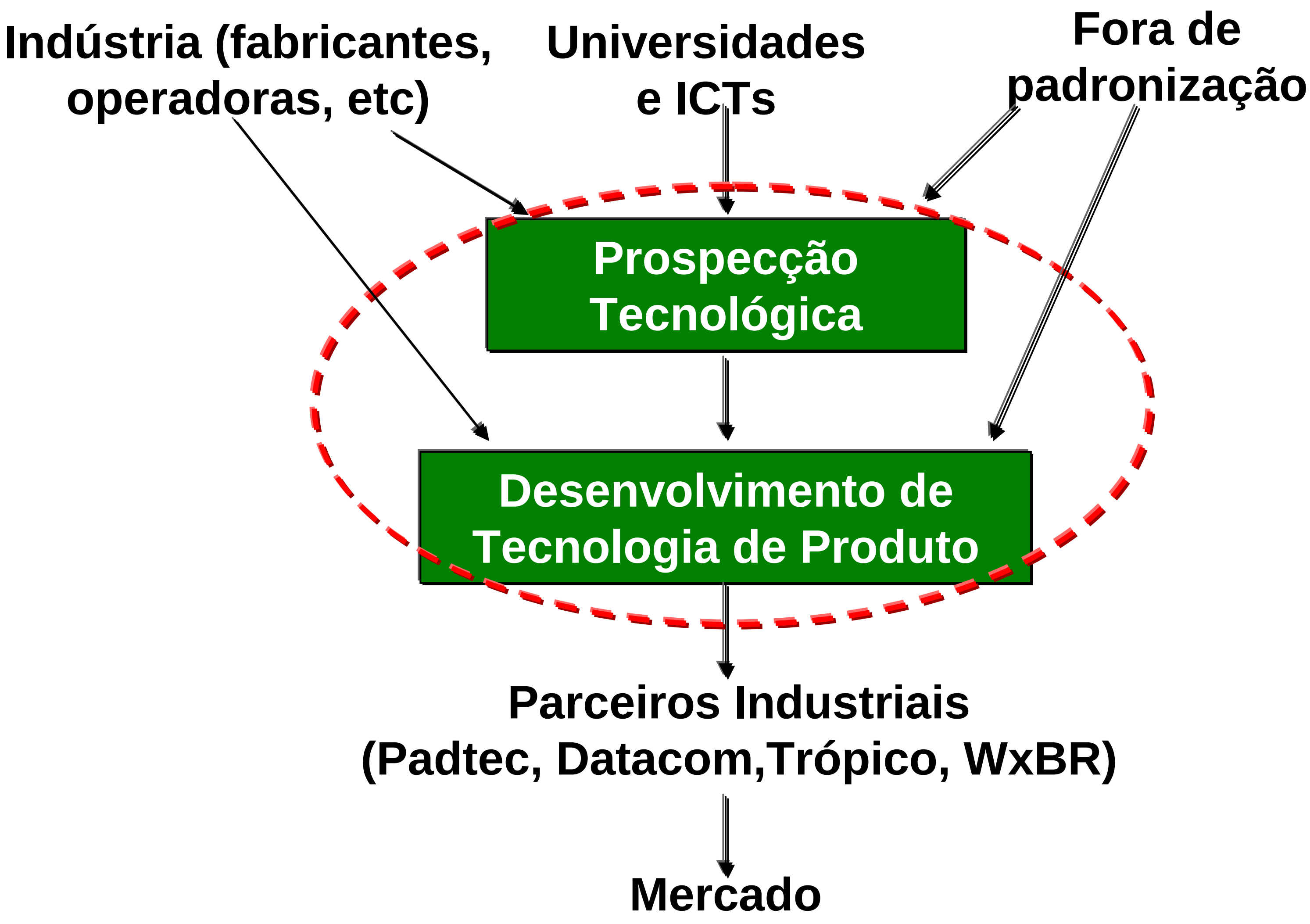
Software Defined IP Routing
- Bridging IP routing and OpenFlow
- Moved to OF 1.3 and multi-controller support
- Brazilian industry embracing OpenFlow/SDN
- First operation pilots reveal added value
- Increasing user/developer community



Software Defined Wireless Networking
- Control OpenFlow 1.3 WiFi router (OpenWRT)
- Consumer-friendly home management
- Control OVS in Linux-based devices (eg. TV)?
- Investigate mesh routing scenarios
- Integration w/ cognitive radio capabilities

Software Defined Telecom Services
- From NGN Diameter interfaces to OpenFlow
- Integrate OSS/BSS with dynamic SDN control
- Hybrid cloud network transport services
- Link with Network Functions Virtualization (NFV) and network management outsourcing

SDN no CPqD
Processo de P&D

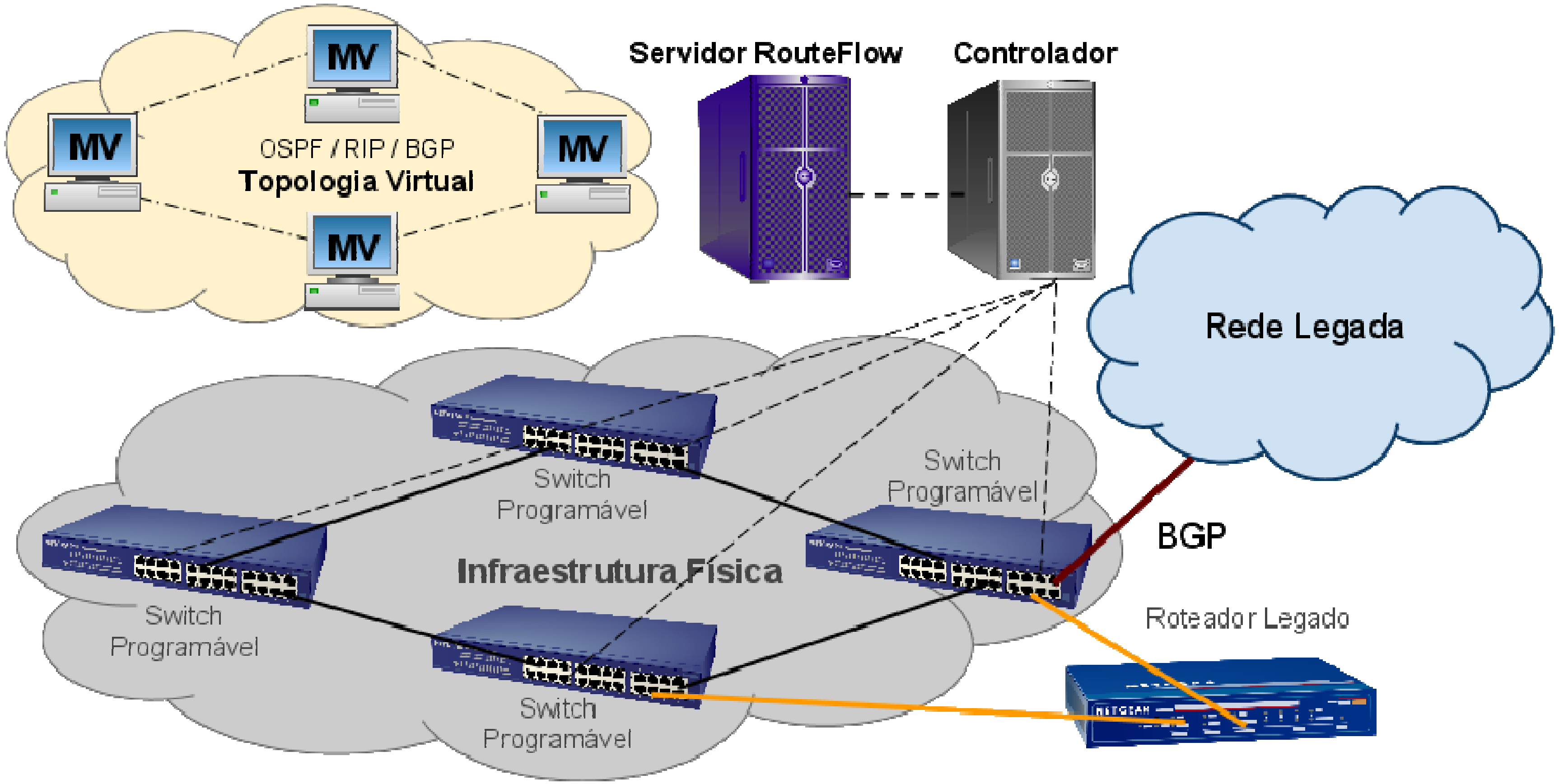


RouteFlow

http://cpqd.github.io/RouteFlow/

From the labs to production

RouteFlow

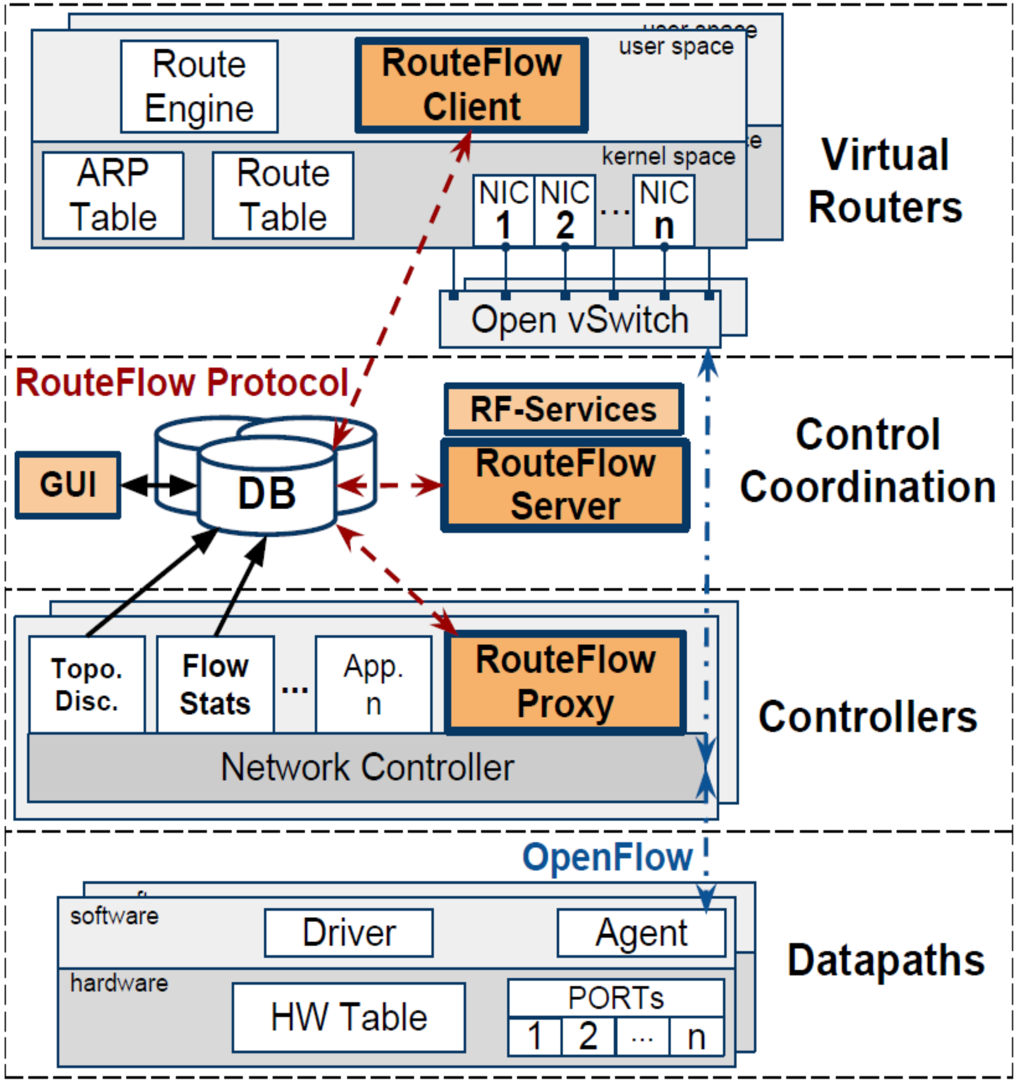


Leverages open source routing Linux suites such as Quagga

Interoperates with legacy routers and routed networks

RouteFlow Architecture

Built for robustness and scale



Key Features

Modular architecture

- RF-Proxy
- RF-Server
- RF-Client

Database layer

- JSON-based IPC
- Resillient core state
- Programmer-friendly

Multi-Controller support

- NOX, POX, Ryu, Floodlight,

OpenFlow version

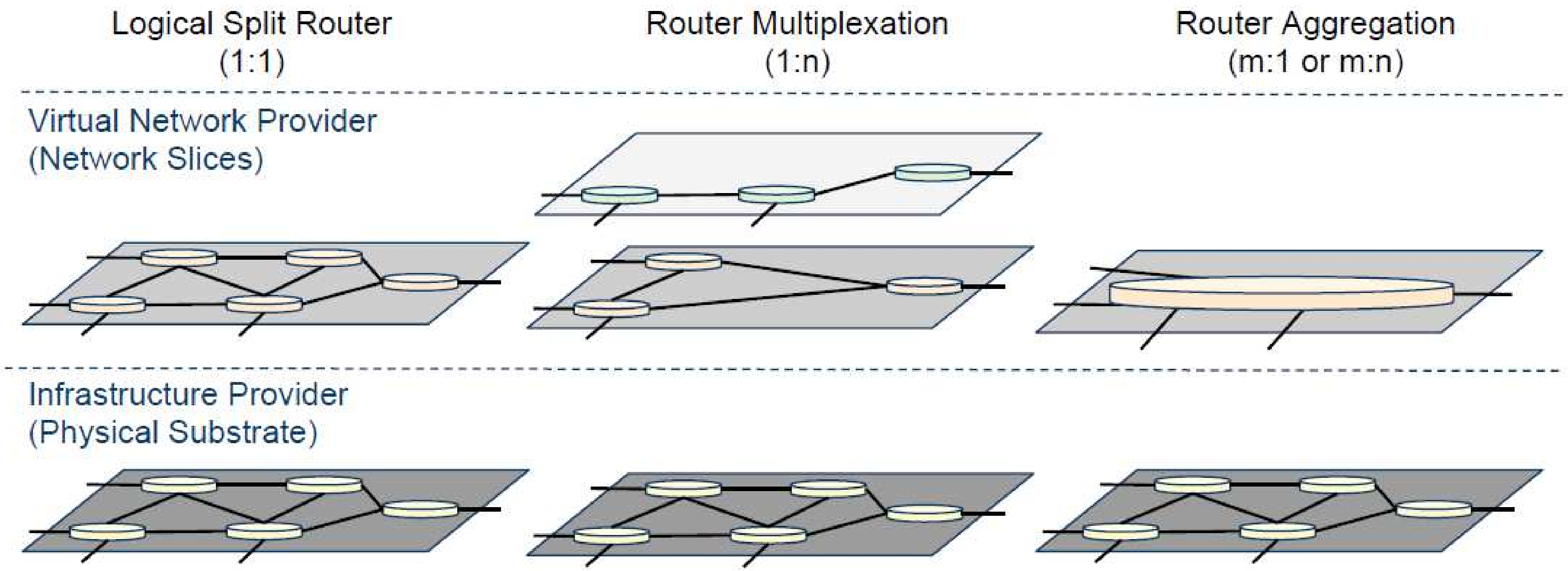
- 1.0: NOX, POX, Ryu, Floodlight
- 1.2/1.3: Ryu

** RouteFlow-specific blocks in orange*

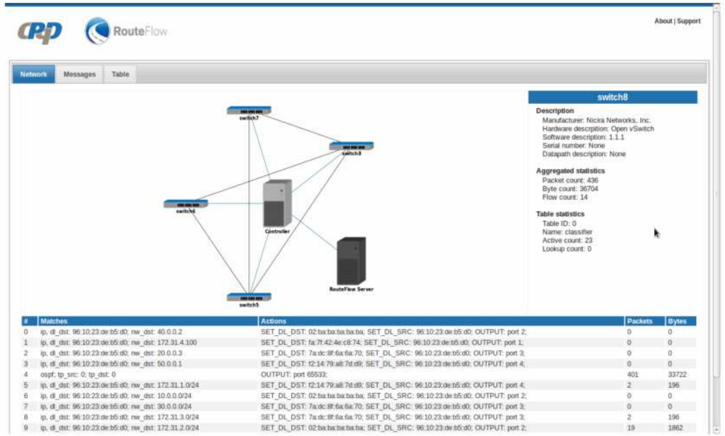
Modes of operation

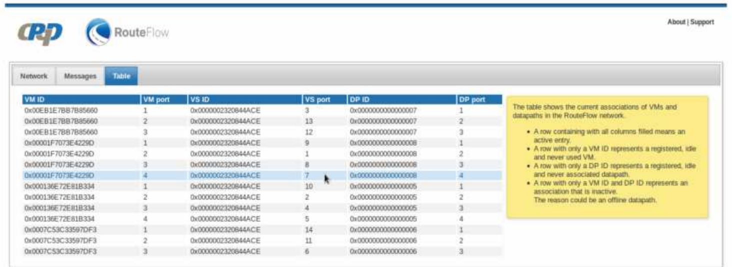
From logical routers (akin VRFs) to single node abstractions over flexible virtual networks

New design choices on the distribution of the control nodes



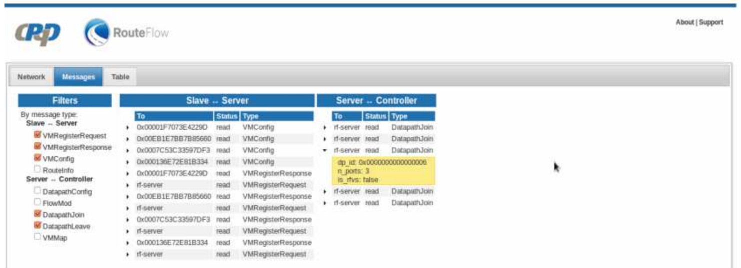
RouteFlow WebUI

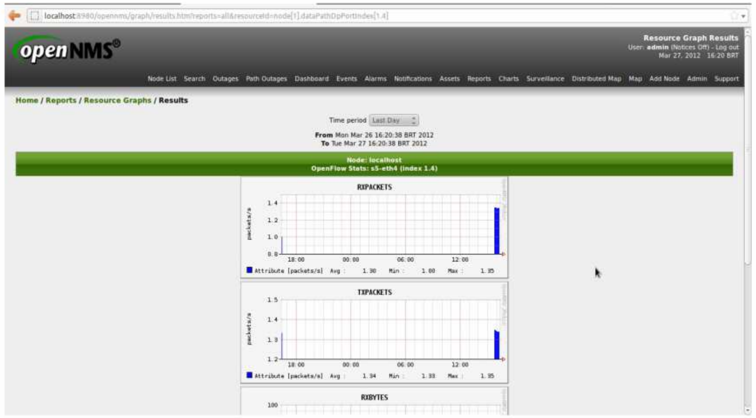




Topology and Statistics

Resource Status and Mapping

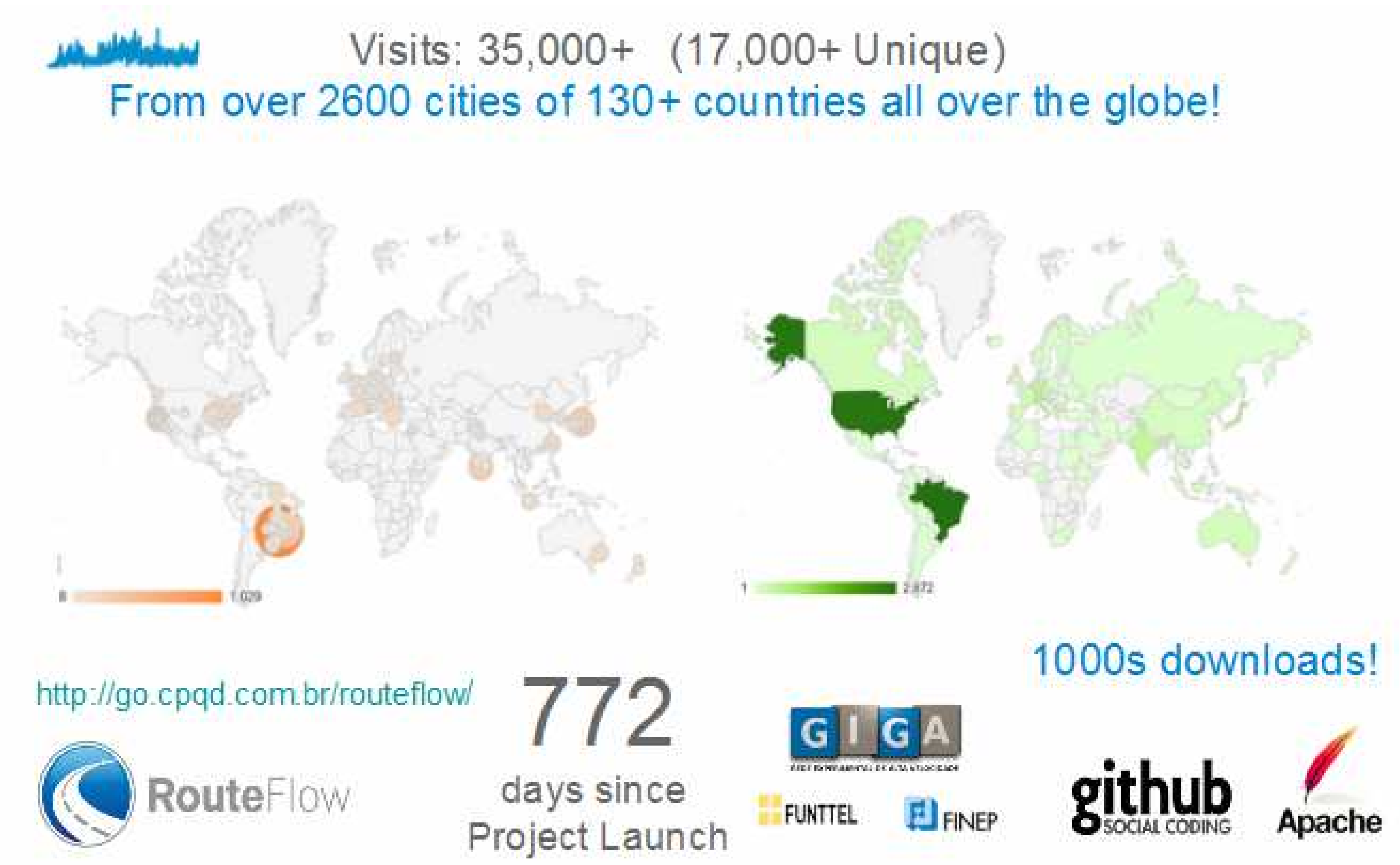




RouteFlow Protocol

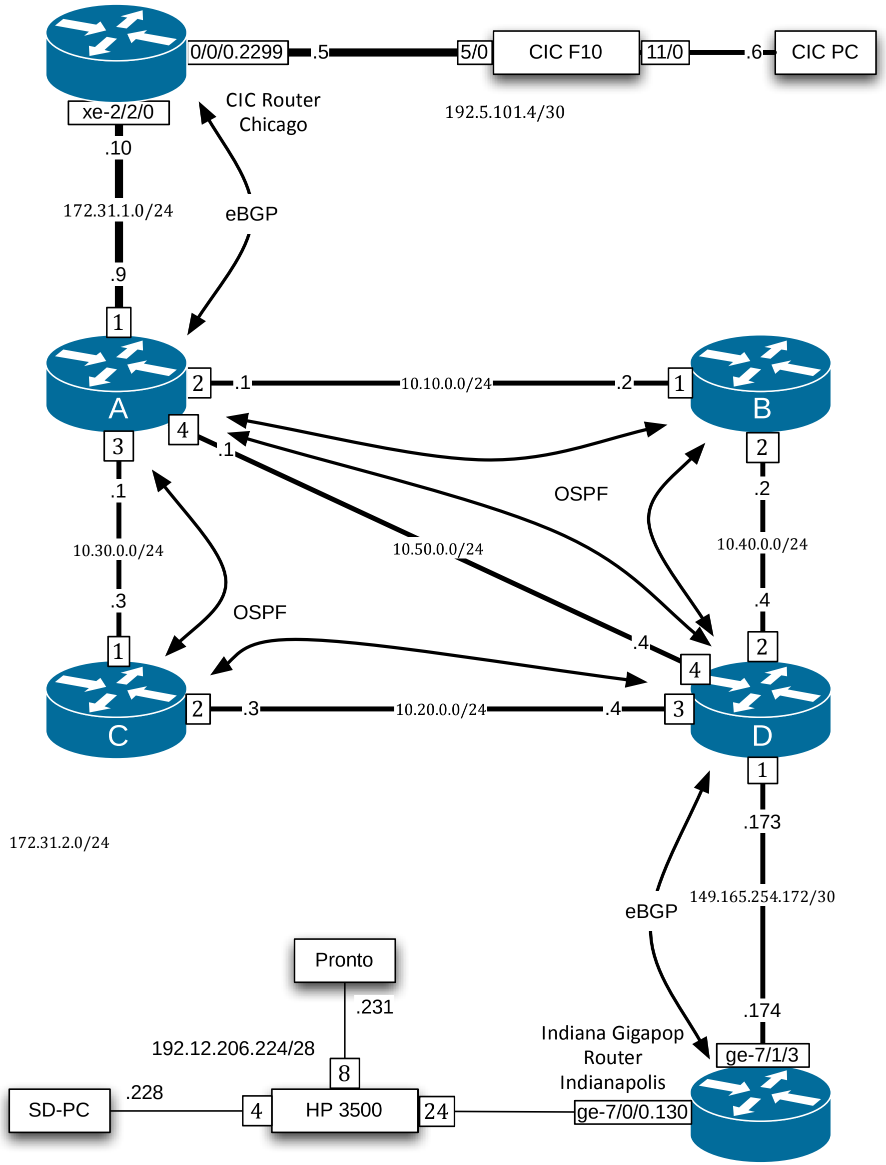
OpenNMS SNMP

RouteFlow Statistics
Building a community of users and developers



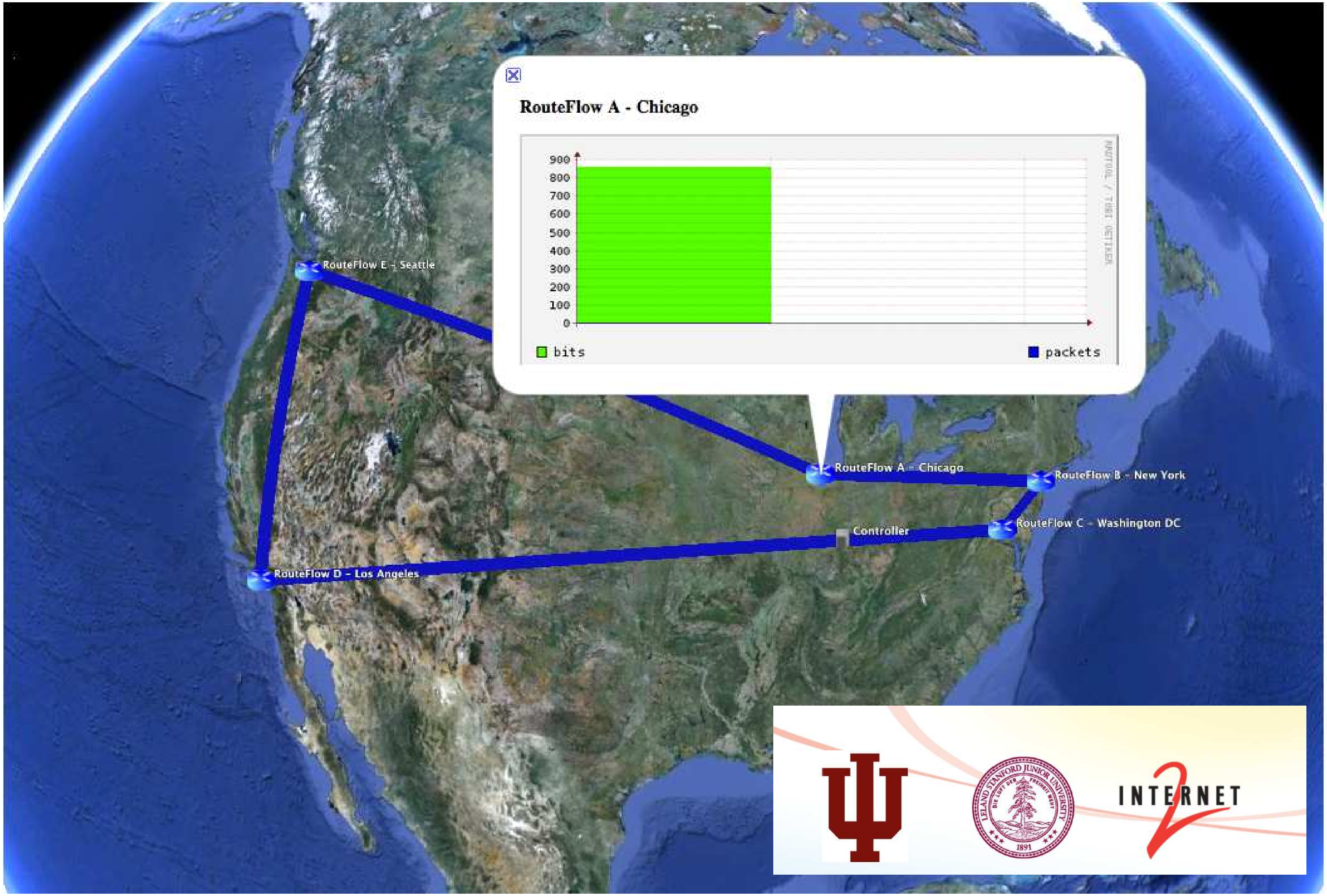
RouteFlow Field Trial at Indiana University

Open Networking Summit 2011 Demo Booth

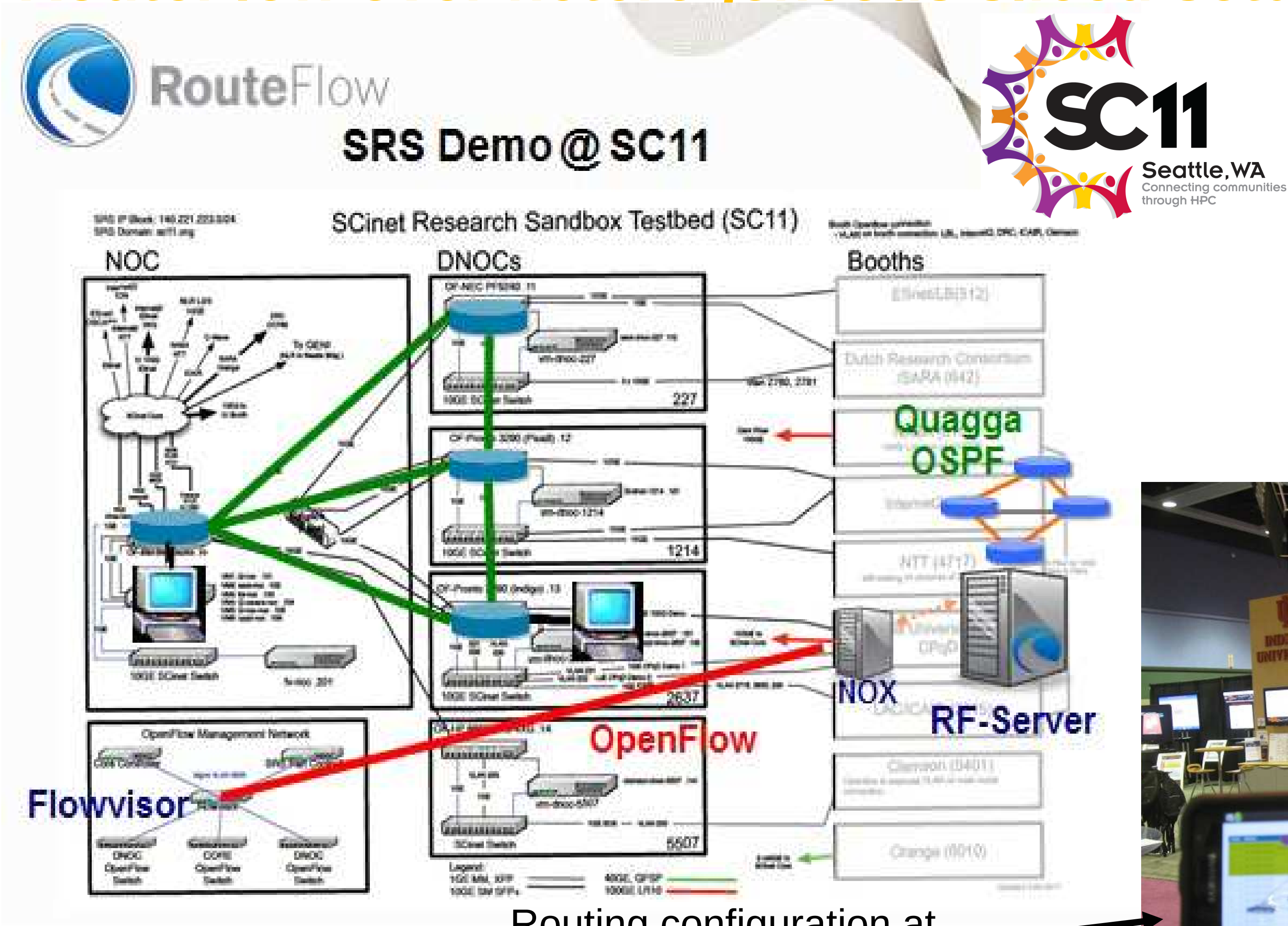


RouteFlow NDDI/I2 Deployment

Joint Techs



Demonstration at Supercomputing 11
RouteFlow over heterogeneous sliced setup



Routing configuration at your fingertips

RouteFlow

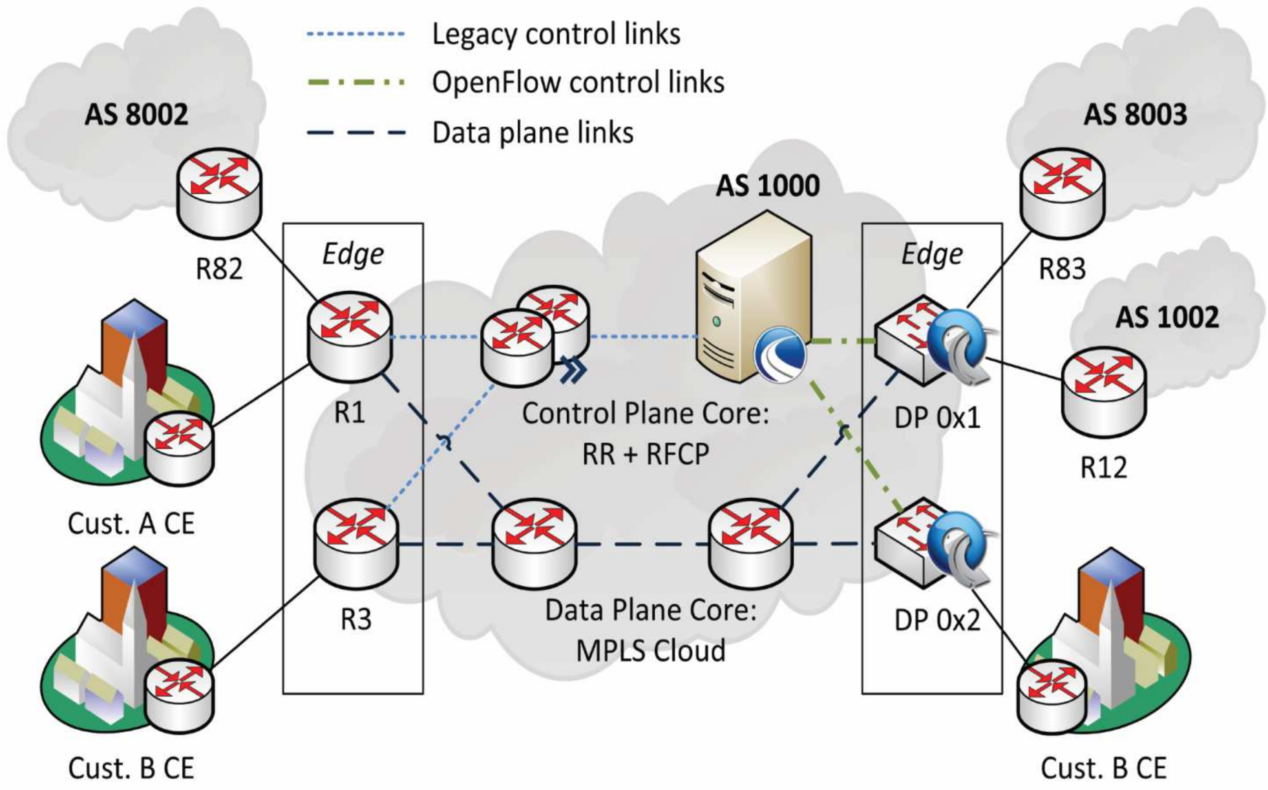
More than a solution... an Innovation Platform

Controller-Centric Hybrid Networking

A migration path to roll out OpenFlow technology

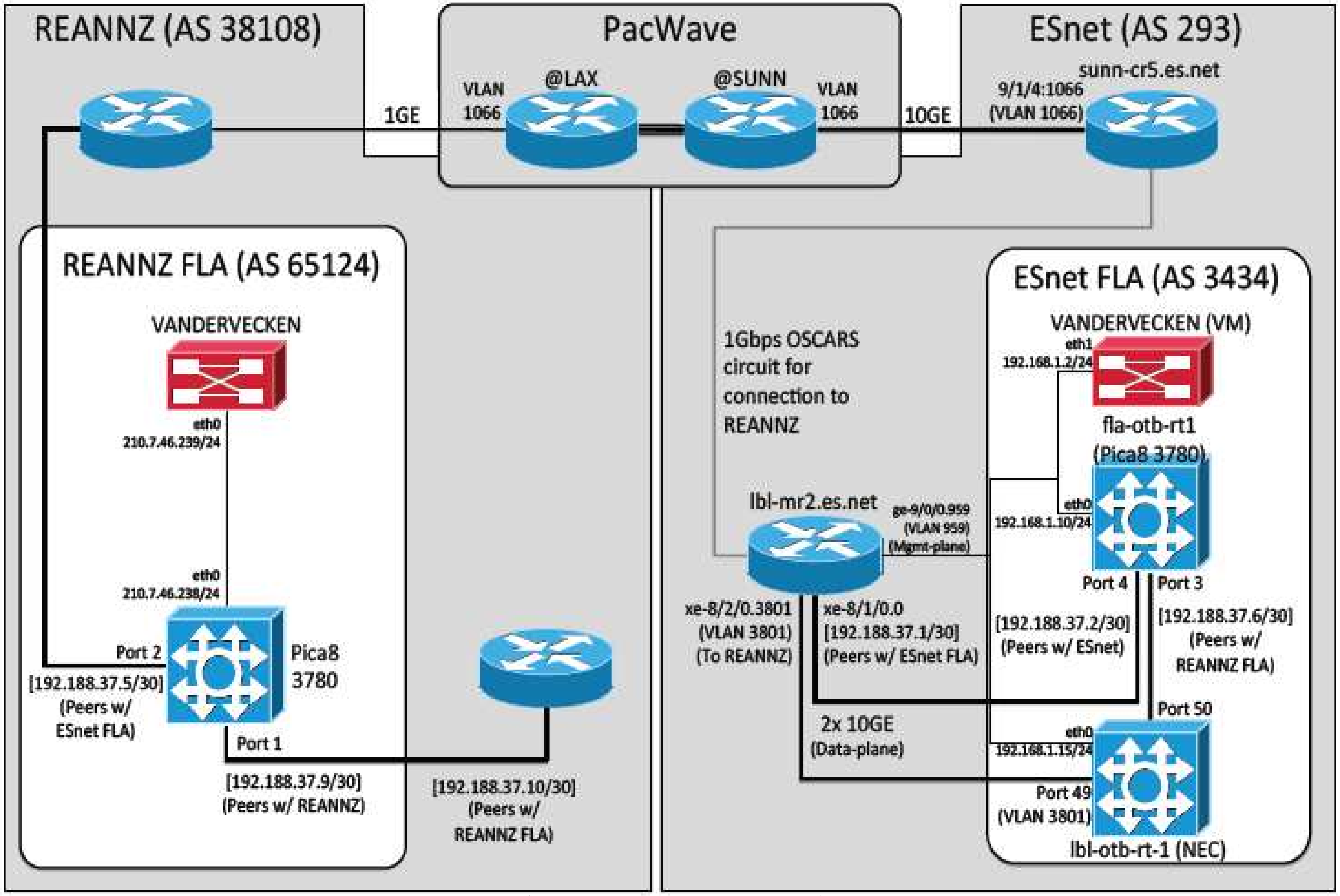
Not a revolution, but an evolution of current iBGP RRs to essentially eBGP Route Controllers

- “BGP-free edge”: A cost-effective simplified edge for SW-driven innovations



International BPG peering using RouteFlow

Route aggregation: 40% reduced FIB size



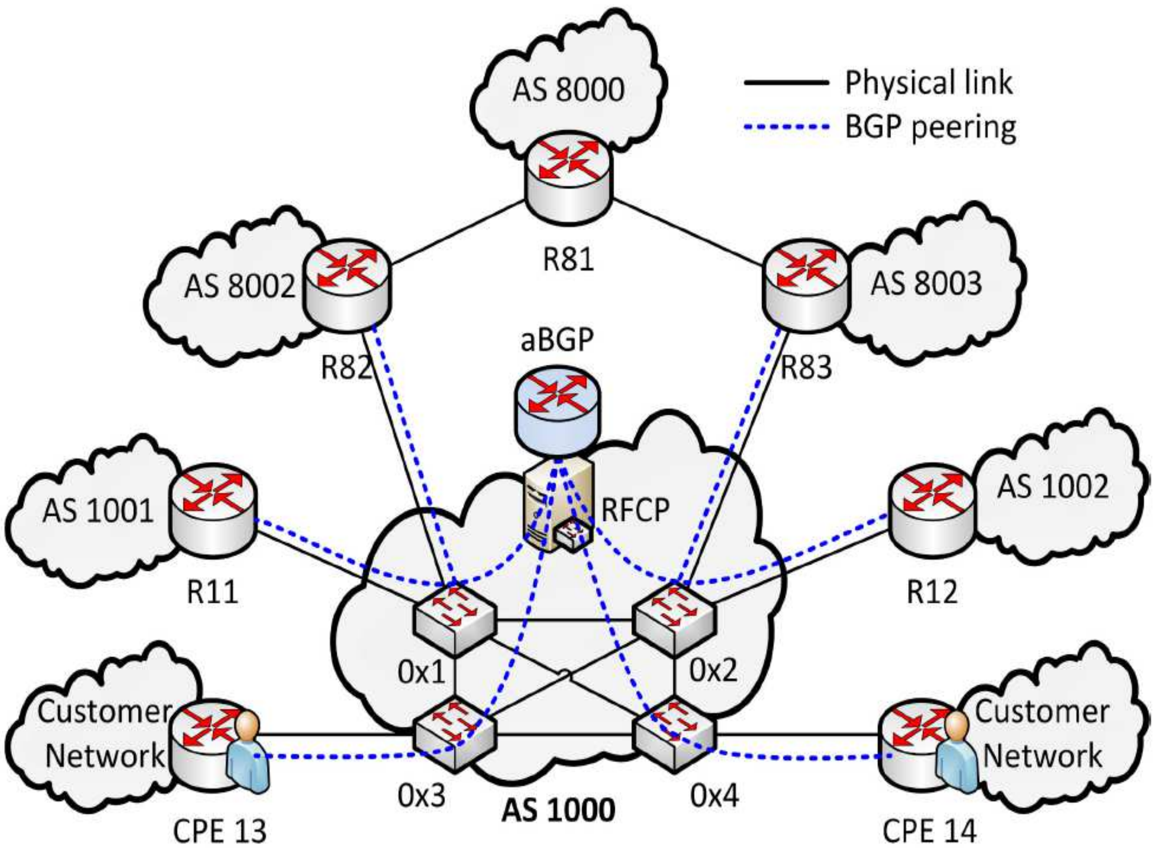
REANNZ   Google   ESnet

Aggregated BGP routing service → RCP

Single node abstraction of a domain-wide eBGP router

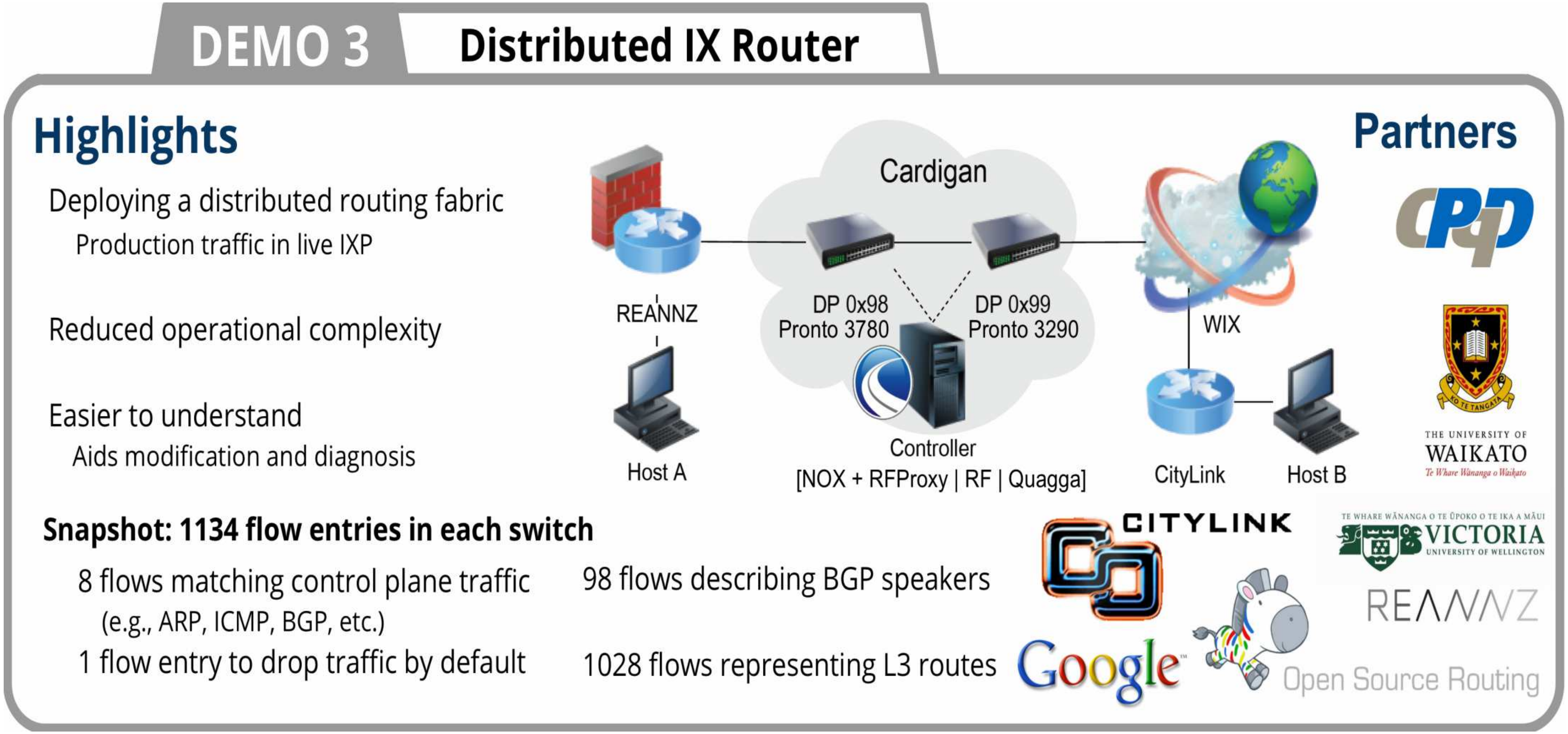
- Think modern multi-chasis routing architectures with external route processors and OpenFlow switches acting as line cards

Aggregation logic defined in the RF-Server



Distributed IX Router

RouteFlow in production (ONS 2013 demo)



InterVLAN Routing (IVR)
RouteFlow in production (ONS 2013 demo)

DEMO 2 InterVLAN Routing

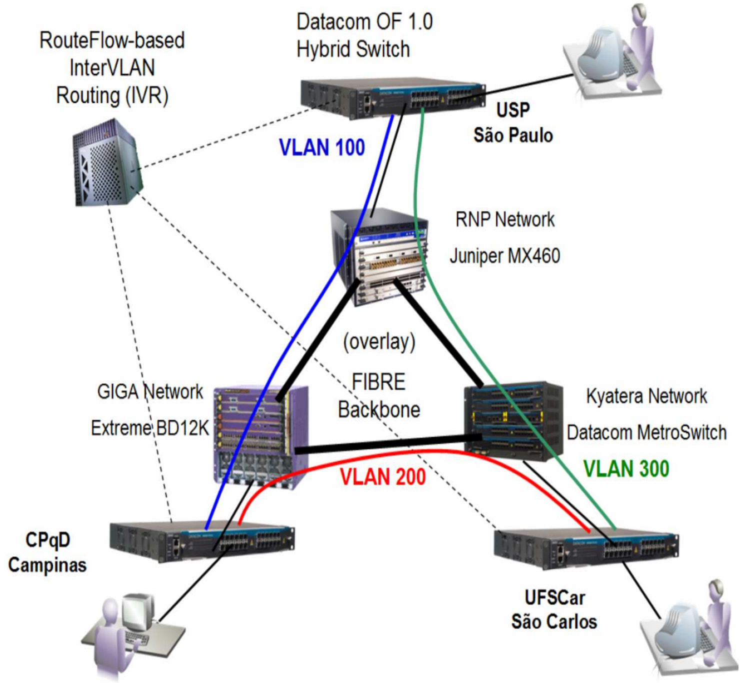
Highlights

Goal: Interconnect 32 campi

RFServer defines InterVLAN routing logic
- Router-on-a-stick paradigm

Seamless VLAN configuration

OpenFlow rules match on destination IP and perform VLAN rewrite actions

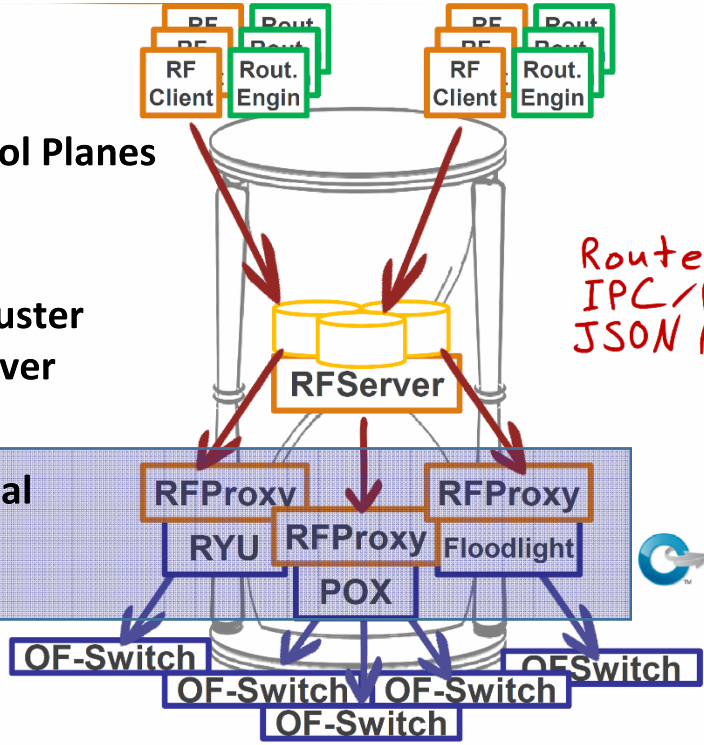


Partners

High Availability

Shadow Virtual Control Planes
Backup VMs

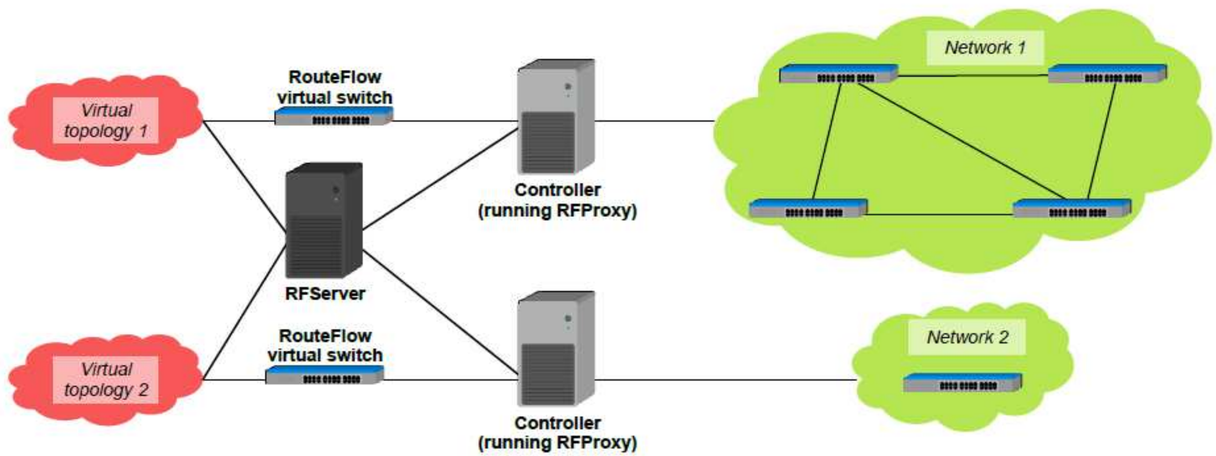
Distributed DB Cluster
State-less RFServer

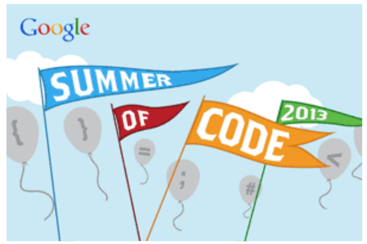


RouteFlow
IPC/RPC
JSON APIs

Controller Cluster Architecture

- M:N OpenFlow Controllers: Master / Slave / Equal
- Distributed Environment
  - Group of Switches / Network Domains

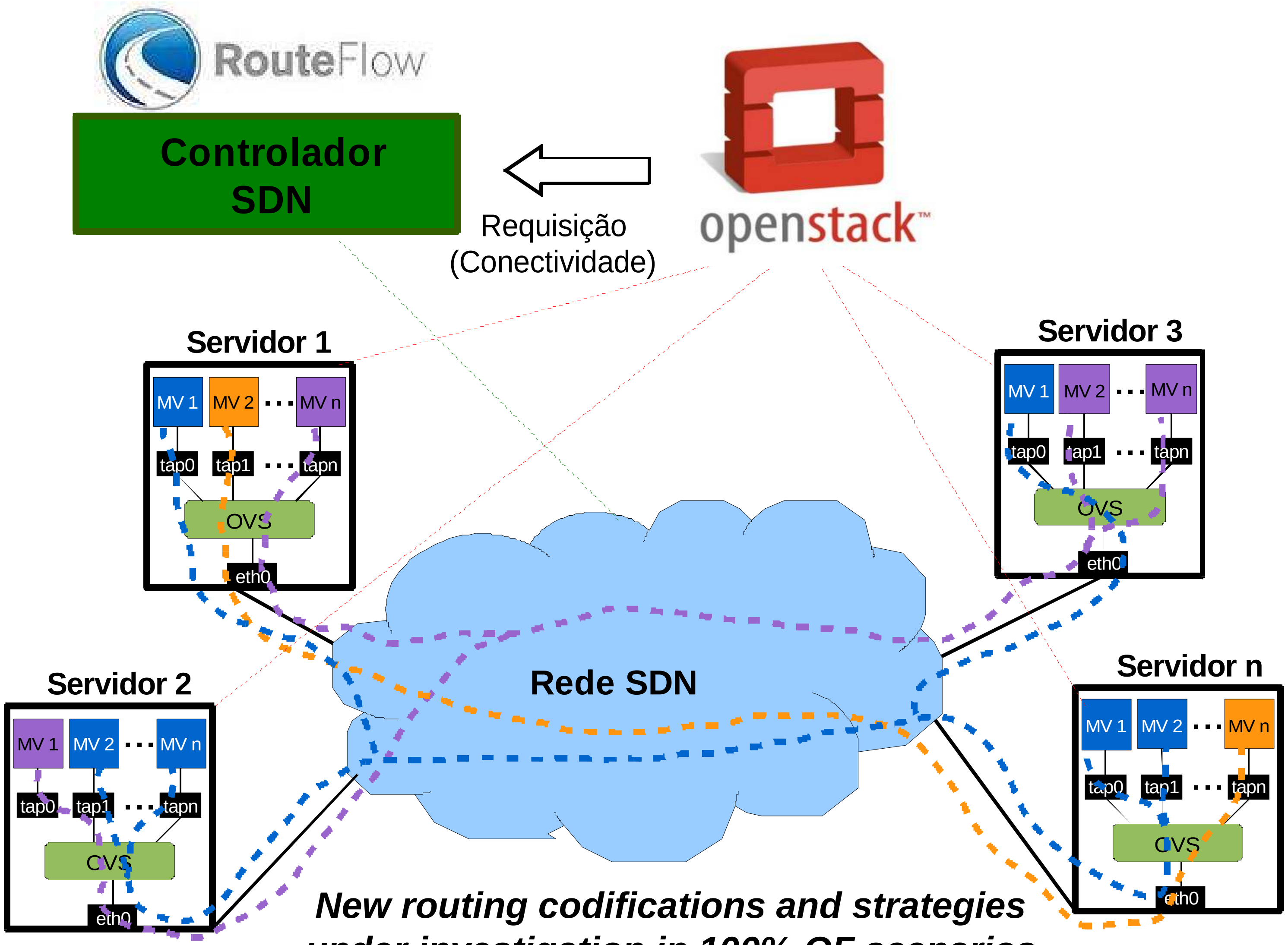




Cloud Datacenter Network

Rede de Datacenter de Nuvem "*multi-tenancy*"

Cenário SDN híbrido OF/legado

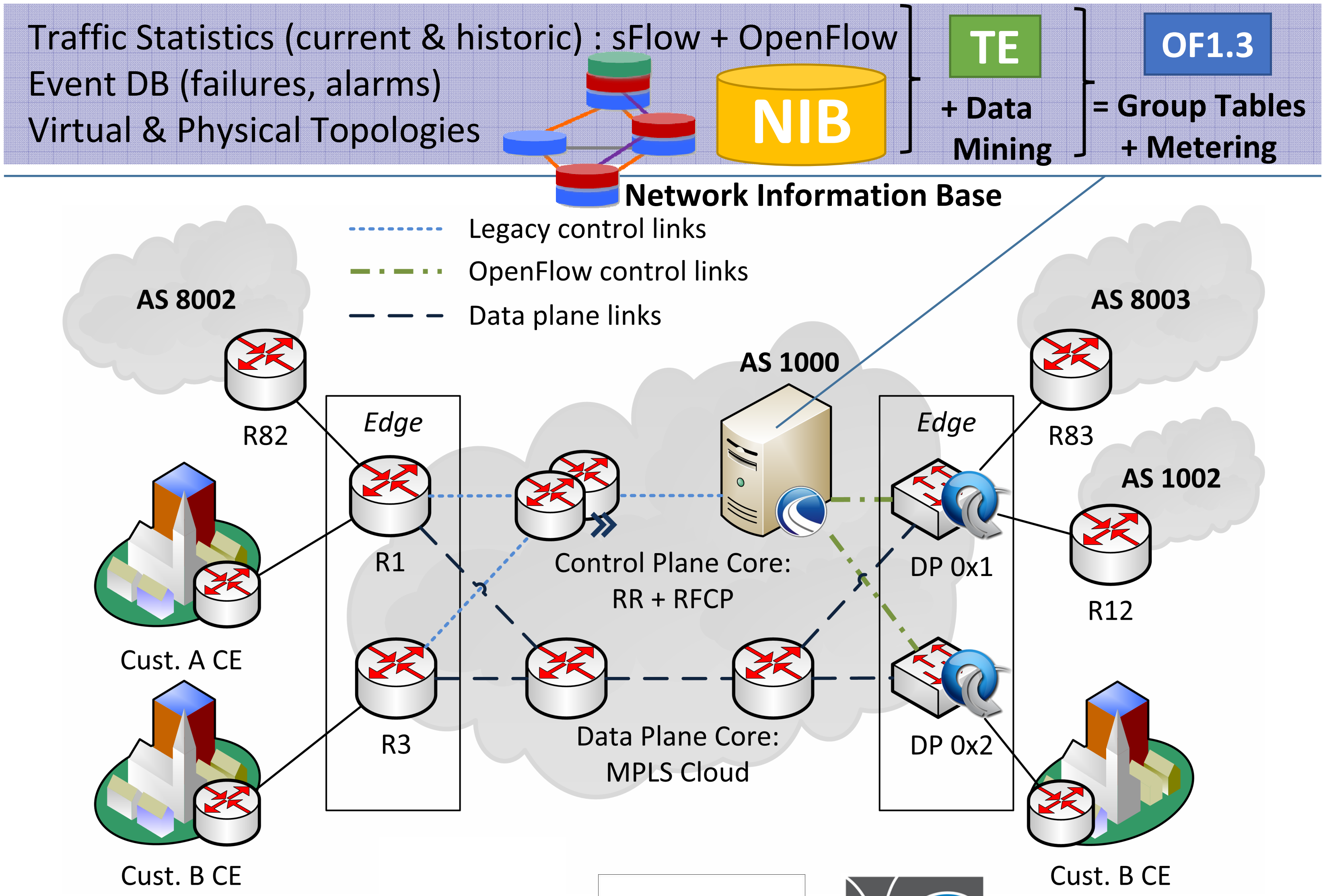


New routing codifications and strategies under investigation in 100% OF scenarios

Software-Defined Traffic Engineering MPLS

Seamless MPLS / MPLS-lite / IP Traffic Engineering

RouteFlow exploiting OF 1.3 and supporting IPv6



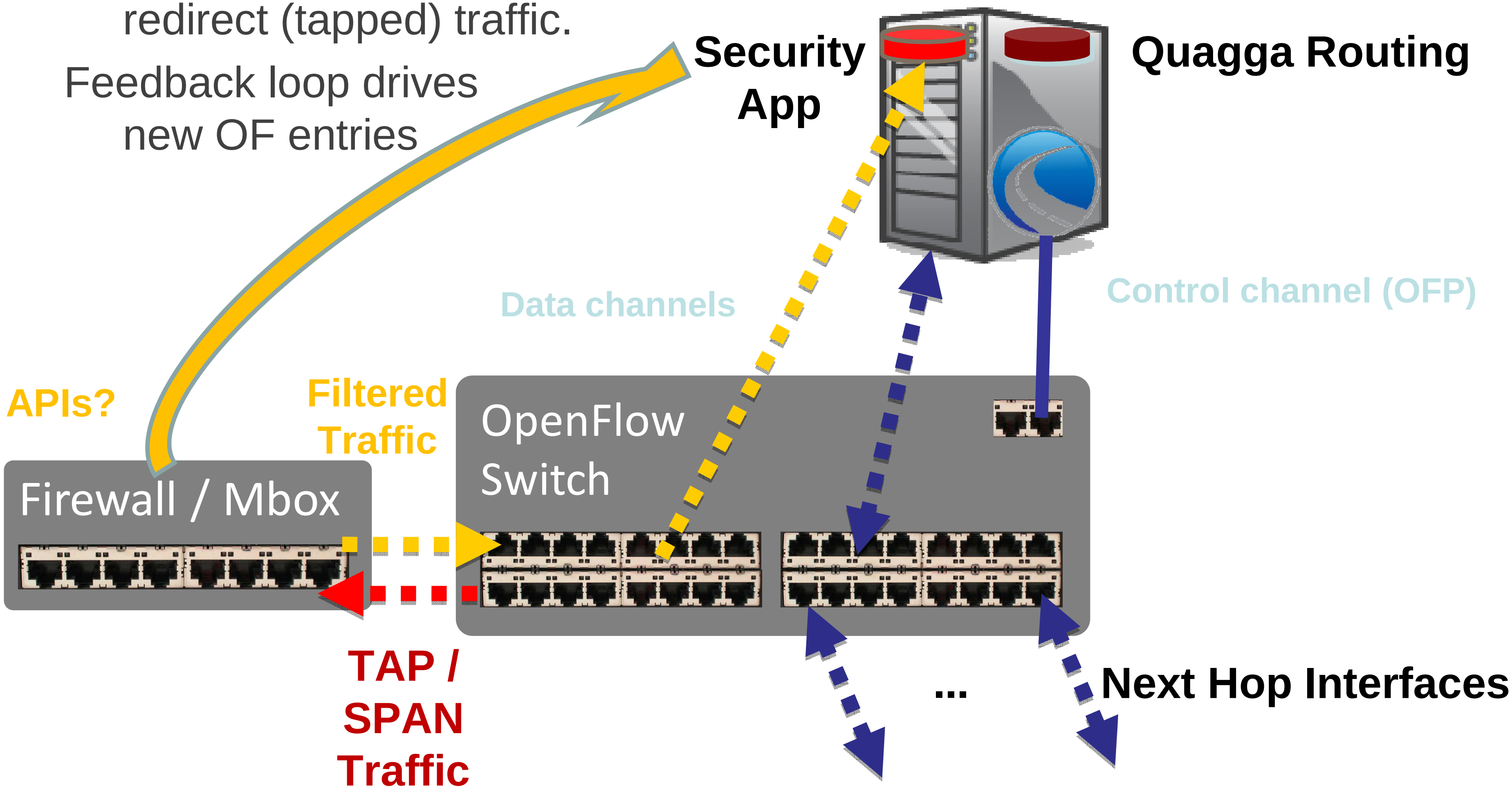
Improved Security

Security
Hybrid Firewall & Intrusion Detection

Centralized analysis of anomalies

Re-use existing firewalls / middleboxes (DPI) and Net/SFlow and redirect (tapped) traffic.

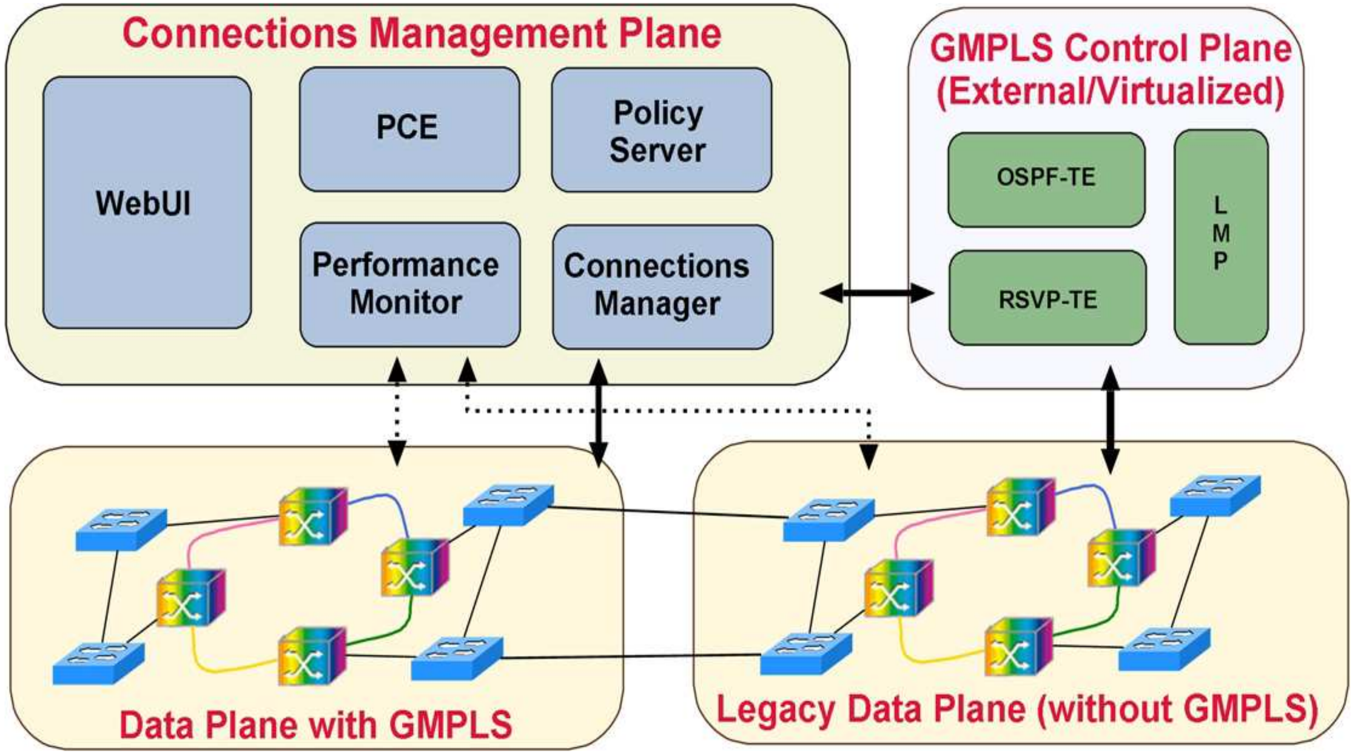
Feedback loop drives new OF entries



Dynamic Circuit Service

(hybrid circuit/packet)

GMPLS Control Plane as (non-OF) SDN Application



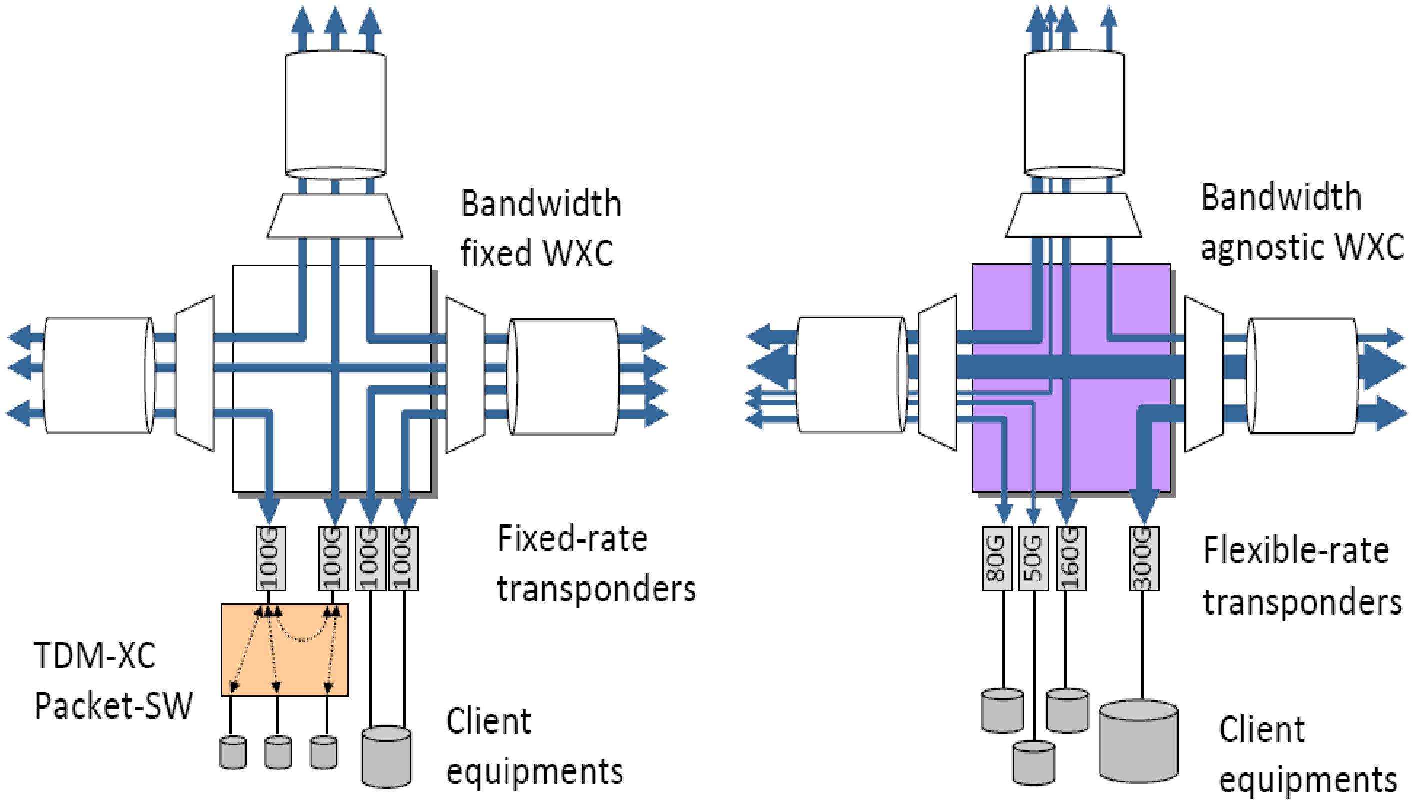
DCS builds on the GMPLS standardized interface

An abstraction layer allows for seamless operation of DCS over multiple technologies regardless of their support to GMPLS

The abstraction layer runs a virtual GMPLS stack (on a virtual machine) per network equipment that does not support GMPLS

Towards Elastic Optical Terabit Transport

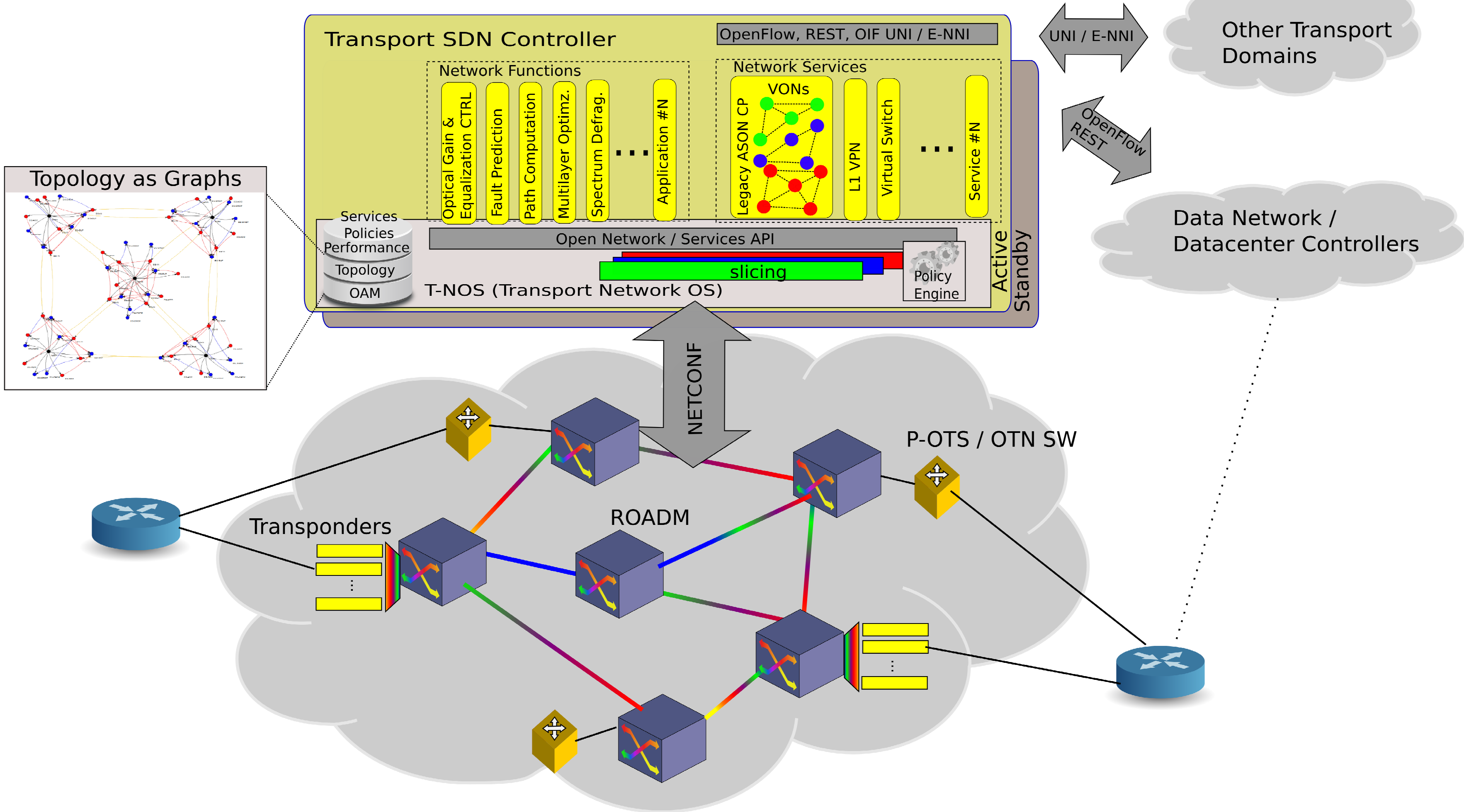
Elastic Optical Networks



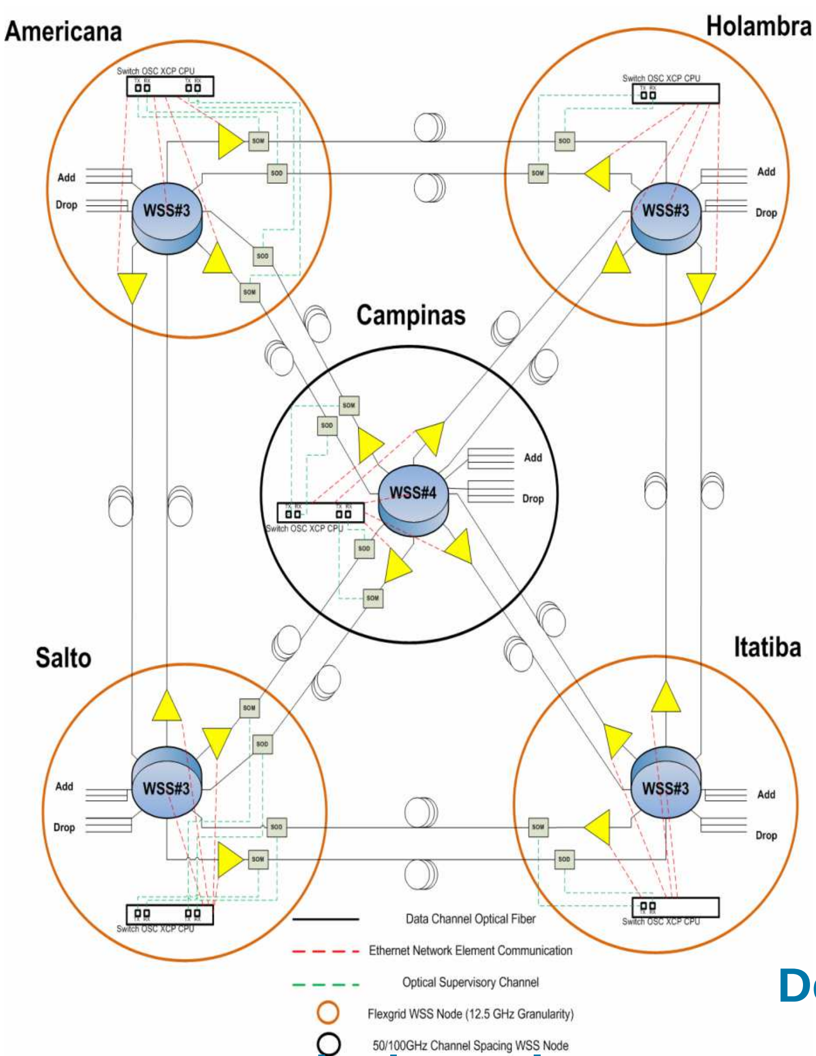
Fixed-grid WSS and transponders

Flexgrid WSS and adaptive transponders

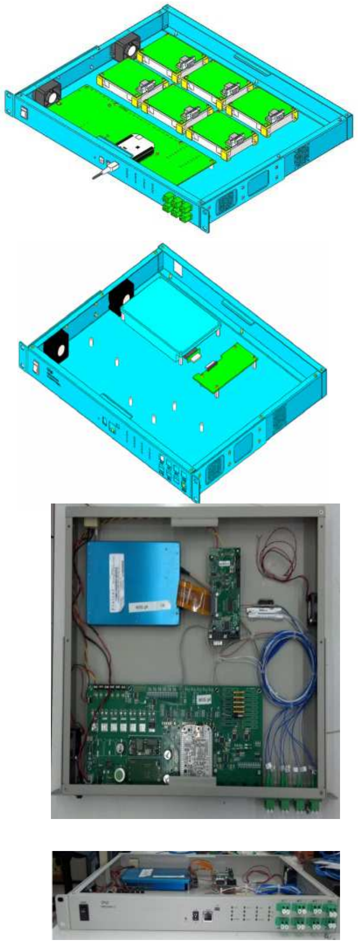
Software-Defined Elastic Optical Transport
(Controller SDN)



Software-Defined Elastic Optical Transport
(Physical Layer)



Testbed Topology

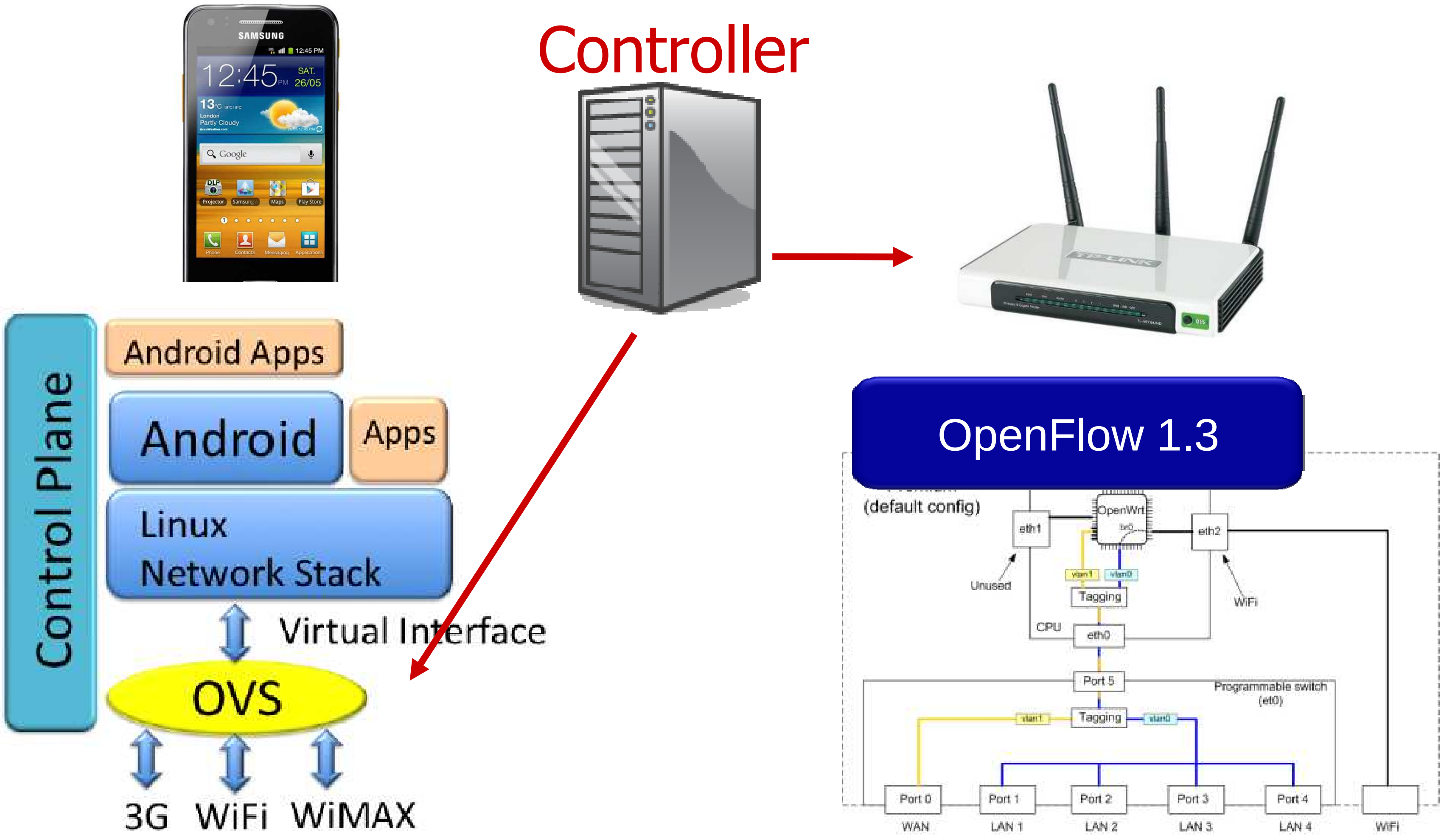


Developed Line Cards (HW/FW)

Laboratorial Testbed

Wireless Home SDN

OpenFlow in the Home:
Two target controllable devices



*OVS was recently upstreamed to Linux kernel 3.3

TP-LINK TL-WR1043ND

OpenFlow switches

Switch 10Gb OpenFlow 1.0 (2010)

100% OpenFlow – funcionalidades obrigatórias

OpenFlow™

Search

Home | Videos | Documents | News | Research | About

« Pantou : OpenFlow 1.0 for OpenWrt now available! (alpha release)　　　OpenFlow at GEC9 »

CPqD Ports OpenFlow to New Platform

October 13th, 2010, dtalayco in OpenFlow Blog

CPqD is a private non-profit Brazilian R&D foundation. Recently they announced the first switch in South America to support the OpenFlow 1.0 specification. The switch uses Broadcom L2/L3 silicon with 24 x 1Gb ports and 2 x 10Gb ports. It has a high performance CPU running the Indigo-beta-4 release from Stanford.

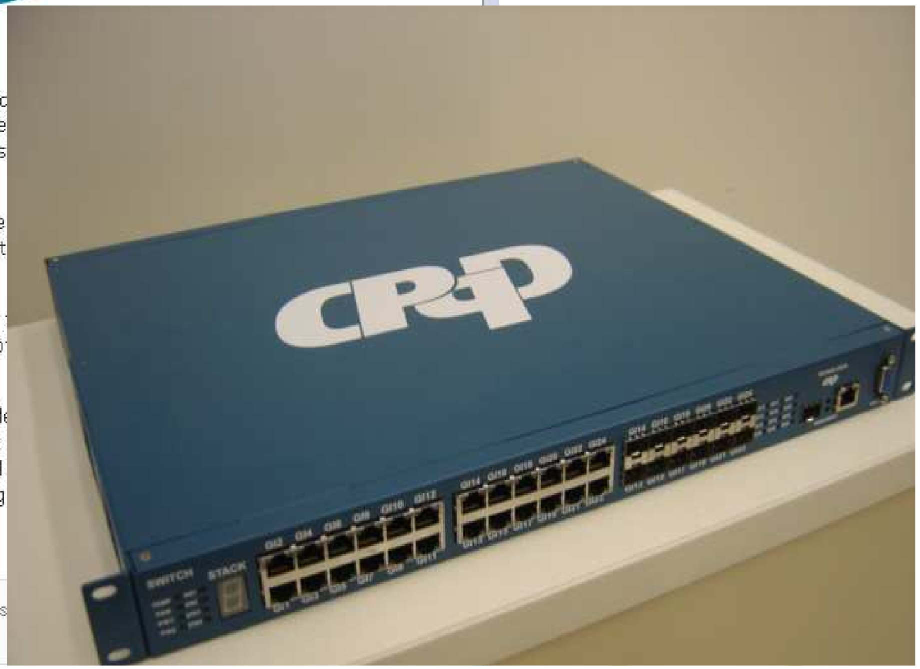
Tens of these OpenFlow switches will be deployed in Project GIGA´s High-speed Experimental Network, an IP/Ethernet/WDM network testbed run by CPqD and RNP (Brazilian NREN). Today the GIGA network connects 66 research labs at multigigabit per second the southeast region of Brazil, but will soon be upgraded to support 100Gb/s bit rates, using te developed in project GIGA, and expanded to all the other regions of the country, using RNP´s resources.

This large-scale OpenFlow infrastructure will be fundamental to the national initiative on Future that CPqD and RNP, amongst others, are leading, as well as to support collaborative experiment to projects GIGA and GENI.

The development of the OpenFlow switch and the development of an IP routing stack solution outside the switches on top of NOX (stay tuned!) are under the Future Internet umbrella o current R&D program, which includes a number of projects, such as Project GIGA.

CPqD was the R&D branch of Brazil´s telephony monopoly system until 1997, when the whole was privatized. Since then CPqD is a private foundation with the goal of bridging the gap university research and product development, helping (mainly) local companies to innovate and in the market. Today CPqD has more than 30 years of existence and 1200 employees carrying activities on various ICT sectors.

This entry was posted on Wednesday, October 13th, 2010 at 12:12 pm and is filed under OpenFlow Blog. You can follow any res this entry through the RSS 2.0 feed. You can leave a response, or trackback from your own site.



Software Switch Timeline

2011 Dec

- OpenFlow 1.1 + IPv6 + NXM

2012 July

- OpenFlow 1.2 Dev/Toolkit

2012 Dec

- OpenFlow 1.3 Dev/Toolkit

2013 April

- OpenFlow 1.3.2, 1.4 feature prototypes, …

OpenFlow 1.3 Dev/Toolkit

OpenFlow software switch (link)

- *OF SoftSwitch, dpctl, …*

OpenFlow Controller (link)

- *based on NOX Zaku ("classic")*

OpenFlow test cases (link)

- *based on OFTest framework*

Wireshark dissector (link)

- *OF 1.0 – 1.3.1 support*

Programming tutorial (link)

Precompiled VM image (link)

Mininet integration (link)

- *"mininet/util/install.sh -n3fxw"*

ONF ONGOING activities

ExtWG

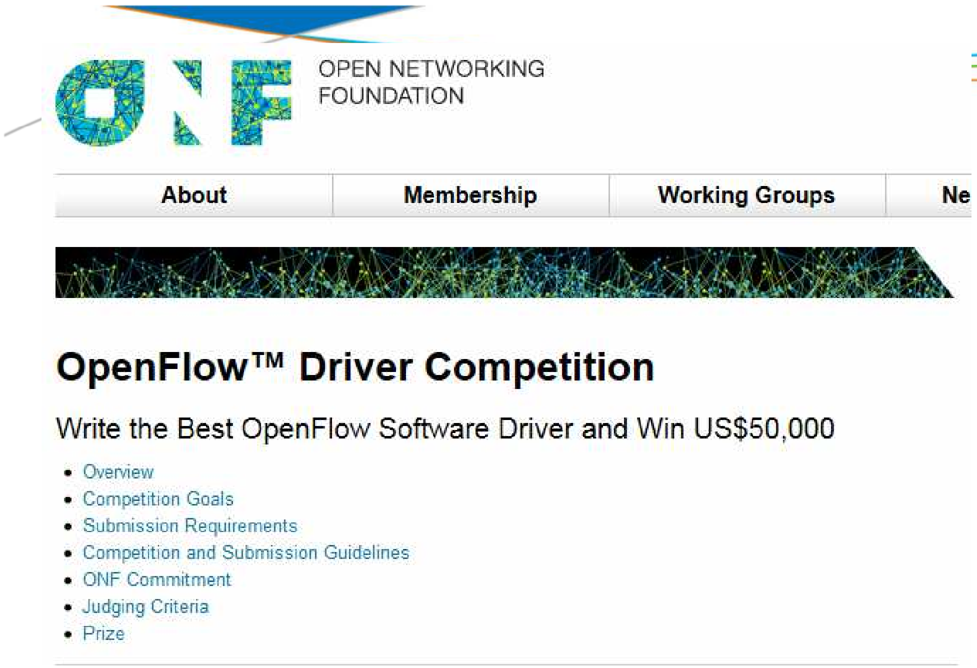
- prototype of OF 1.4 features (link)
- will integrate into “ONF OF 1.4 SoftSwitch”

TestWG

- merge OFTest code to “main” branch
- feed existing tests as test cases

Number	Main contact	Status	Codebase	Ticket name
EXT-136	Jean Tourrilhes	Implemented	SoftSwitch	EXT-136
EXT-154	Dan Malek	In Progress	SoftSwitch dpctl	EXT-154
EXT-187	Ben Pfaff	Implemented	OVS	EXT-187
EXT-191	Linda Dunbar	Implemented	SoftSwitch	EXT-191
EXT-192-e	Linda Dunbar	Partially implemented	SoftSwitch	EXT-192
EXT-192-v				EXT-192
EXT-230	Johann Tonsing	In Progress	SoftSwitch	EXT-230
EXT-232	Jean Tourrilhes	Implemented	SoftSwitch	EXT-232
EXT-233				EXT-233
EXT-235	Jean Tourrilhes	Implemented	SoftSwitch	EXT-235
EXT-236	Jean Tourrilhes	Implemented	SoftSwitch	EXT-236
EXT-237	Ben Pfaff	Implemented	OVS	EXT-237
EXT-256	Jean Tourrilhes	Implemented	SoftSwitch	EXT-256
EXT-260	Ben Pfaff	Implemented	OVS	EXT-260
EXT-261		Already implemented	SoftSwitch	EXT-261
EXT-262-p	Dan Malek	In progress	OVS/SoftSwitch	EXT-262
EXT-262-t	Dan Malek	In progress	SoftSwitch	EXT-262
EXT-262-a	Dan Malek	In progress	SoftSwitch	EXT-262
EXT-262-e	Dan Malek	In progress	SoftSwitch	EXT-262
EXT-262-i	Dan Malek	In progress	SoftSwitch	EXT-262
EXT-262-q	Dan Malek	In progress	SoftSwitch	EXT-262
EXT-262-x	Dan Malek	In Progress	SoftSwitch	EXT-262
EXT-264	Jean Tourrilhes	Implemented	SoftSwitch	EXT-264

[https://www.opennetworking.org/wiki/display/EXT/Prototyping]



OPEN NETWORKING FOUNDATION

About | Membership | Working Groups | Ne

OpenFlow™ Driver Competition

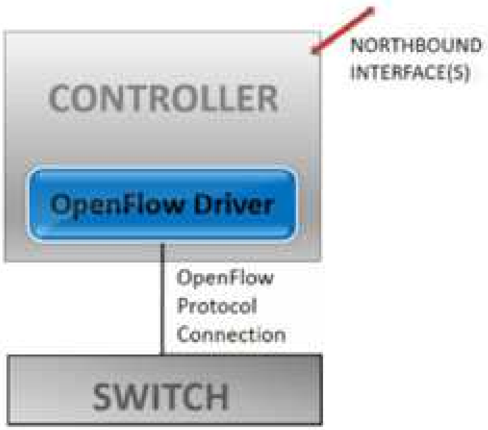
Write the Best OpenFlow Software Driver and Win US$50,000

- Overview
- Competition Goals
- Submission Requirements
- Competition and Submission Guidelines
- ONF Commitment
- Judging Criteria
- Prize

CPqD implementation:

- **Fully compliant to OpenFlow 1.3 and 1.0**
- **C++ with binding to Java and Python**
- **Compilation to Linux PC and Android/ARM**
- **6-million flows per second under a learning switch application**

Figure 1. OpenFlow Protocol Software Driver Controller/Switch Interaction



Comentário Finais

- Transição para SDN parece irreversível
  - De forma gradual, coexistindo e adicionando valor ao legado, seja pela otimização da operação ou agilidade na oferta de novos serviços

- SDN apresenta oportunidades inéditas
  - Para a tecnologia nacional, para os fabricantes, para as operadores e os provedores

- CPqD está atuando em com parceiros industriais (ex.: Datacom) para construir soluções tecnológicas campeãs

Comentário Finais

- O CPqD tem contribuído para o avanço do estado da arte de SDN/OpenFlow
  - Dynamic Circuit Services (2010): solução SDN de aprovisionamento automático de circuitos, com garantia de qualidade e proteção, pelo próprio cliente em redes multi-tecnologia (ex.: Ethernet e WDM)
  - Switch (de 10G) puramente OpenFlow (2010): 1o. desenvolvido na LATAM
  - RouteFlow (2011): única solução de roteamento IP virtualizado para SDN/OpenFlow disponível no mundo
  - Software Switch OpenFlow 1.3 (2012): único switch OpenFlow 1.3 completo e kit completo correspondente disponível no mundo; base para protótipo OF 1.4 da ONF e framework de testes de OF
  - Plugin OpenFlow (2013): plugin OF 1.3/1.0 em C++ (6 milhões de fluxos por segundo!) com suporte a binding para Java e Python e compilável em Linux PC e Android/ARM – concorrente na competição internacional da ONF
  - Participante ativo na ONF e na OIF no contexto de SDN

Obrigado!

www.**cpqd**.com.br