NoviFlow
SDN made smarter

Scale-Out SDN

Marc LeClerc, VP Strategy and Marketing, NoviFlow Inc.

ONS

A NEW ERA OF {OPEN SOURCE} NETWORKING
DEVELOP | INTEGRATE | DEPLOY

📅 March 14 - 17, 2016   📍 Santa Clara Convention Center, Santa Clara, CA
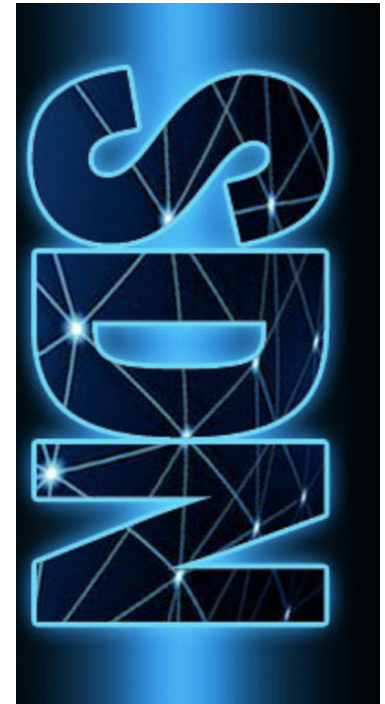
March 16th 2016

www.noviflow.com

Agenda

- Intro to NoviFlow
- The force driving the move to SDN
  - Drivers for SDN
  - SDN and hyperscale networking
- Using SDN to build a Scale-Out Router
  - What is it?
  - How Scale-Out SDN *scales*
  - Use Cases
- Use case: AARNet's Autralia's Wide-Area SDN Testbed
  - The 16,000km wide router!
  - Scalability and SDN
- Q&A

About NoviFlow

> *NoviFlow develops Fully Programmable SDN Forwarding plane software, SDN Applications, and High Performance SDN Switches*

Customers: Products deployed at 35 customers around the World: service providers, internet brands, NRN, Acad., etc

Products:
- ✓ *NoviWare:* Forwarding Plane Software for SDN and NFV, leveraging NPU-based platforms
  - Supports **ALL OpenFlow 1.3 actions, instructions and matching fields, most OpenFlow 1.4 features**
  - Compatible with the leading controllers and applications, incl. ONOS, OpenDaylight, NEC, Ericsson, Ryu
  - Included in all *NoviSwitch* products; Licensed to ODMs (for use in WhiteBox or OEM products)

- ✓ *NoviSwitches* : Pure-play OpenFlow switches based on NPUs
  - Delivering unparalleled OpenFlow throughput, flow table capacity and flow handling capabilities
  - NPU-based and fully programmable
  - Running *NoviWare software*.

- ✓ *NoviApps*: SDN applications

**Technology** • Innovative use of Network Processors, instead of ASIC, X86 or FPGA

Key Use Cases: SD-WAN, Data Center, Mobile and Fixed Networks, NFV Forwarding Plane

Company:
  - Headquarters in Montreal, Canada, and sales offices in Sunnyvale (USA) and Singapore, and   distributors in Taiwan, Japan, South Korea, Israel and Austria.

NoviWare Inside ™

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NoviFlow 's Focus

SDN Architecture

- Application Plane
- Control Plane
- Forwarding Plane

NoviApps SDN Applications

Scale-Out Router® | App #2 | ... | App #n

Programmable APIs

SDN Controllers

ERICSSON
NEC
ONOS
Open Network Operating System
OPEN DAYLIGHT

OpenFlow 1.3/1.4

Forwarding Plane Software and SDN switches

NoviWare Inside ™
OpenFlow
NoviSwitch®

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Traditional Networking Isn't the Right Solution for Hyperscale and Carrier Cloud Networks
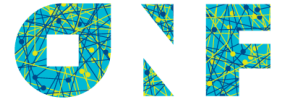
Not Cost-Effective
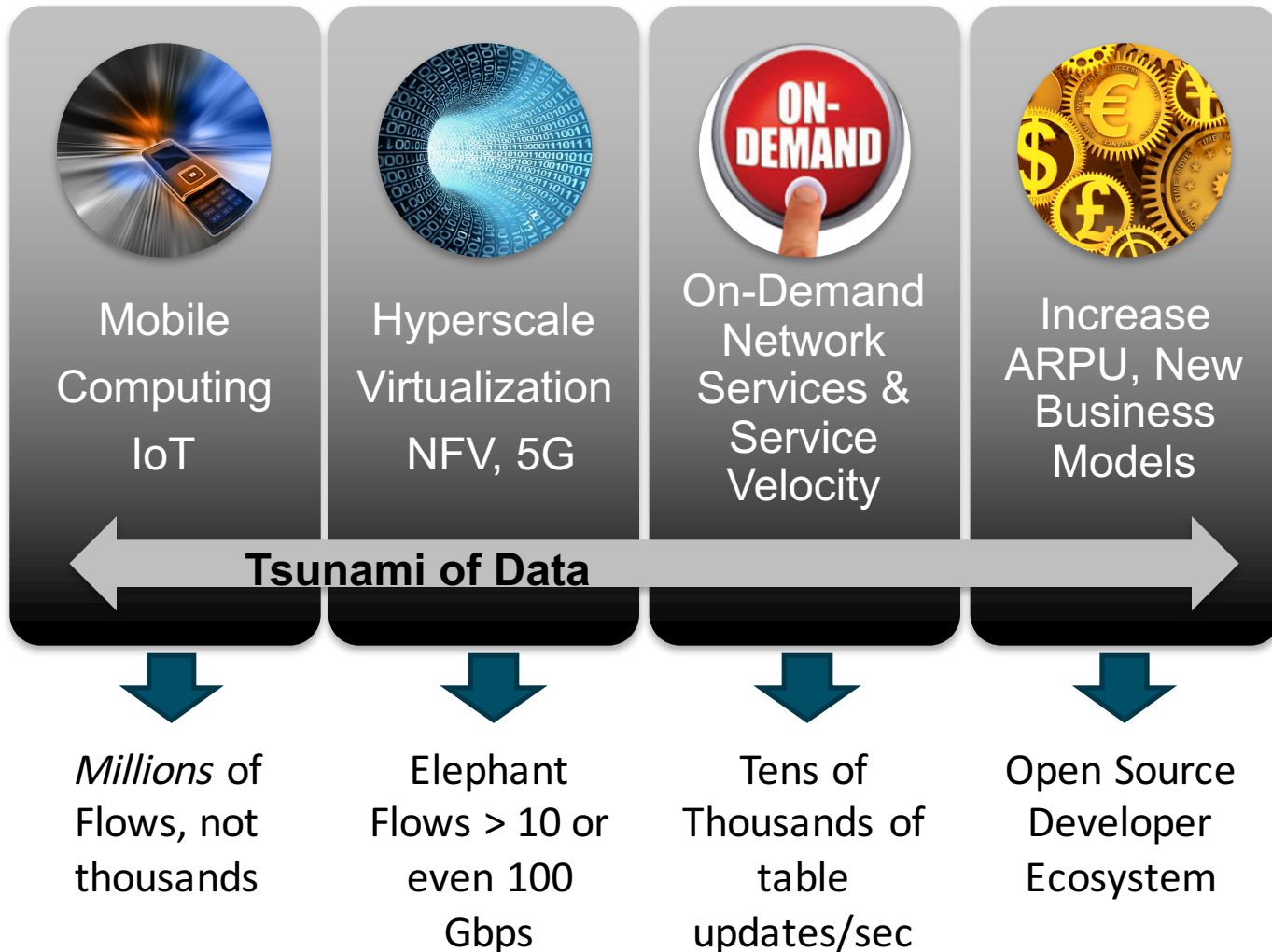
- CAPEX
- OPEX

Not Agile Enough for On-Demand

- Time-to-market
- Rapid service provisioning

Not Designed for Virtualization

- East-west traffic support
- Bottleneck for server virtualization

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The New Truth, and the New Consequences

Mobile Computing IoT	Hyperscale Virtualization NFV, 5G	On-Demand Network Services & Service Velocity	Increase ARPU, New Business Models

Tsunami of Data

Millions of Flows, not thousands	Elephant Flows > 10 or even 100 Gbps	Tens of Thousands of table updates/sec	Open Source Developer Ecosystem

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Evolutionary Steps in DC Disaggregation

1st Gen: Compute

1 Virtualized Application Servers

Hypervisors vSphere, KVM
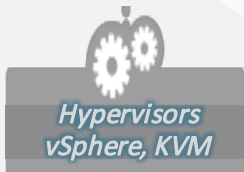
2nd Gen: Storage

2 Virtualized Storage Systems

Hadoop, NetApp,

3rd Gen: Network

3 Virtualized *Network Control And Forwarding*

SDN and NFV
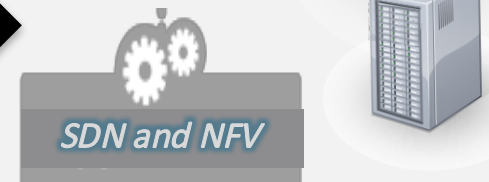
In 2009 Google and Stanford initiate "Clean-Slate" project to enable networking virtualization. Software Defined Networking is born and fosters vendor independence and reduces costs of both hardware and operations
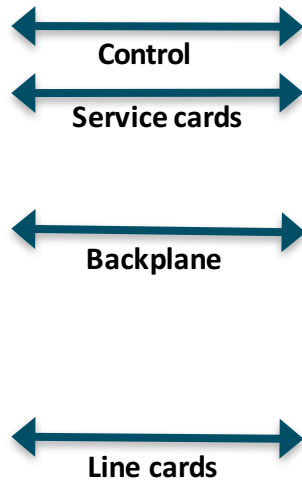
Starting in late 2014, enterprises implementing SDN realize that ASIC based SDN equipment offer only limited SDN/NFV functionality, and X86 based vSwitch solutions are unable to scale. The solution: high-performance NPU based OpenFlow Forwarding Planes and the Scale-Out architecture!
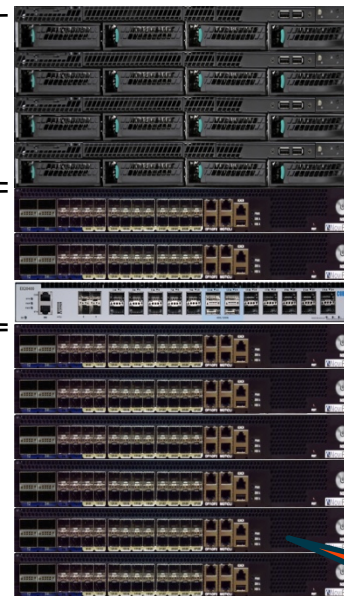
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The Disaggregated Scale-out Router

ATRIUM

Typical (Scale-Up) router

NoviFlow's Scale-Out Router Architecture

Control

Service cards

Backplane

Line cards

OpenFlow Controller and Scale-Out Router Application (VMs on COTS servers)

NoviRouter BGP ™

ONOS
Open Network Operating System

OpenFlow Leaf Switches

Spine (L2 Switch)

OPEN DAYLIGHT

OpenFlow Switches

NoviWare Inside ™

Expensive to Operate
Scale-up costs
Vendor lock-in
Proprietary

Economical to Operate
Scale-Out simplicity
COTS hardware
Open Source software

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SDN Scale-out Router
Enabling graceful, modular capacity growth

SCALE: Add switches

m

4

OpenFlow Router App

Controller

| NoviSwitch® 2128 |
| NoviSwitch® 2128 |
| NoviSwitch® 2128 |
| NoviSwitch® 2128 |
| NoviSwitch® 2128 |
| NoviSwitch® 2128 |
| NoviSwitch® 2128 |
| NoviSwitch® 2128 |

L2 Switch

L2 Switch

3

OpenFlow Router App

Controller

| NoviSwitch® 2128 |
| NoviSwitch® 2128 |
| NoviSwitch® 2128 |
| NoviSwitch® 2128 |

L2 Switch

2

OpenFlow Router App

Controller

| NoviSwitch® 2128 |
| NoviSwitch® 2128 |

1

OpenFlow Router App

Controller

NoviSwitch® 2128

NoviFlow
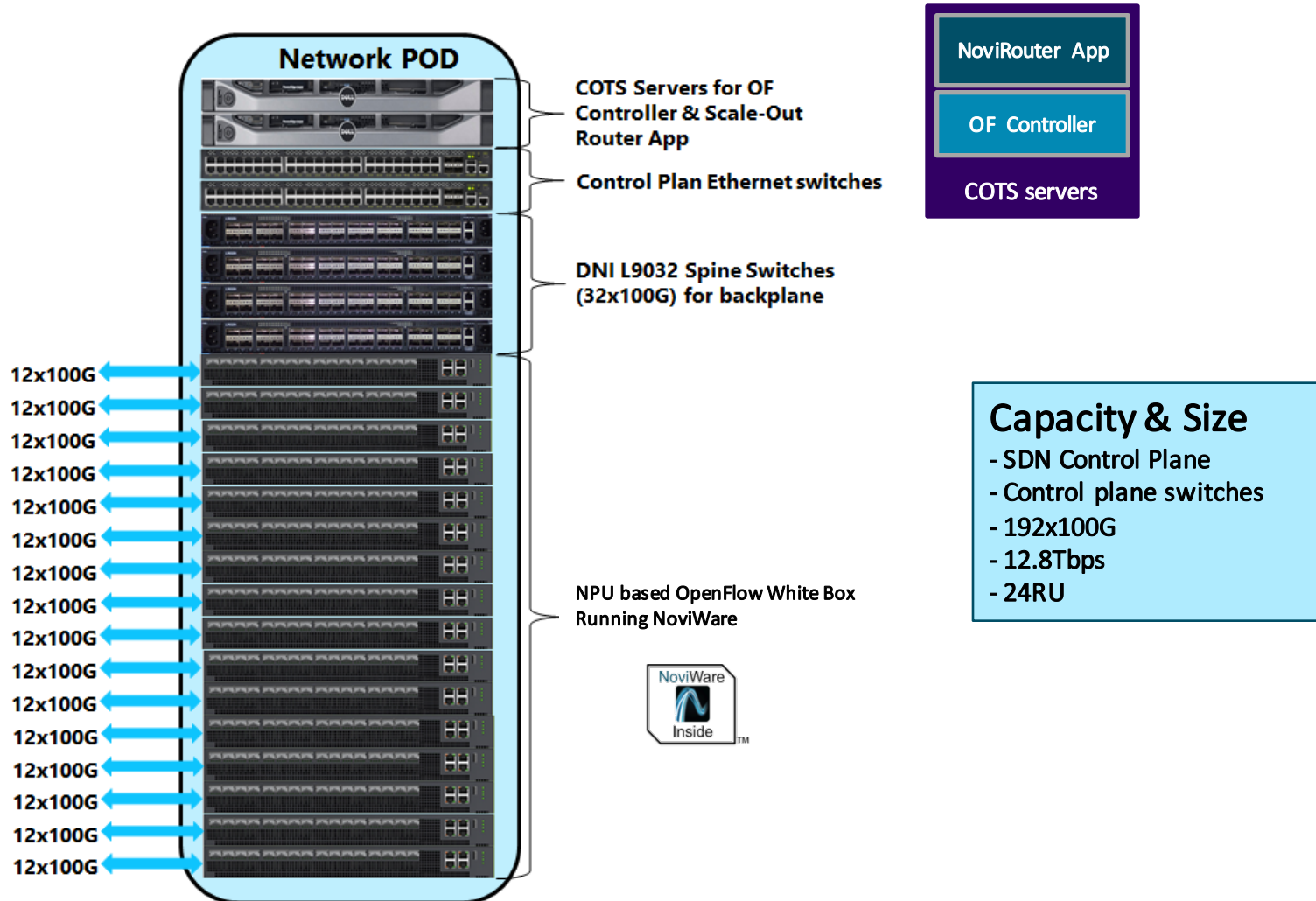SDN made smarter

SDN Scale-out Router:

Large scale configuration example, using high-performance OpenFlow Switches and Open Source SDN application

Router App

OF Controller

COTS servers

L2 Switch

L2 Switch

COTS Server

COTS Server

L2 Switch

L2 Switch

OF Switch

OF Switch

OF Switch

OF Switch

OF Switch

OF Switch

OF Switch

OF Switch

OF Switch

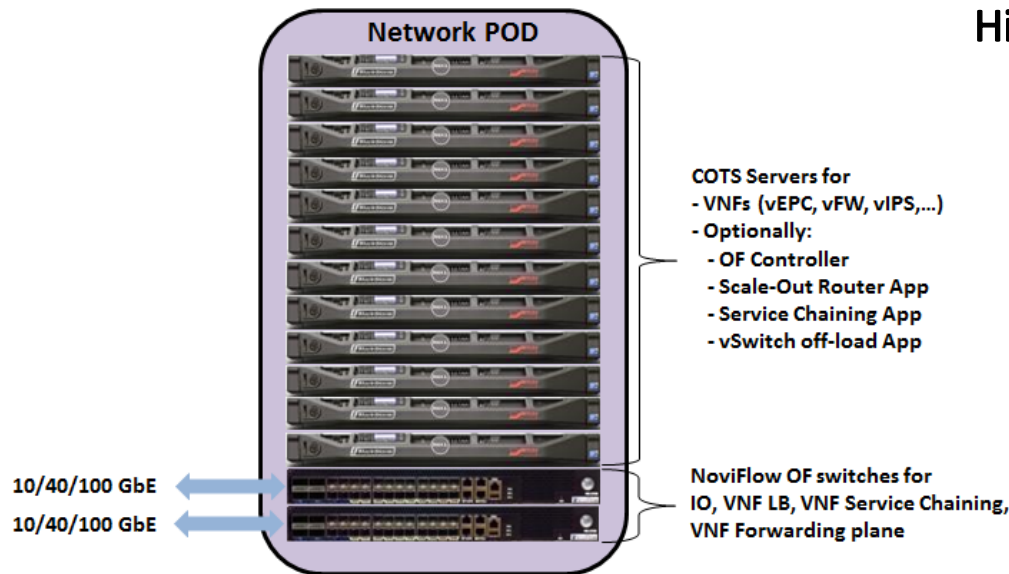OF Switch

Access

Core

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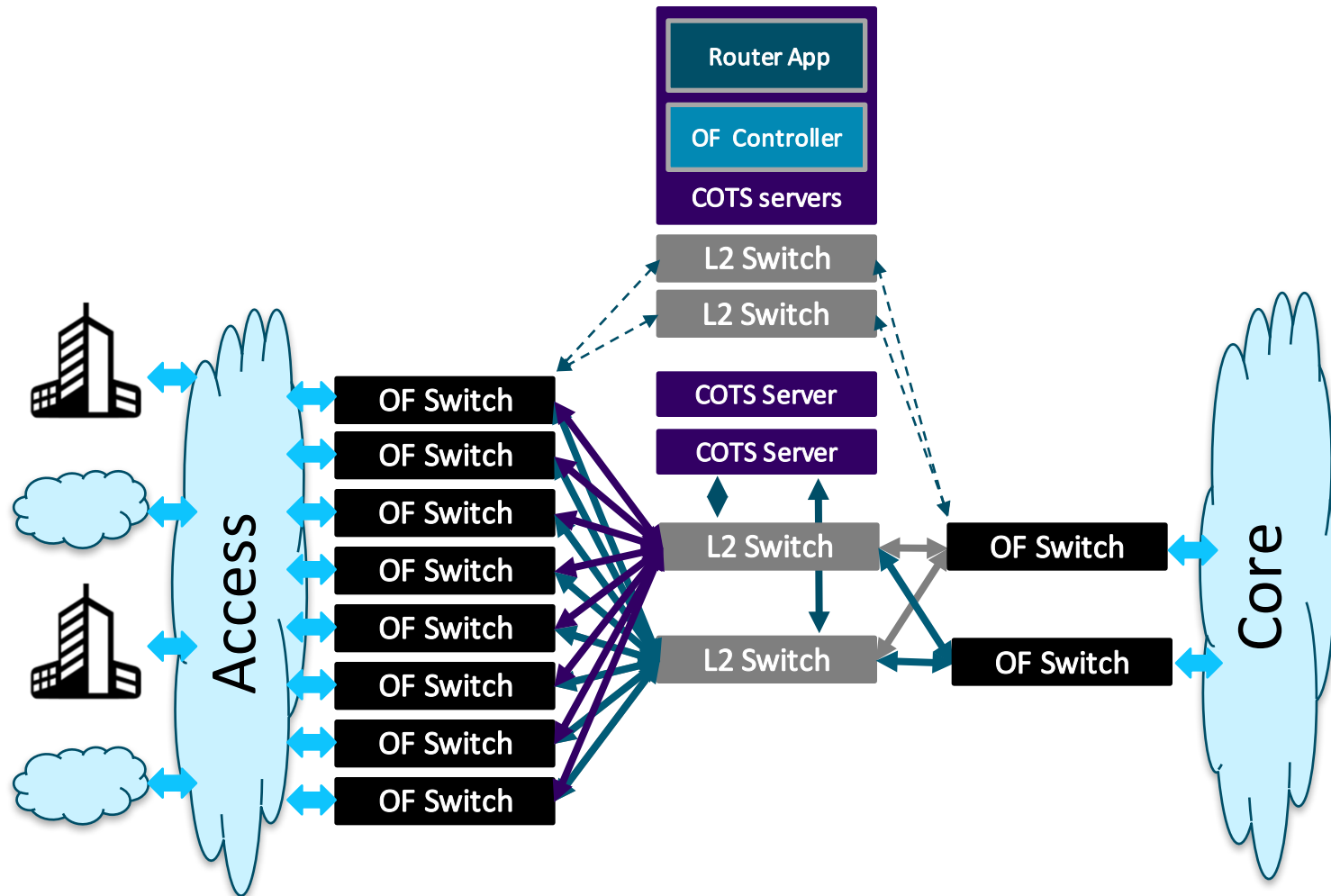
NoviFlow *SDN Scale-out Router:*

12.8Tbps Network POD configuration example, based on 3rd Party white boxes and NoviRouter open source SDN app
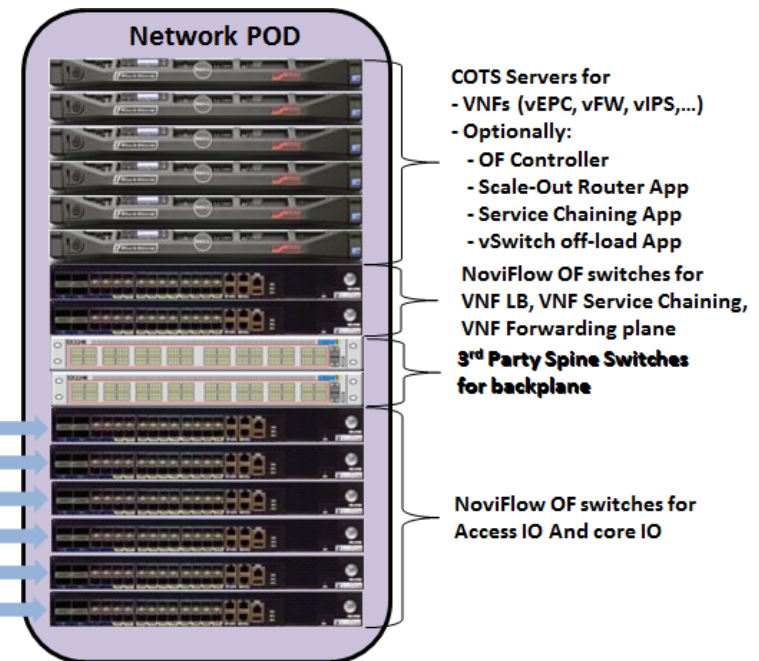
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SDN and NFV Solutions using *Scale-Out Router*

Network POD

COTS Servers for
- VNFs (vEPC, vFW, vIPS,…)
- Optionally:
  - OF Controller
  - Scale-Out Router App
  - Service Chaining App
  - vSwitch off-load App

10/40/100 GbE
10/40/100 GbE

NoviFlow OF switches for
IO, VNF LB, VNF Service Chaining,
VNF Forwarding plane

High Performance NFV
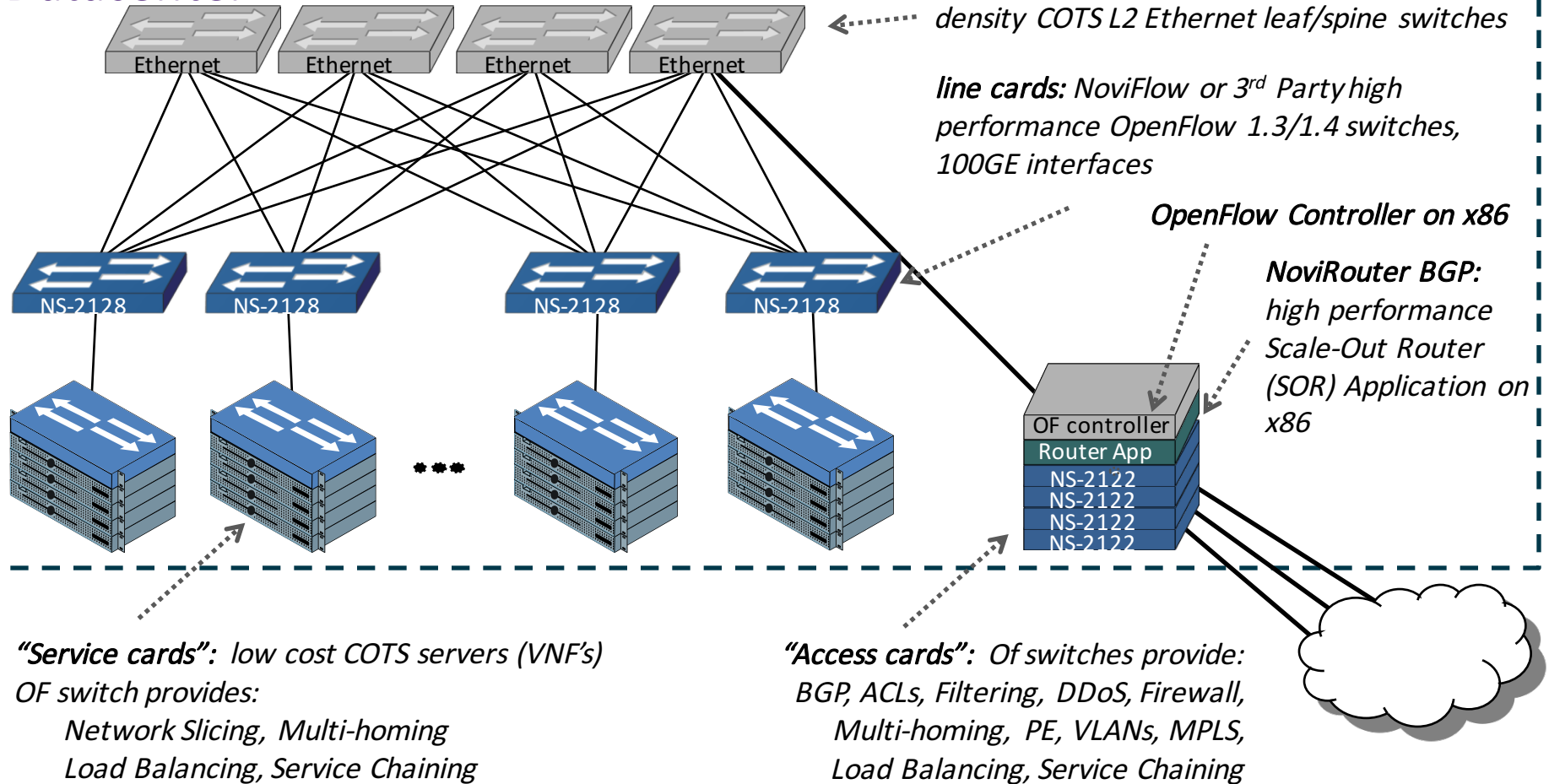
– Low and deterministic latency & Jitter

– High PPS throughput

Scale-out Architecture

– Seamless capacity growth

– Mix and match components

– Distributed or centralized SDN control

Network POD

COTS Servers for
- VNFs (vEPC, vFW, vIPS,…)
- Optionally:
  - OF Controller
  - Scale-Out Router App
  - Service Chaining App
  - vSwitch off-load App

NoviFlow OF switches for
VNF LB, VNF Service Chaining,
VNF Forwarding plane

3rd Party Spine Switches
for backplane

1/10/40/100 GbE
1/10/40/100 GbE
1/10/40/100 GbE
1/10/40/100 GbE
1/10/40/100 GbE
1/10/40/100 GbE

NoviFlow OF switches for
Access IO And core IO

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Deployment scenario: Locally Distributed

Datacenter

"Backplane": Low cost, low latency and high density COTS L2 Ethernet leaf/spine switches

line cards: NoviFlow or 3rd Party high performance OpenFlow 1.3/1.4 switches, 100GE interfaces

OpenFlow Controller on x86

NoviRouter BGP: high performance Scale-Out Router (SOR) Application on x86

OF controller
Router App
NS-2122
NS-2122
NS-2122
NS-2122

"Service cards": low cost COTS servers (VNF's) OF switch provides:
Network Slicing, Multi-homing
Load Balancing, Service Chaining

"Access cards": Of switches provide:
BGP, ACLs, Filtering, DDoS, Firewall,
Multi-homing, PE, VLANs, MPLS,
Load Balancing, Service Chaining

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Scale-Out Router – Geographically Distributed

NoviRouter: *NoviFlow open source high performance Scale-Out Router (SOR) Application*
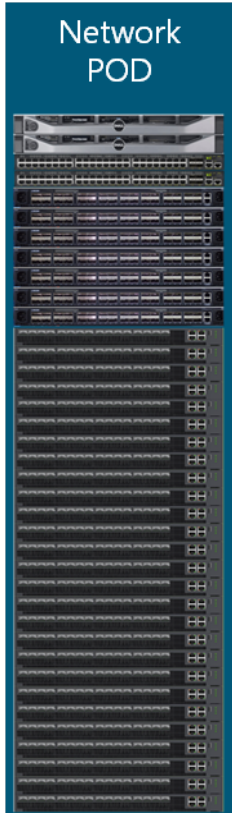
Scale-Out Router App

OF Controller

OpenFlow Controller on x86

NETFLIX

Microsoft Azure

amazon webservices™

Private Cloud

NS-2128

NS-2128

NS-2128

NS-2128

NS-2128

NS-2128

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Customer Networks

Customer Networks

Customer Networks

Customer Networks

line cards: *NoviFlow or 3rd Party high performance OpenFlow 1.3/1.4 switches, 100GE interfaces*

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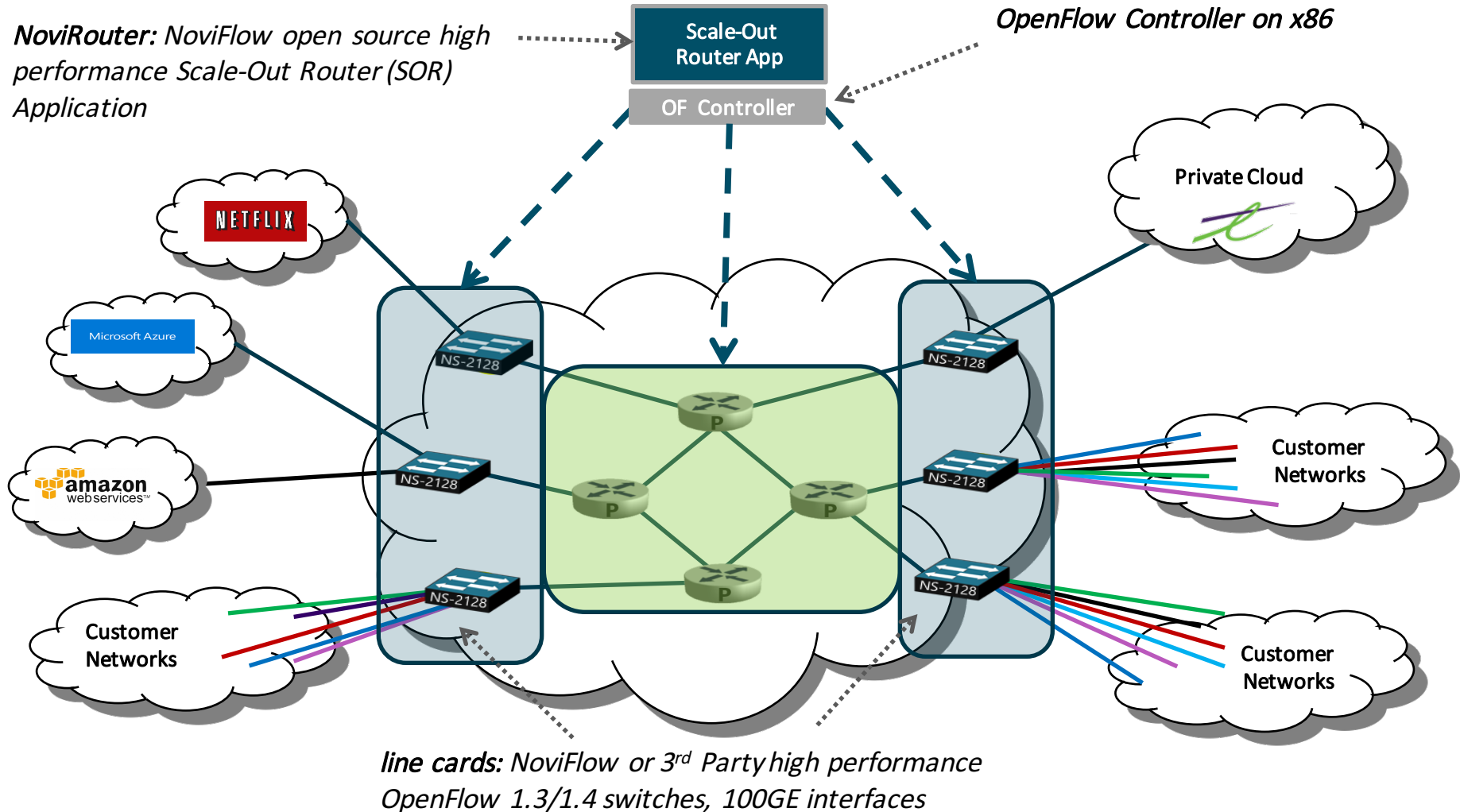
NoviFlow *SDN Scale-out Router Evolution*
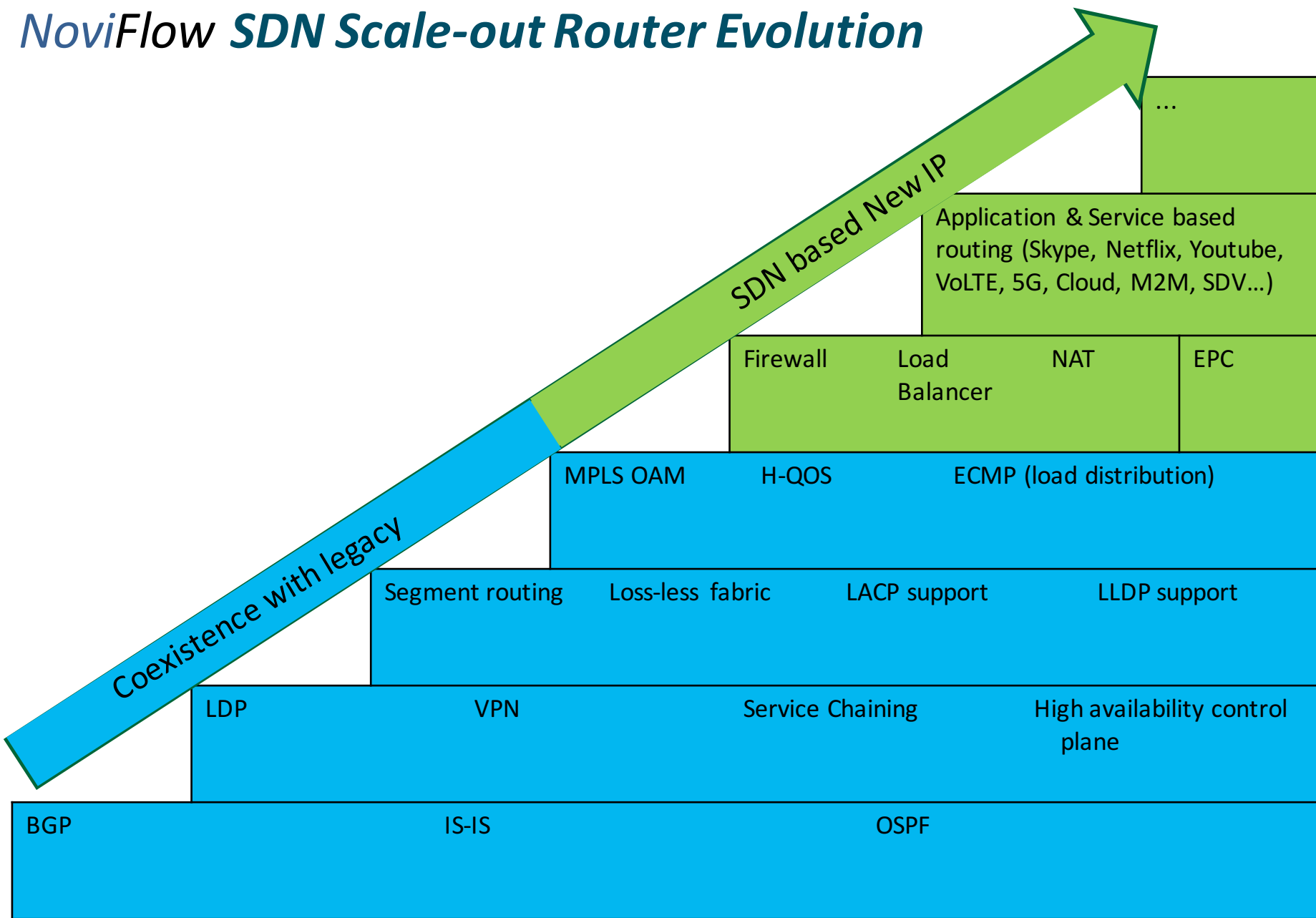
Router Cost Savings

NoviFlow Scale-Out Router

Leading Scale-up Router Chassis

VS

CAPEX

	NoviFlow Scale-Out Router	Leading Scale-Up Router	Comparison
Number of 100G ports	324	320	Same
Height (Rack Units)	38	88	50%
Price ($M)	7	27.8 [1]	25%

[1] – assuming discounted price

OPEX

SDN based Router Cost Reductions
Savings of 65% from SD WAN deployment at a 250-branch WAN.

* 3 year costs for 250-Branch WAN			
Item	Traditional	SD-WAN	*Savings*
Router Capex	$1,000,000	$250,000	*75%*
Router Maint/Support	$180,000	$150,000	*17%*
Staffing OpEx	$105,000	$52,500	*50%*
Total:	$1,285,000	$452,500	*65%*

**Source: Gartner, 2015*

*Same capacity in **half** the footprint for **25%** of the price!*

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Use Cases where NoviFlow Switch is or can be used as the Forwarding Plane Device, FPD

Domain	DC			WAN (SD-WAN)					Network Appliances			Mobile Networks			
SDN/NFV Use Cases	ToR	GW	vSO	R	PE	CE	IPE	VPN	FW	LB	NAT	EPC	TAP	SCH	PC
ICT Service Providers	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Key Benefits	• CAPEX reduction: R, PE, EPC, Network Tapping, VNFs • OPEX reduction: Simplified operations, Service provisioning, Centralized network control layer and network management across the telecom networks, IP networks and IT systems • Service Introduction: VPN, M2M, 5G, Cloud services														
Acronyms	• ToR: Top of Rack • GW: GateWay • vSO: vSwitch Offload			• R: Router • PE: Providers Edge • CE: Carrier Ethernet • IPE: IP network Edge • VPN: virtual Private Network					• FW: Fire Wall • LB: Load Balancer • NAT: Network Address Translation			• EPC: Evolved Packet Core • TAP: Network Tapping • SCH: Service Chaining • PC: Packet Classification			

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aarnet

Australian Wide-Area SDN Testbed

THE AARNET SDN TESTBED

SDN as enabler

Network

SDN

Compute

Storage

Software tools

User engagement

Full-service « ecosystem »
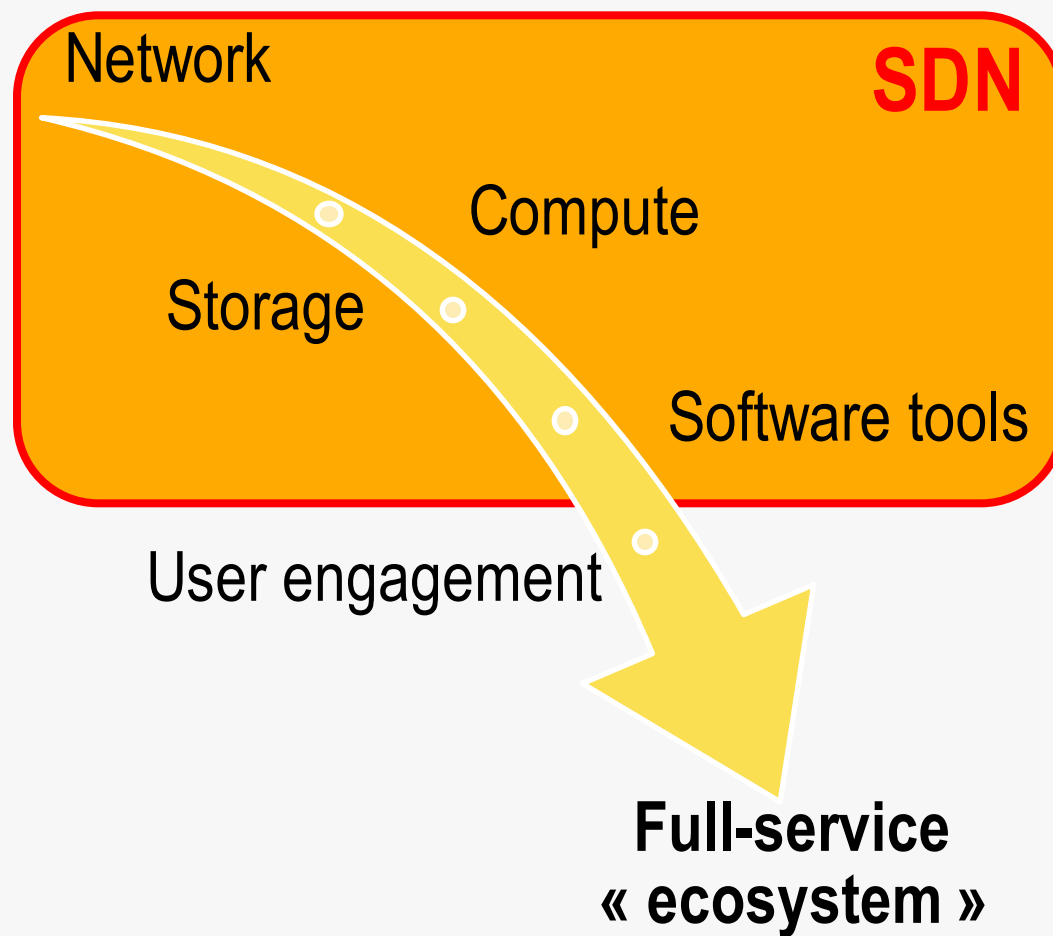
The ANZ SDN testbed

LIEF: Linkage Infrastructure, Equipment and Facilities
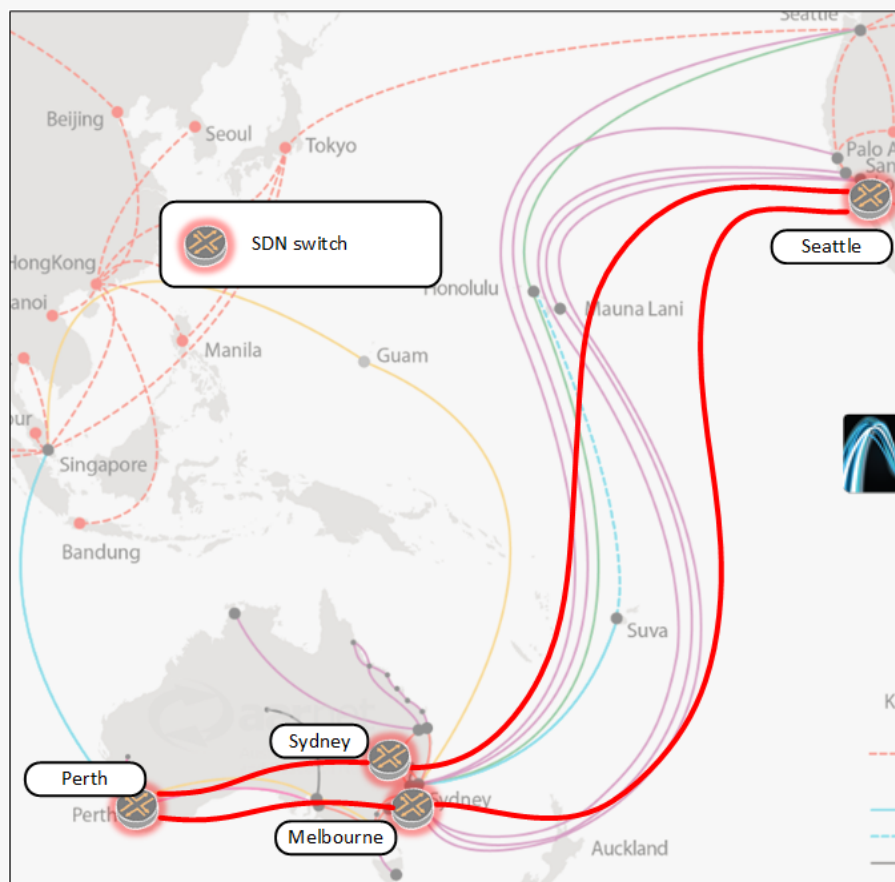
Testbed – participating institutions

LIEF: Linkage Infrastructure, Equipment and Facilities

Towards an SDN testbed
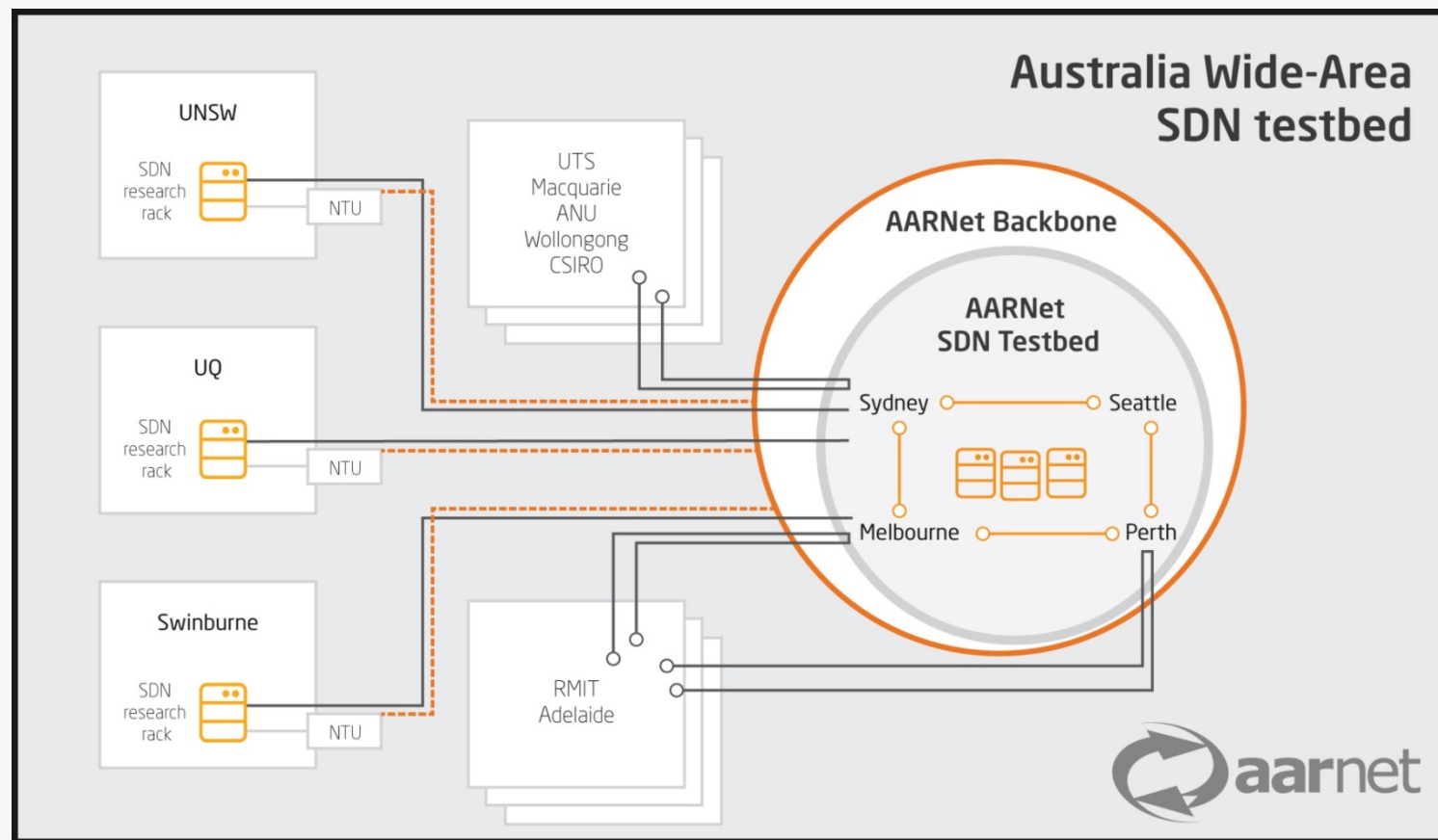
Step 1: the AARNet SDN testbed

The ANZ SDN testbed

Step 2: *extend…*
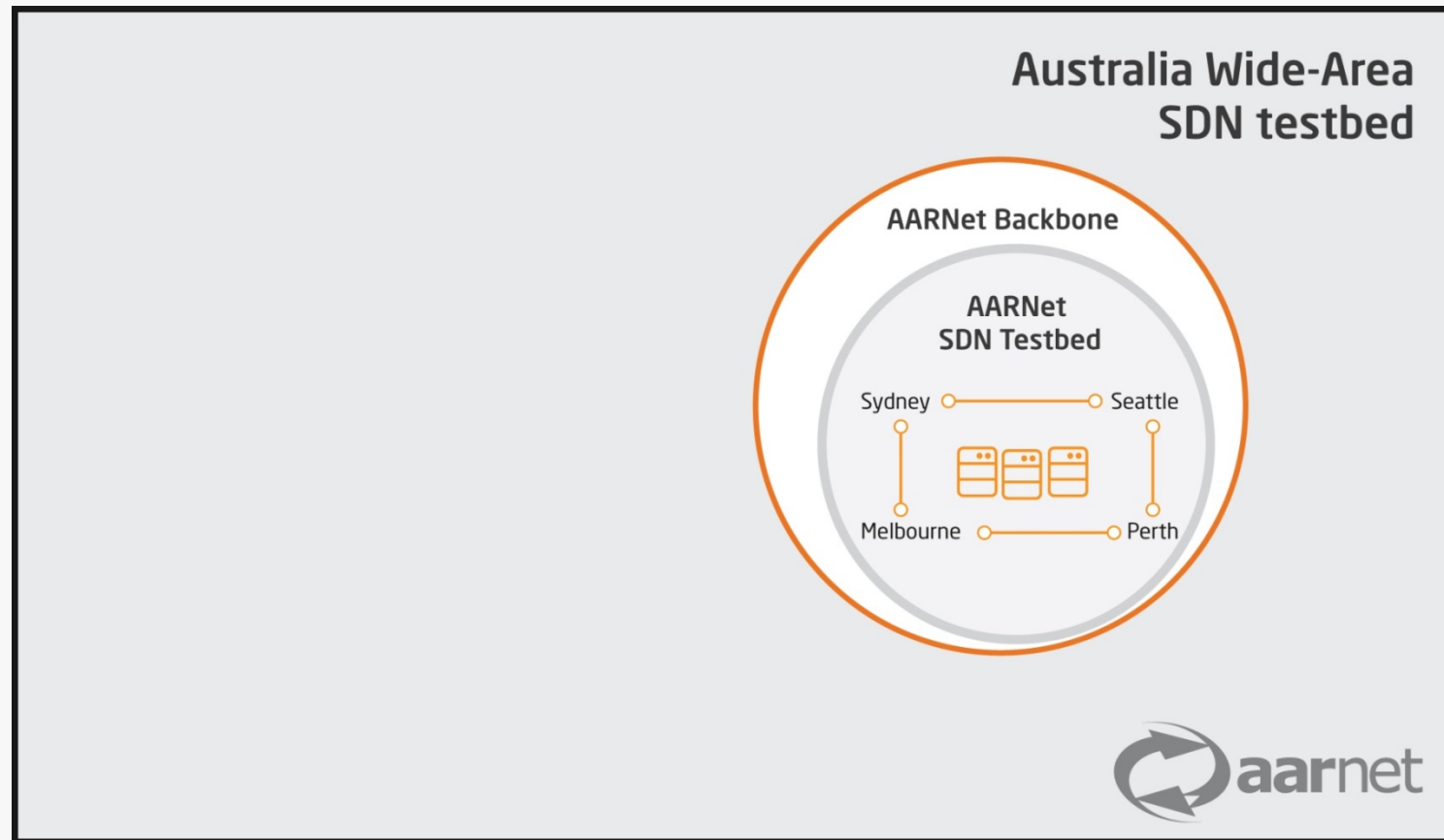
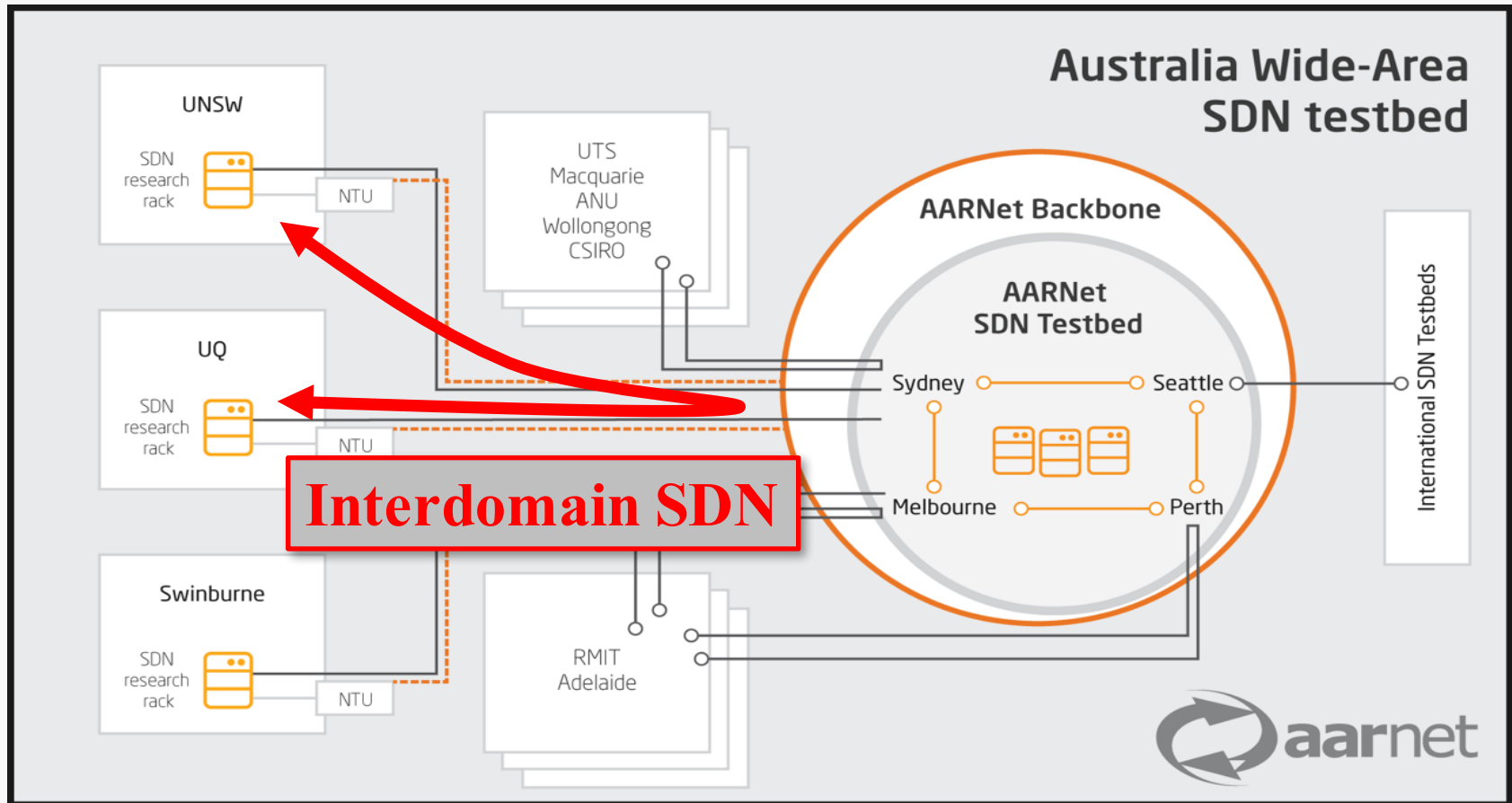# The ANZ SDN testbed

Step 2: the Australia-wide SDN testbed …
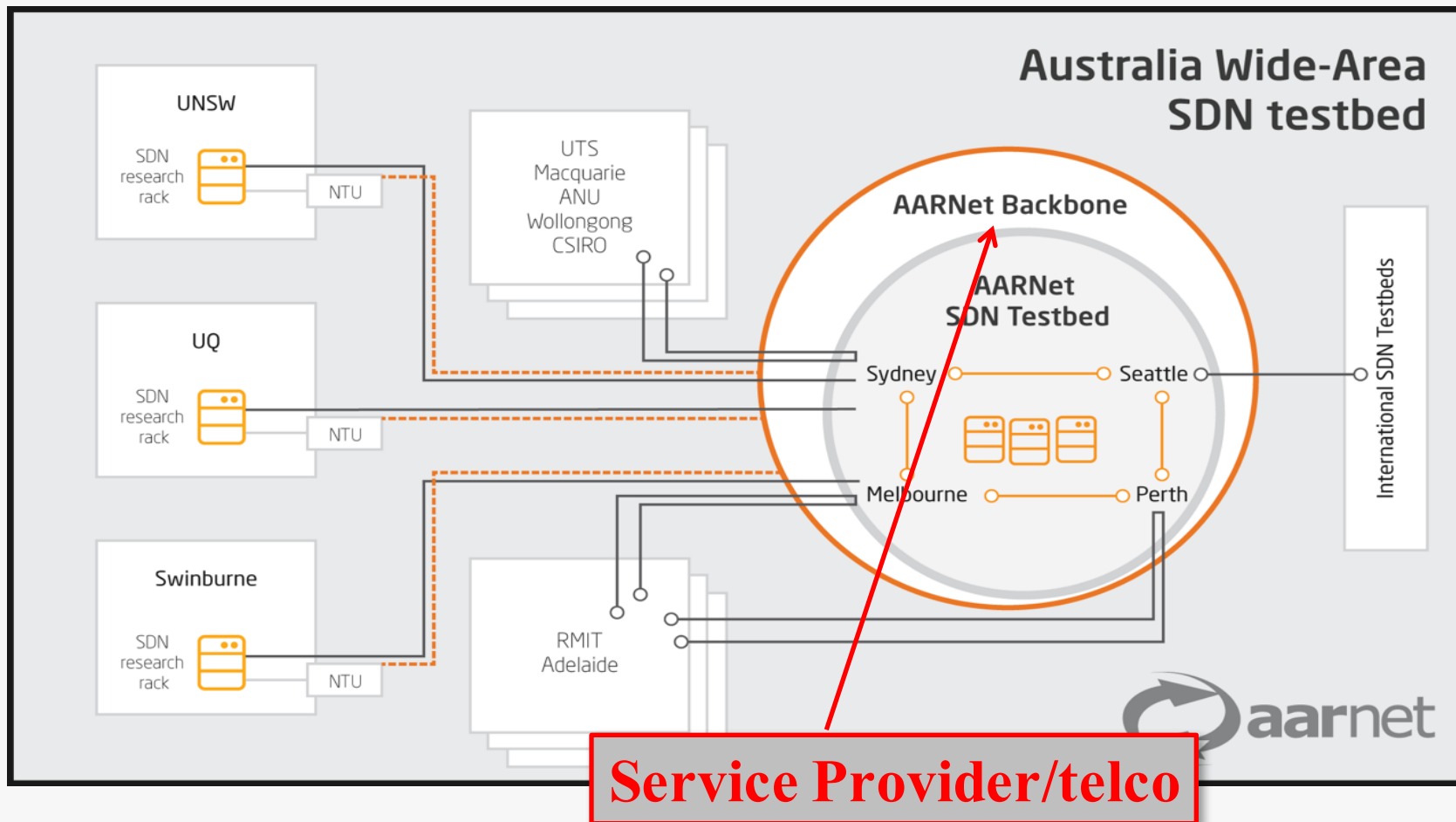
The ANZ SDN testbed

Step 3: …and finally, international extension.
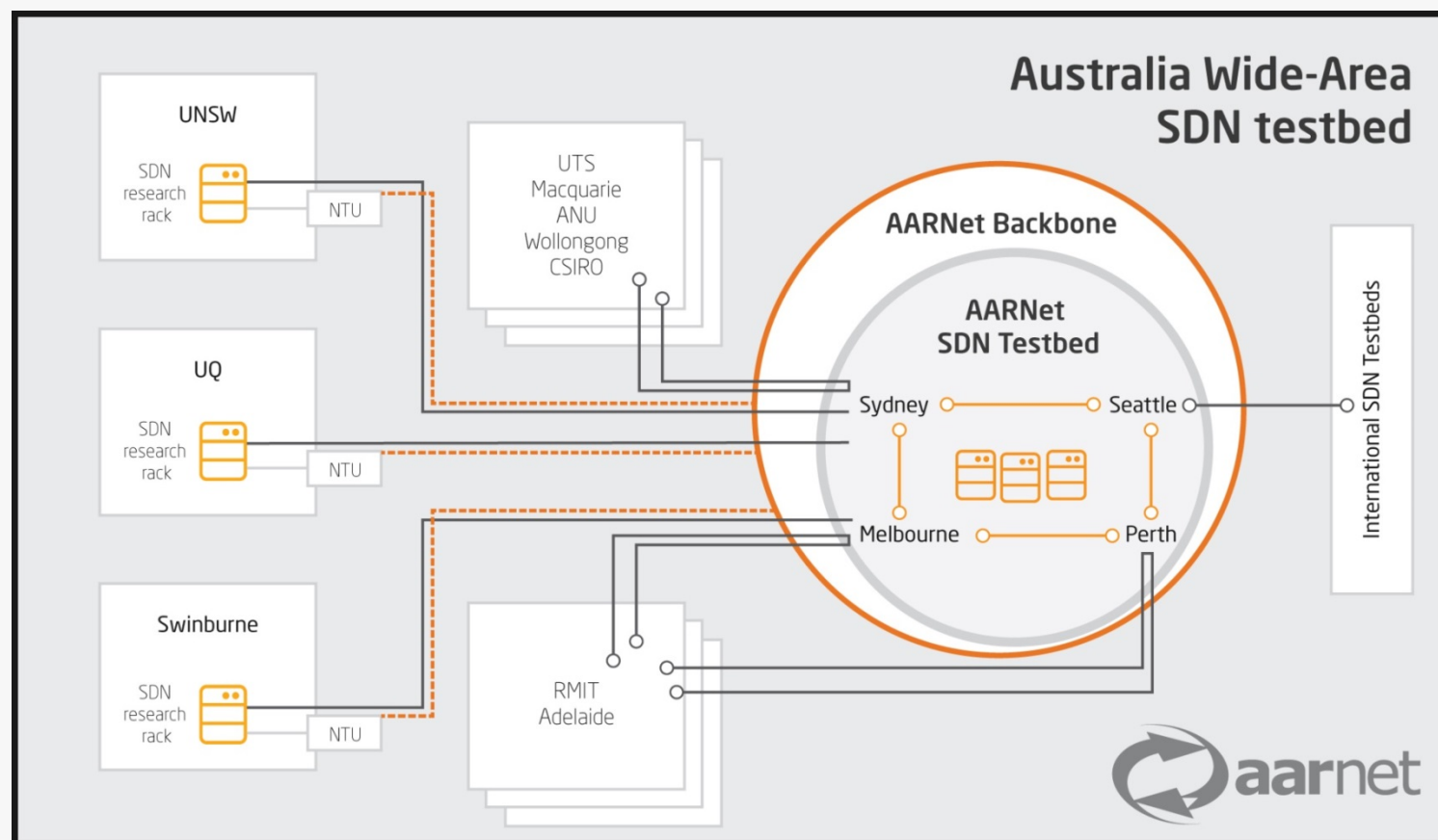
Focus: interdomain SDN

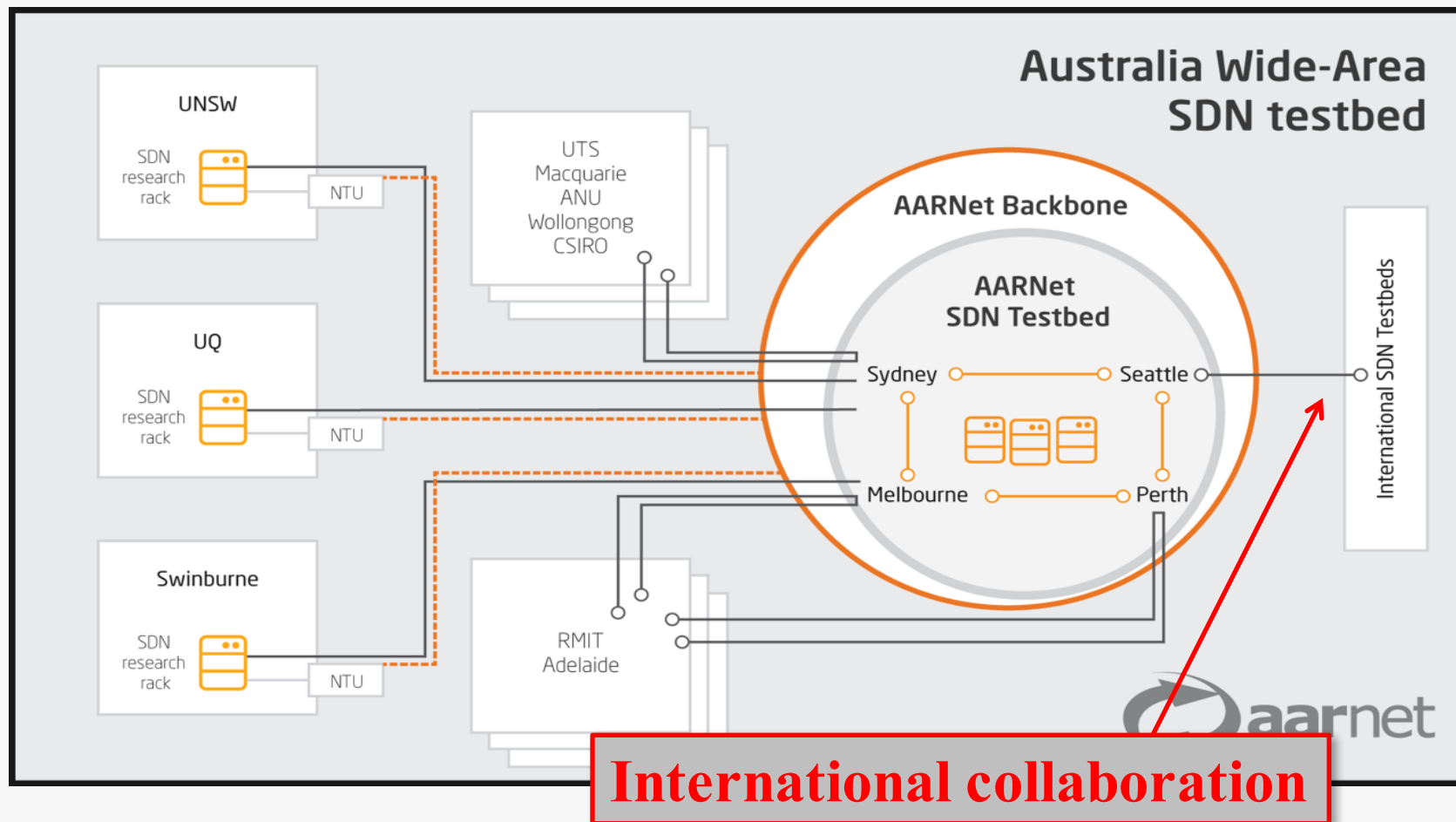# Focus: SP/telco

Service Provider/telco

Focus: internet-scale
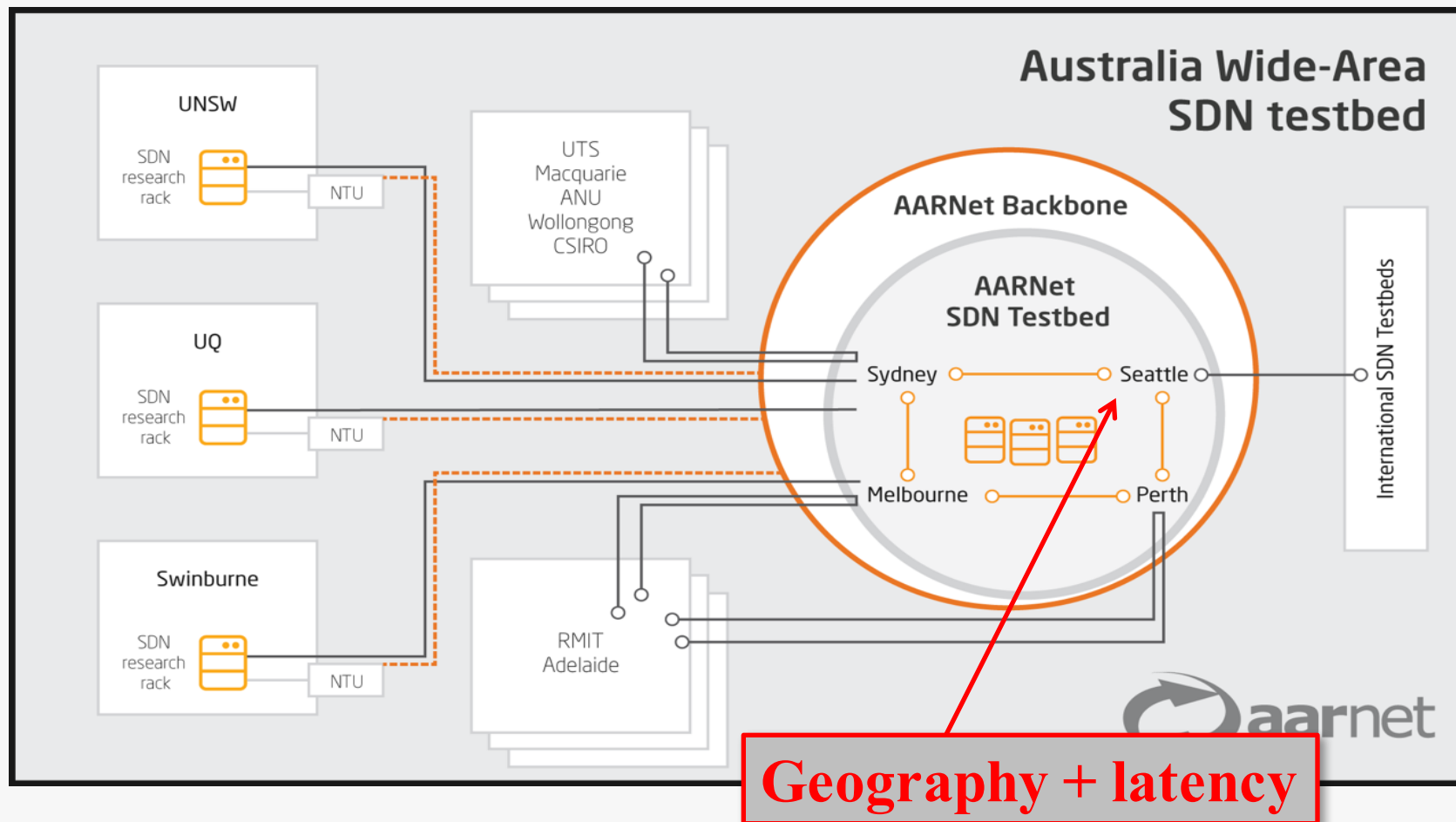
Focus: international collaboration

Australia Wide-Area SDN testbed

The aim:

**Collectively build understanding of
the SDN ecosystem**

Summary: The SDN Scale-Out Router

Proven implementation of the Scale-Out Router concept!

- COTS h/w and Open Source s/w
    - No vendor lock-in
    - No hardware obsolescence issues
- Geographically distributed
- Multi Domain
- Hyperscale (ready for IoT, 5G, etc...)
- Step-wise implementation for easy deployment and smooth migration from legacy

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