Juniper Networks

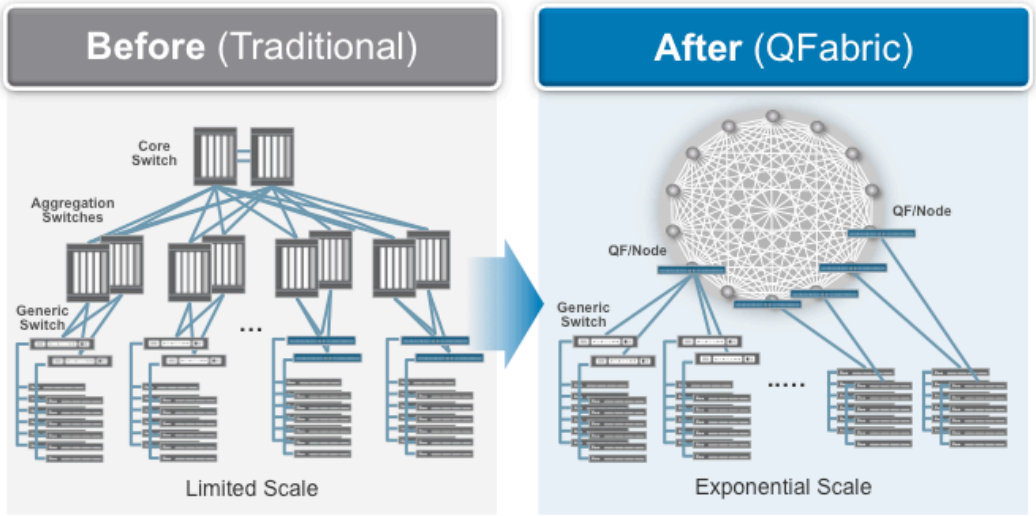
Academic Engagement & Research

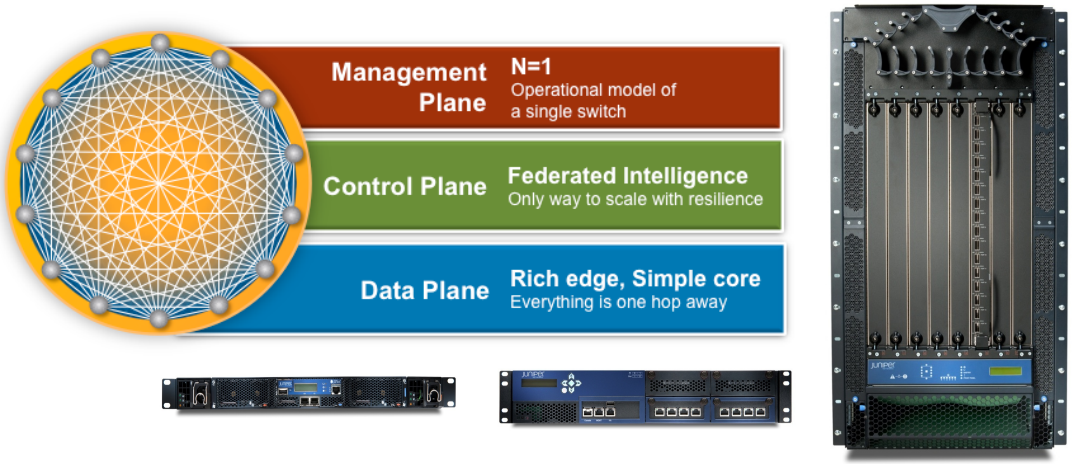
Joel Obstfeld
Director, PSG CTO Team
jobstfeld@juniper.net

JUNIPER NETWORKS – A DECADE OF INNOVATION

Revenue	$500M		$1.3B	$2B	$2.3B	$2.8B	$3.5B	$3.3B	$4.1B
Employees	1000	1500	2500	3500	4800	5300+	6500+	7000+	7500+

2011 – not just more ‘iron’ but different ‘iron’





Industry’s only integrated native MPLS switching and optical transport system

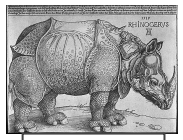
PTX Series

- Industry-leading density at 10G and 100G
- Efficiency of packet switching and value of optical transport

Engagement with Academic research community

- Juniper's 'Academic Alliances' program provides data-networking education
- Membership of cross-industry forums
  - IETF
  - Open Networking Foundation
  - OpenFlow Consortium
  - SIGCOMM/ACM
  - ITU
  - IEEE
- Membership & participation of groups with primarily Academic audiences
  - Internet2, Canarie, APAN, Terena etc.
- Direct engagements with universities & research groups

FEDERICA



Renaissance

IIJ Internet Initiative Japan

ESnet

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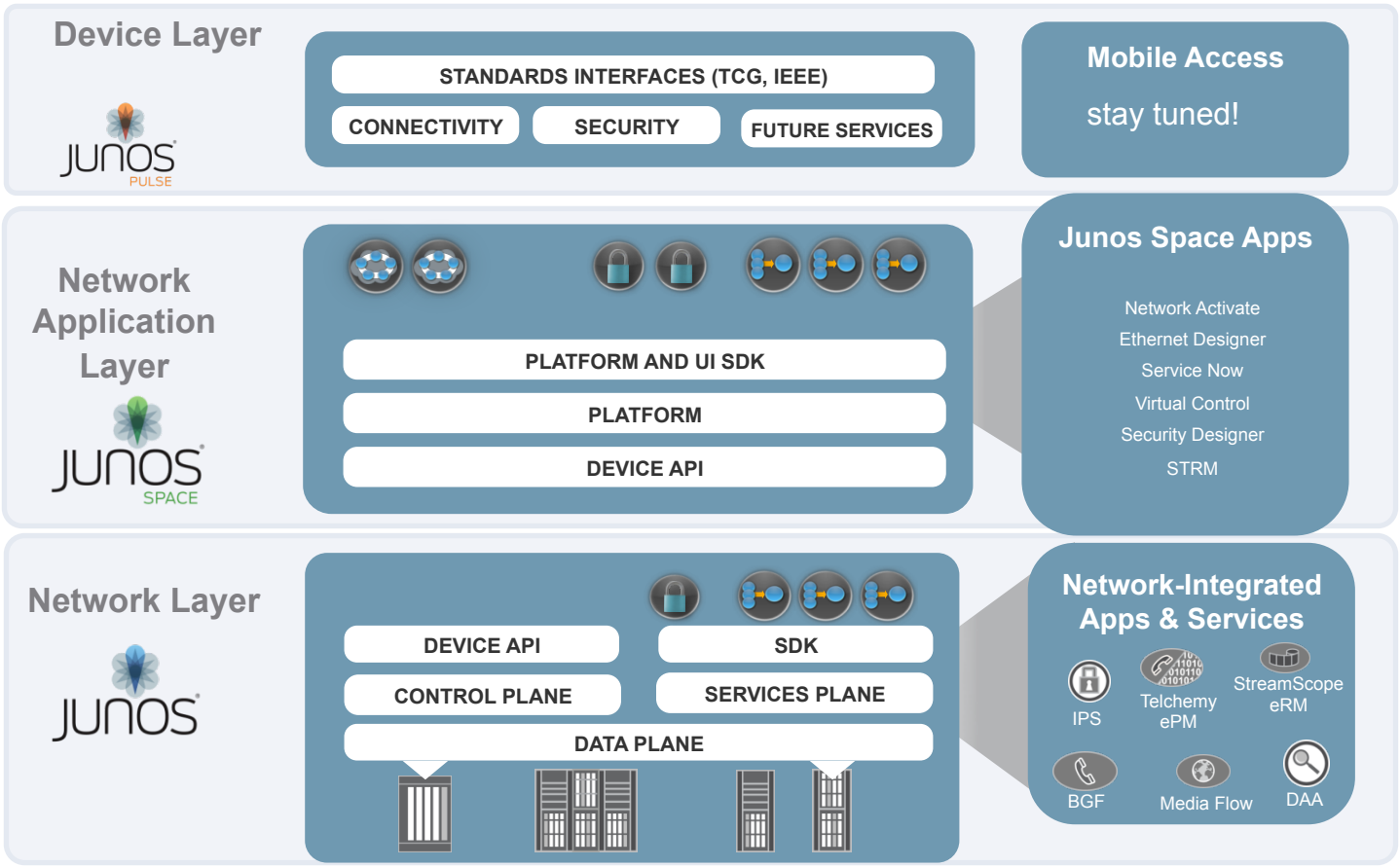
ACADEMIC ALLIANCE TRACKS

TTI - Expand student opportunities through technical training and certification programs

RAD - Enable real-world research and development incorporating Juniper SDK family - Junos, Space & Pulse

Open Ecosystem

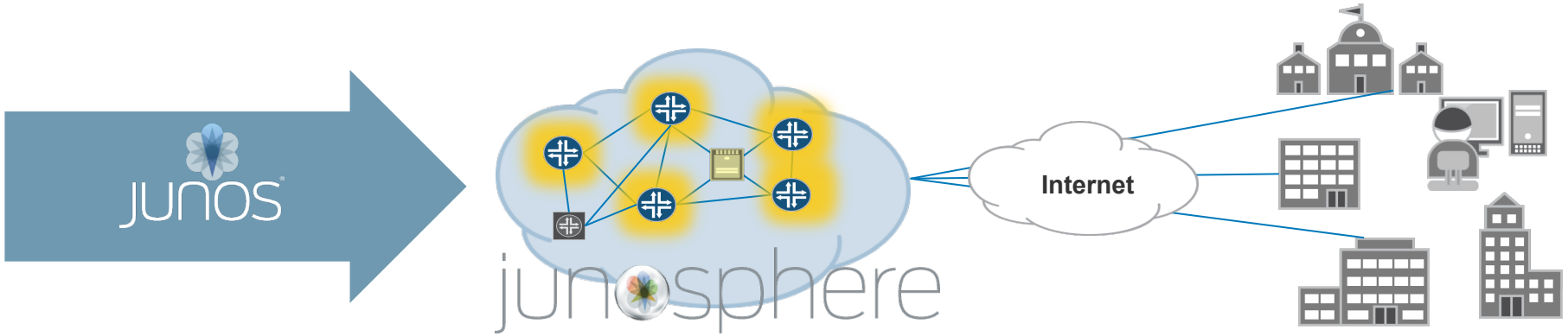


junosphere

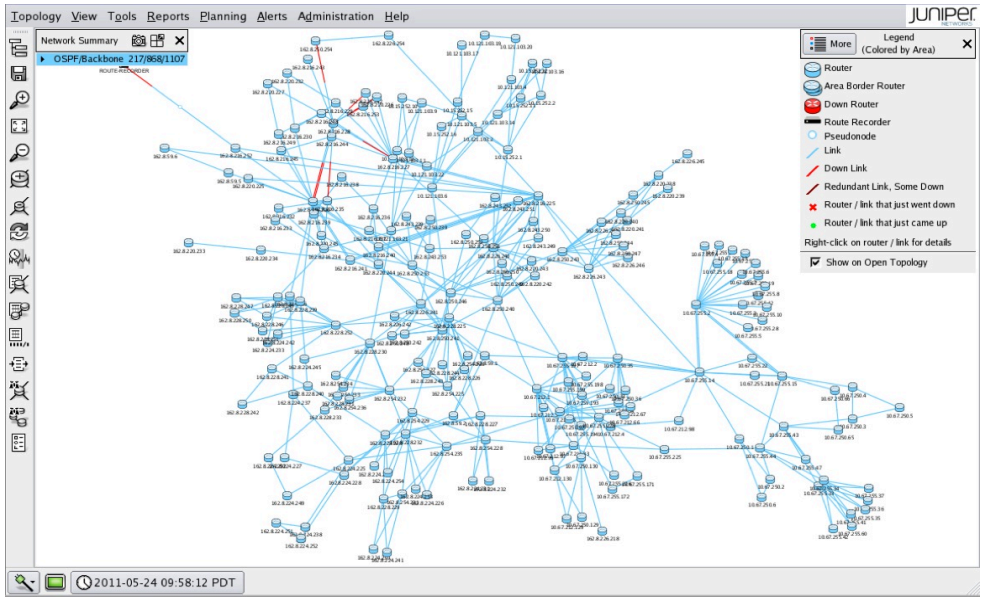
Junosphere is a secure Cloud-based environment that provides access to virtual routers running JUNOS

Junosphere is an enabler for a wide range of uses

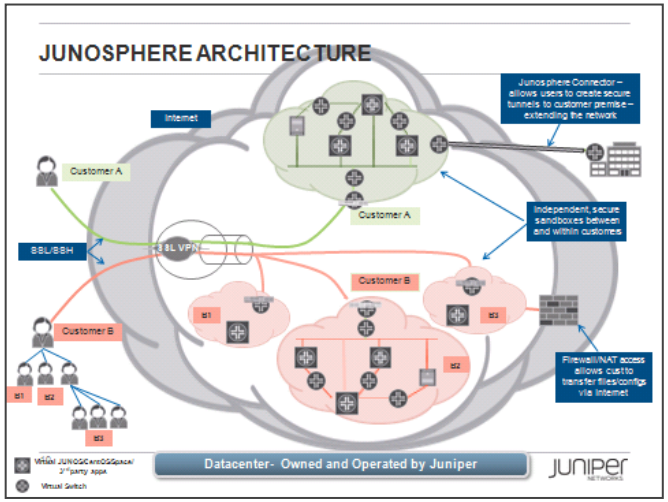
- Teaching & training - using Virtual network equipment
- Virtual labs – testing new features and functionality, build extensive models of real-world networks
- Host Juniper's development partners – provide partners with virtual equipment to work with
- Research platform – work with teams on networking research



Junosphere - network virtualization in the cloud



junosphere



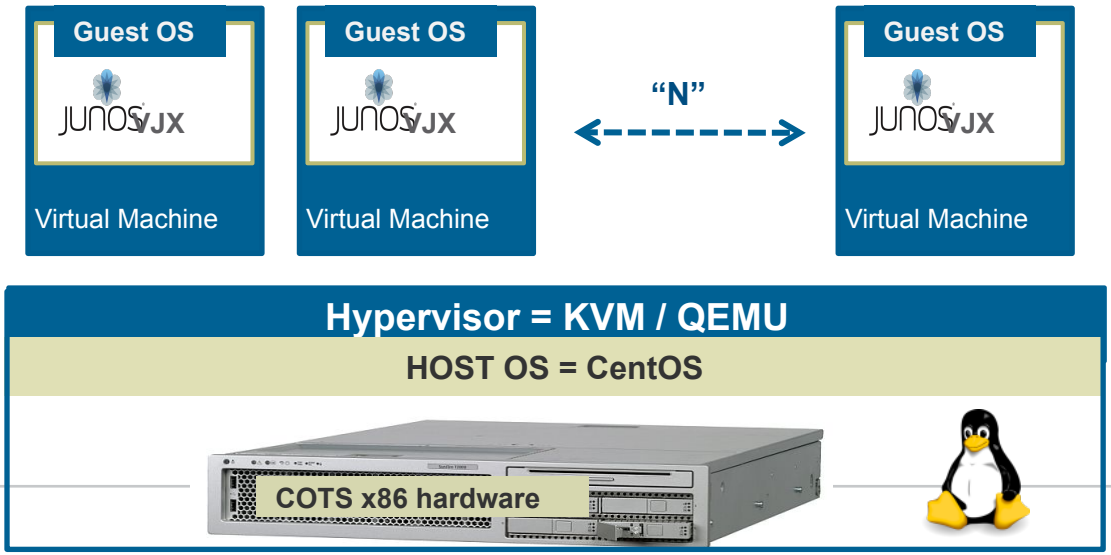
- Spin-off project building on internal technology development
- PaaS offering on-demand access to a network of virtual routers, end hosts, NMS and testing devices
- Scales to host very large network models
- Wide range of uses being discussed and developed

Introducing VJX Series

VJX Series is a new family of virtual machines that run JUNOS on a hypervisor, on standard x86 hardware

- Full control plane, management plane and forwarding plane features
- VJX1000 is the first product in this series

- IPv4/IPv6 Unicast / Multicast
- Full Routing suite: OSPF, MP-BGP (all supported AFs), RIPv2, Static routes, IS-IS,…)
- Multicast: IGMPv3, PIM, SDP, DVRMRP, Source Specific)
- MPLS: Layer 2 VPN (PWE3, VPLS etc), Layer 3 VPN, LDP, RSVP
- Encapsulations: Ethernet (MAC and tagged), PPPoE
- NAT/Stateful Firewall Filters/Intrusion Detection
- Tunneling: GRE, IP in IP
- COS
- User Authentication/Access: RADIUS, RSA SecureID, LDAP
- J-Web, CLI



Queen Mary University of London

Junosphere Trial Overview

Goal:

- Replace existing student router testbed with virtualized environment
- Current environment 4 testbeds composed of PC's running Quagga and Ethernet switches (32 machines)

Junosphere provided:

- 24 virtual testbeds of Juniper routers (192 machines)
- Courseware shared and reused by other Universities in other countries
- Enabled much improved student to equipment ratios (3:1 vs 20:1)
- Distance Learning: Students connecting from UK, Portugal, Spain and China

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ELE403 – Routing Exercise in JUNOSPHERE

- Testbed cloned and scaled according to the numbers of students
- Testbeds spun-up / spun-down in a matter of minutes
- Impossible to achieve with physical equipment

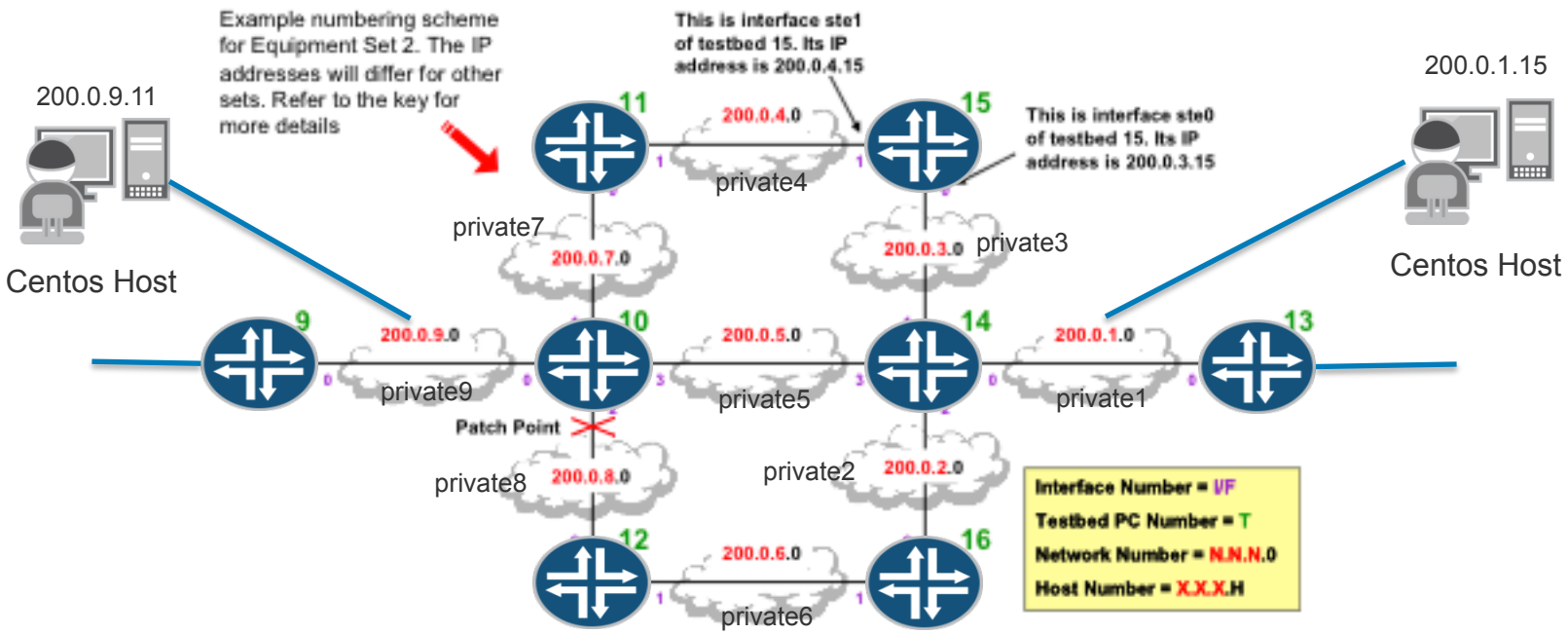


Figure 1:- Router Topology, Subnet and Interface Assignments

JUNOSPHERE FOR R&D

Roma Tre University in Italy has a long-standing relationship with Juniper

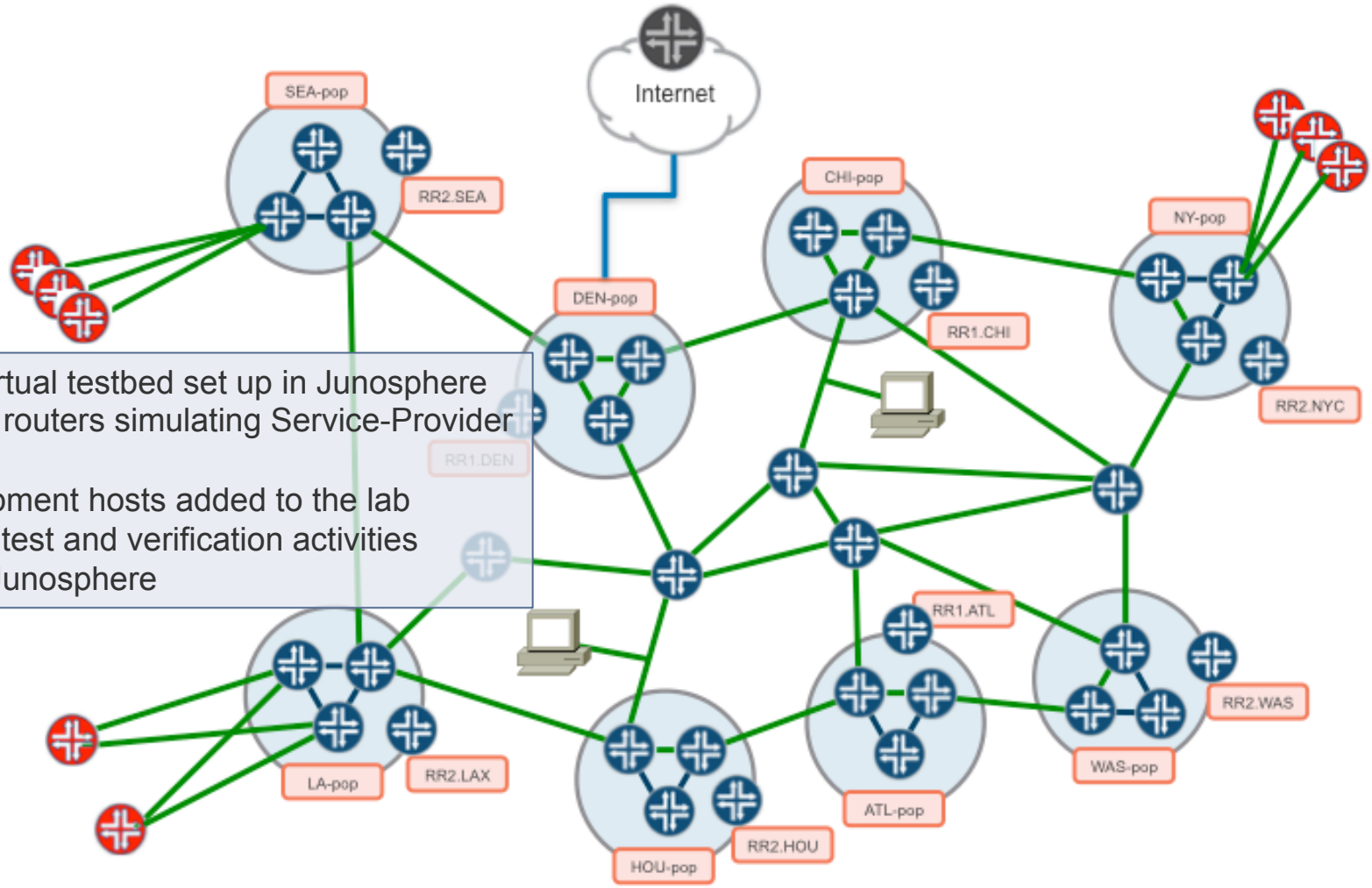
- Existing JUNOS SDK development-partner
- Well-respected by companies such as Telecom Italia, FastWeb, WIND et al

Research team were trying to develop a new methodology for monitoring and troubleshooting VPN services in Service Provider or Enterprise networks

Problem - How do you develop and test new tools in a lab of only 2 physical routers?

Junosphere for R&D

- Large-scale virtual testbed set up in Junosphere
- Juniper virtual routers simulating Service-Provider network
- Virtual development hosts added to the lab
- Development, test and verification activities conducted in Junosphere

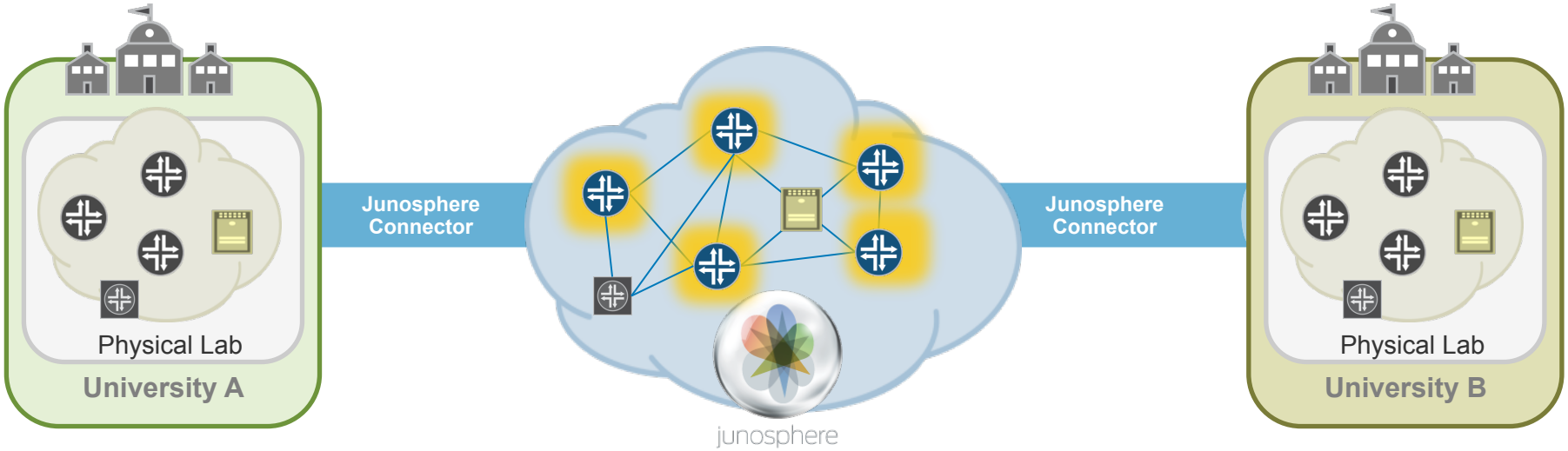


Junosphere Connector

Secure Ethernet-over-SSH tunnel into the cloud

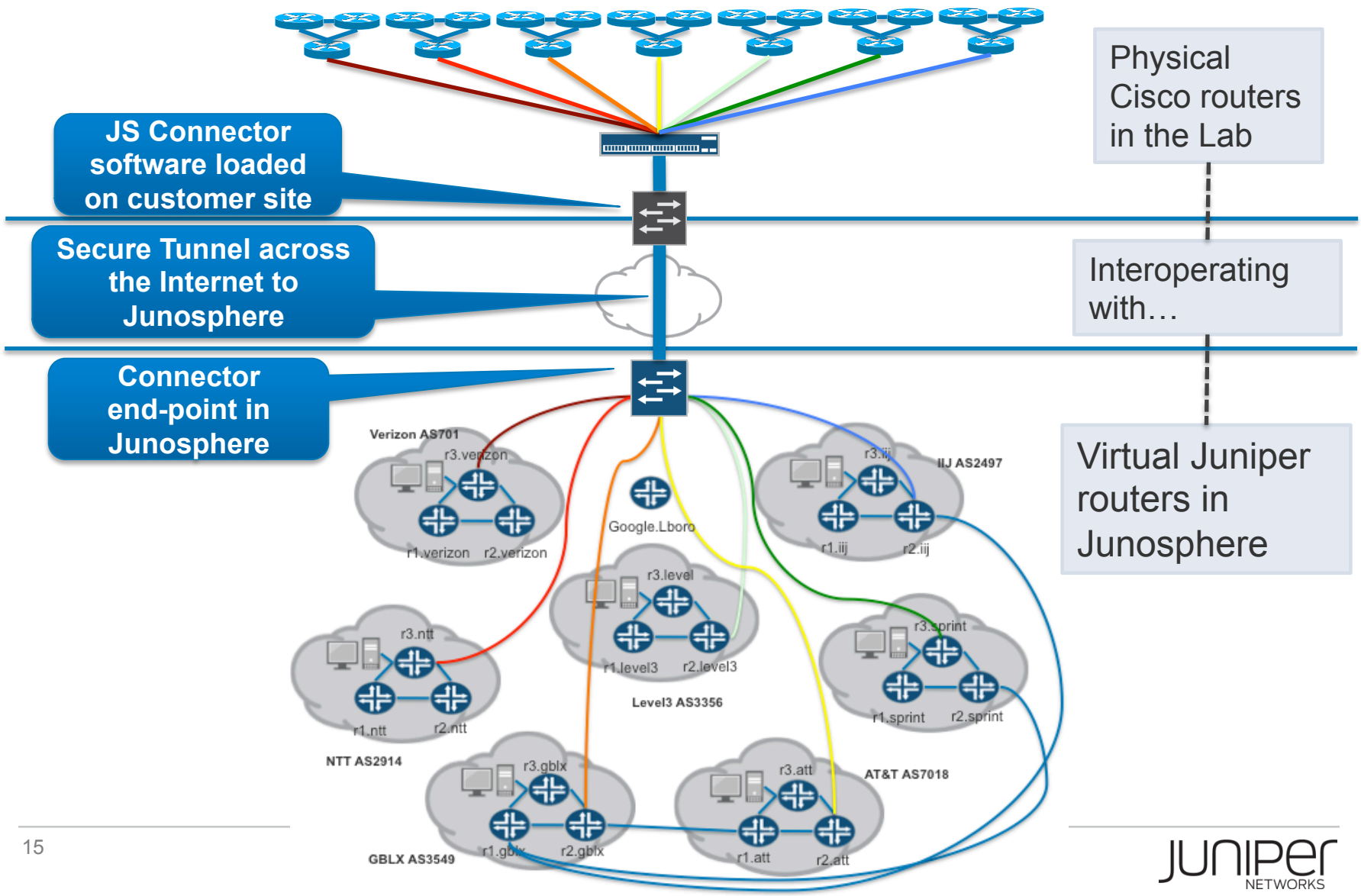
Enables the interconnection of physical and virtual networks

Powerful tool for collaboration, research, and experimentation



Connector in action

Loughborough University



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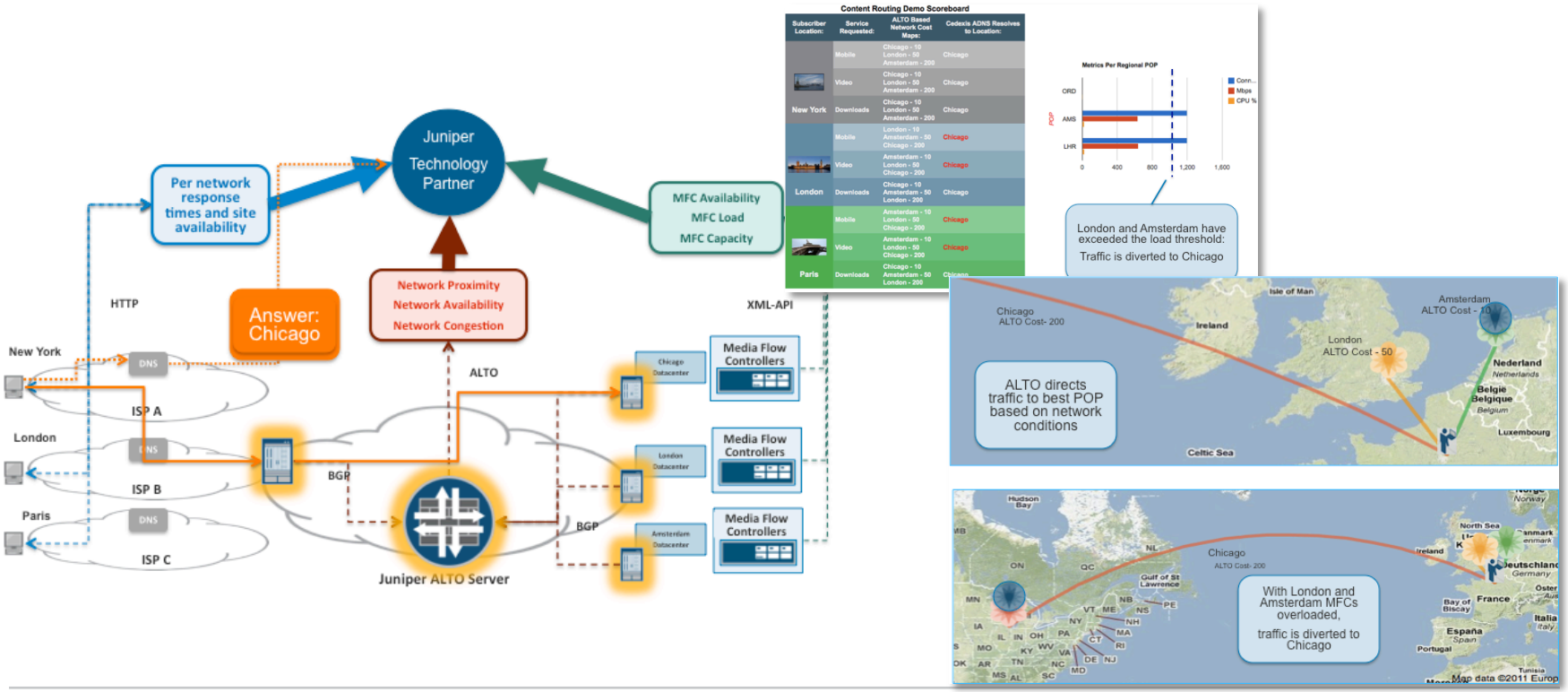
I E T F 80 – Prague – ALTO DEMO

Juniper and Neustar give first public demonstration of advanced content routing protocol (Alto)

Virtual Routers in Junosphere demonstrate protocol in operation, working with physical clients across the internet



So why are we here?

- Juniper is looking to extend it's relationships between Juniper's engineering community and thought-leaders in Academic Research
- Partner with groups on areas of joint interest
  - Provide access to Juniper tools (SDKs, Junosphere etc.) or where appropriate prototype/beta code
  - Direct engagement with Juniper Development engineers where appropriate
  - Enable publication of research!


everywhere

CONTACT INFO

academicalliance@juniper.net
http://www.juniper.net/us/en/training/academicalliance/

Nic Xenos: nxenos@juniper.net (Program Lead)
+1 (408) 933- 6226 Office
+1 (714) 269-5632 Mobile

Kate Lipmann klipmann@juniper.net (EMEA)
+44 (0) 1372 385500 ext 39065 Office
+44 777 57 20034 Mobile