ONOS and CORD

Summary and Future Plans

#ONOSProject

Open Network Operating System

Agenda

- Who we are
- What we do: ONOS and CORD
- **Focus on M-CORD and 5G**
- Deployments
- Conclusions

Who we are

Open Networking Lab (ON.Lab)

"The Open Networking Lab was founded as a 501 (c) (3) non-profit to pursue our vision of what Software Defined Networking could be for the public good."

Nick McKeown
KP, Mayfield, Sequoia
Professor, Stanford

Scott Shenker
Professor, UC Berkeley
Chief Scientist, ICSI

Guru Parulkar
Executive Director, ON.Lab,
Executive Director ONRC
Consulting Professor, Stanford

Larry Peterson
Robert Kahn Professor
Princeton (Emeritus)

ONOS Partnership and Community

ON.LAB	SERVICE PROVIDER PARTNERS	VENDOR PARTNERS	COLLABORATORS	VOLUNTEERS
ON.LAB	at&t, China unicom中国联通, NTT Communications, SK telecom, verizon	Alcatel·Lucent, ciena, CISCO, ERICSSON, FUJITSU, intel, HUAWEI, NEC	BLACKDUCK, cnit, CREATE-NET, ETRI, Consortium GARR, happiest minds, Infoblox, INTERNET2, KREONET, KISTI, ON.LAB, SRI International, KAIST, NAIM, CRITERION NETWORKS Total 20+ Orgs	

- Added four service providers and two vendors as partners
- Added 20+ collaborating organizations -- many R&E network operators

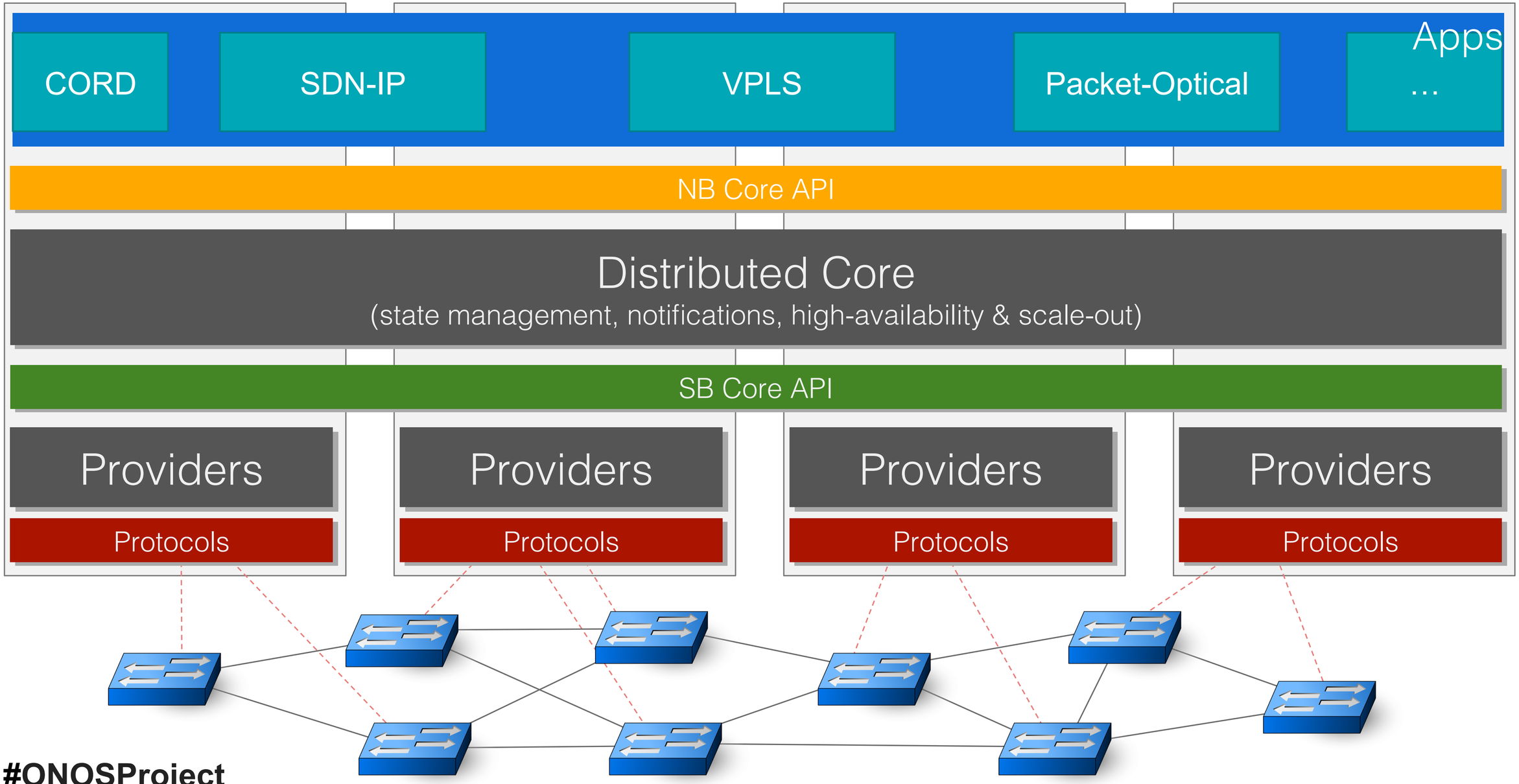
Strong Partnership & Community in a year

What we do

ONOS for Service Providers

- Scalability, High Availability & Performance
- Northbound & Southbound Abstractions
- Modularity

ONOS Architecture



Central Offices Re-architected as Datacenter

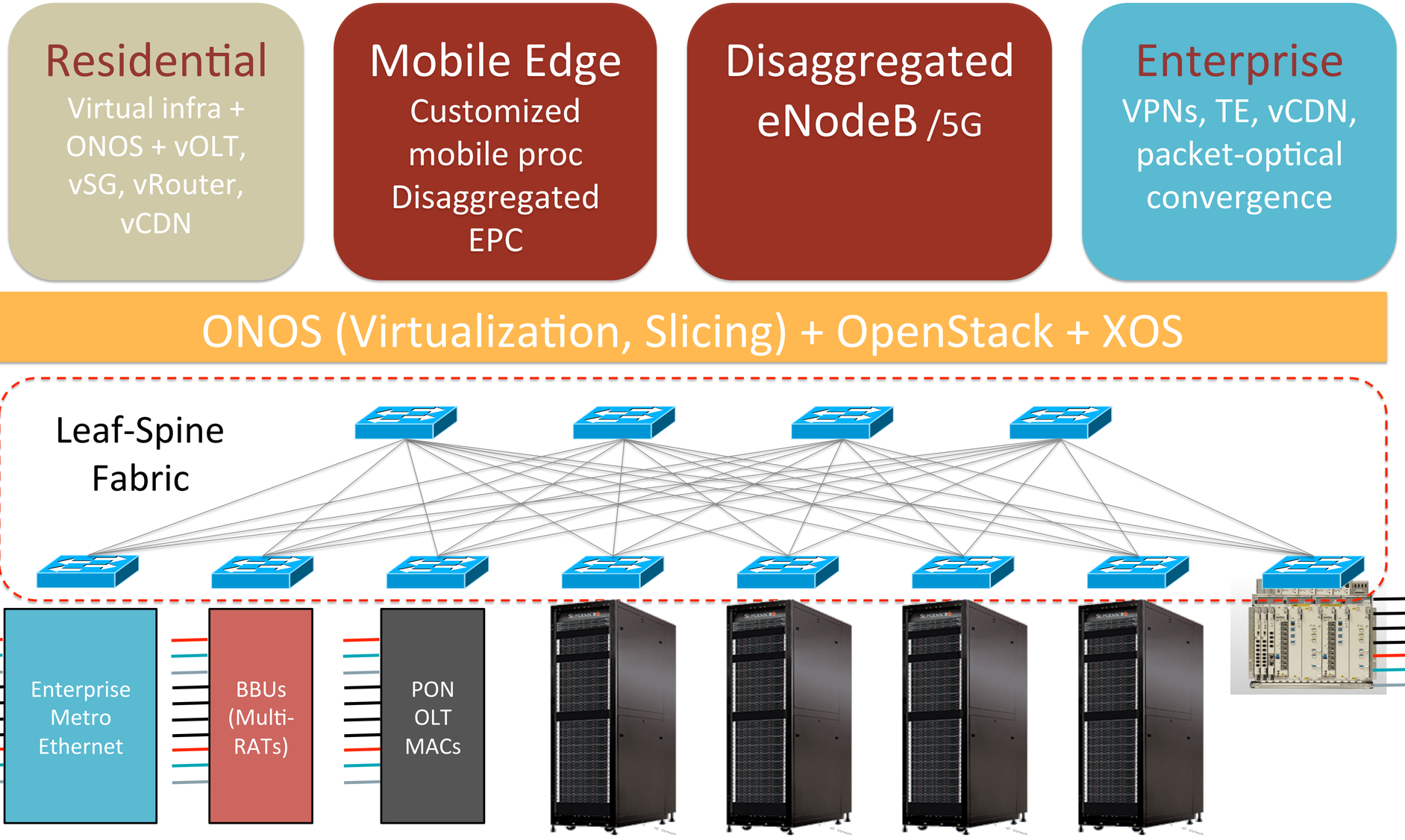
Economies of a datacenter

Infrastructure built with a few commodity building blocks using open source software and white-box switches

Agility of a cloud provider

Software platforms that enable rapid creation of new services

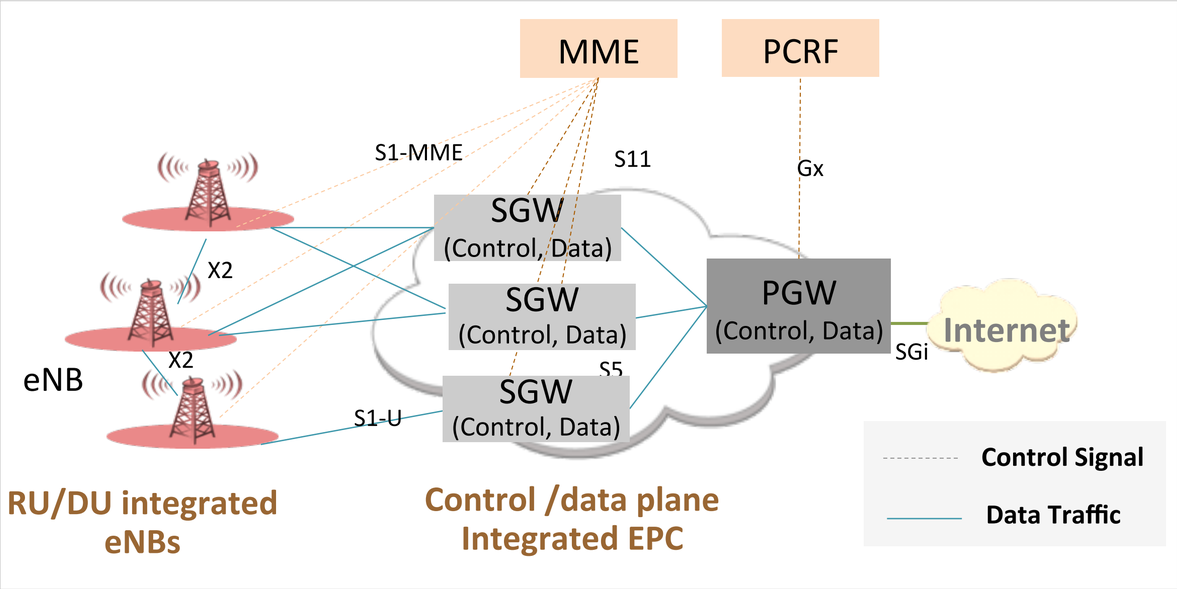
CORD Architecture and Use-Cases



Commodity Servers, Storage, Switches, and I/O

M-CORD (Enable 5G on CORD)

Traditional Architecture



with proprietary boxes & solutions

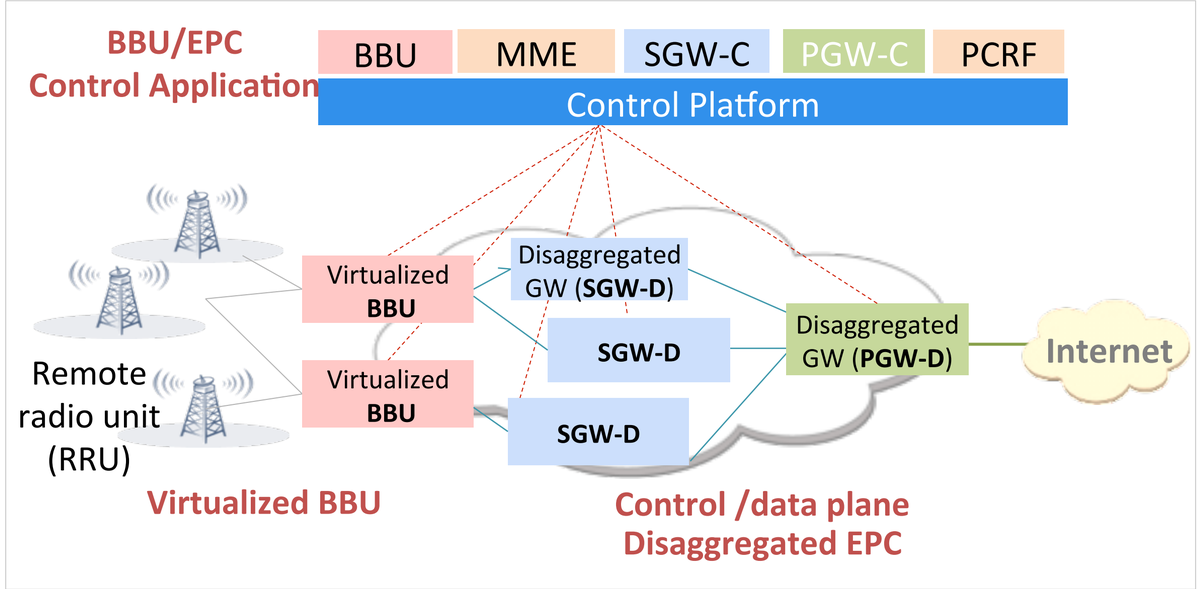
RU/DU integrated RAN

- Limited Scalability
- Inefficient coordination
- Sub-optimal spectrum usage
- High Cost

Control/data plane integrated EPC

- Limited scalability
- Discrete control
- Proprietary H/W for all-purpose
- High Cost

Target Architecture



with commodity H/W & open source/open API

Disaggregated & Virtualized RAN

- High Flexibility & Scalability
- Centralized Coordination
- Spectrum usage optimization
- Reduced Cost
- Enable New Innovative Services

Disaggregated & Virtualized EPC

- Independent Scalability
- Centralized Control
- Choice of solutions
- Reduced Cost
- Enable New Innovative Services

Deployments

Motivation and Goals

REN, Network Operators and Users

Create a global SDN network

Provide L2 and L3 connectivity without "legacy" equipment in the network core

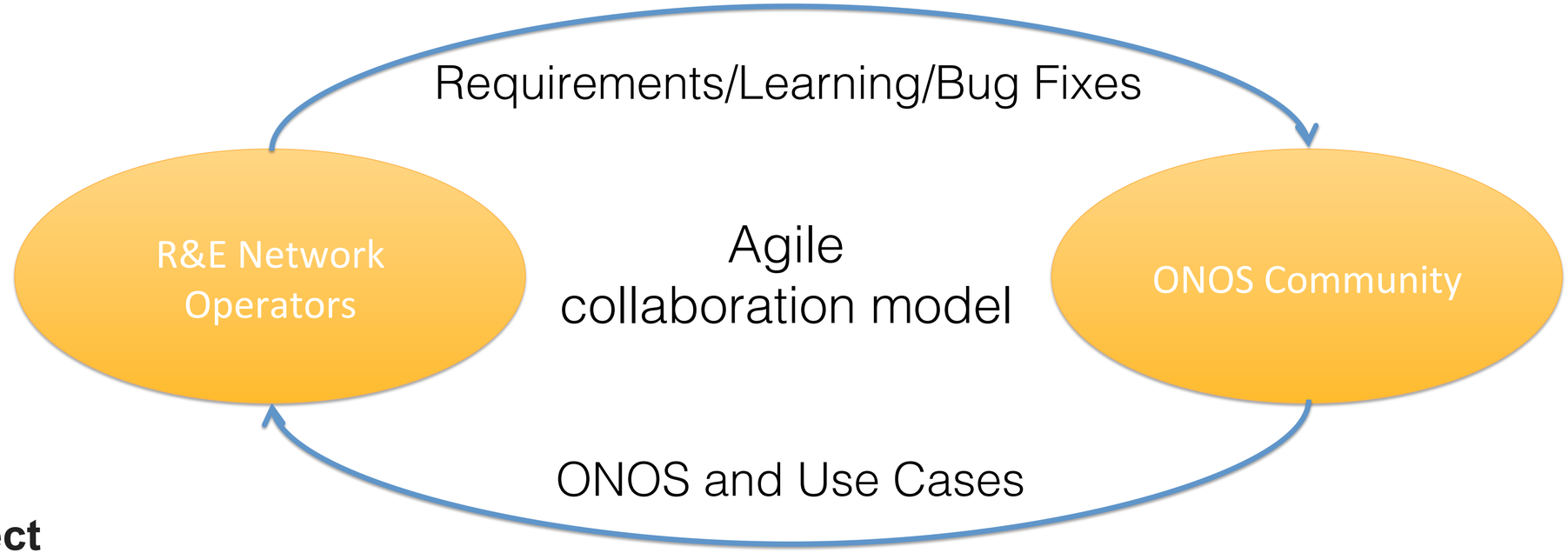
Enable network and services innovation

ONOS community

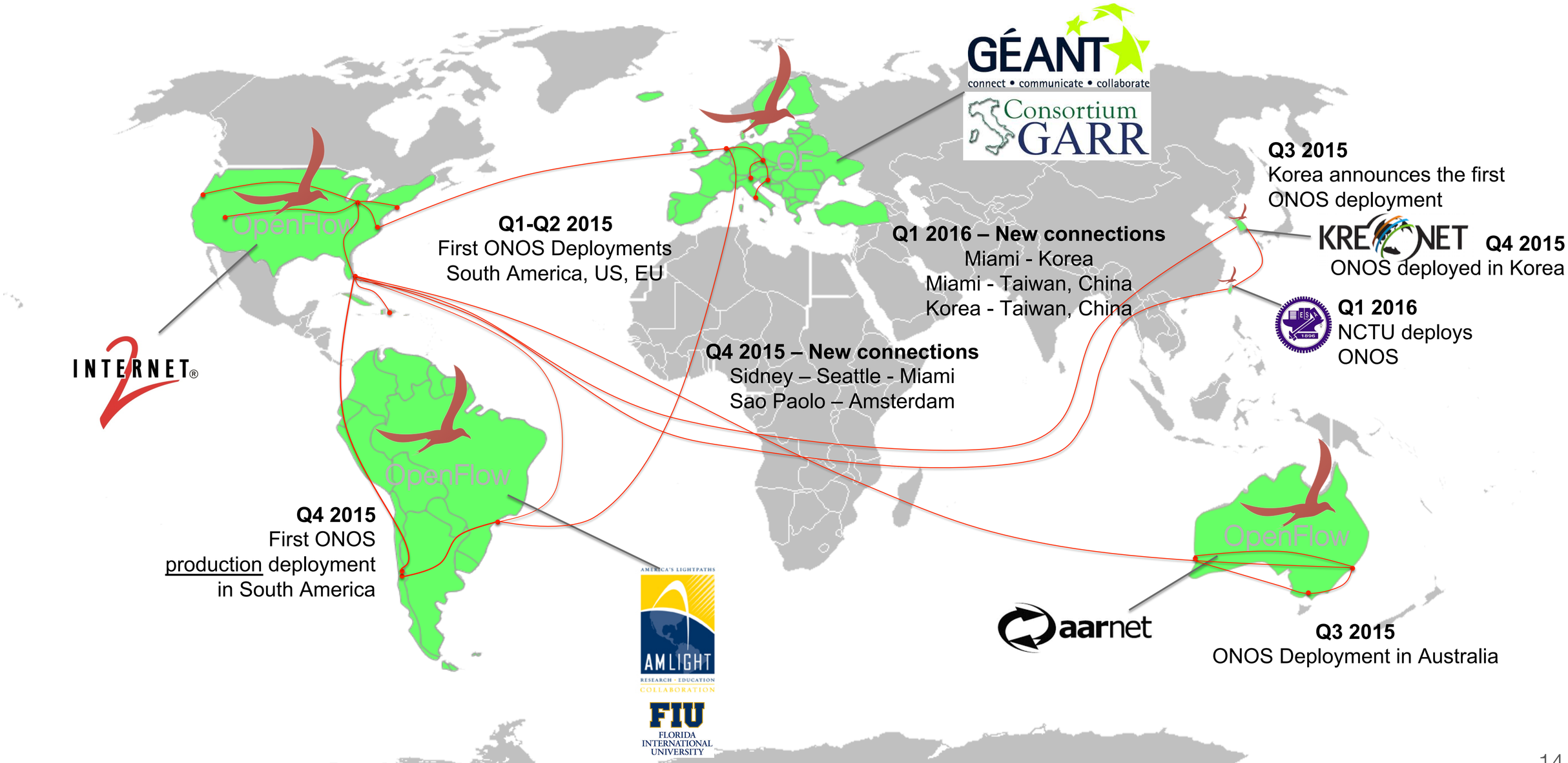
Demonstrate ONOS in real networks

Test High performance, HA and scalability in real networks

Learn and improve



Global SDN Deployment Powered by ONOS



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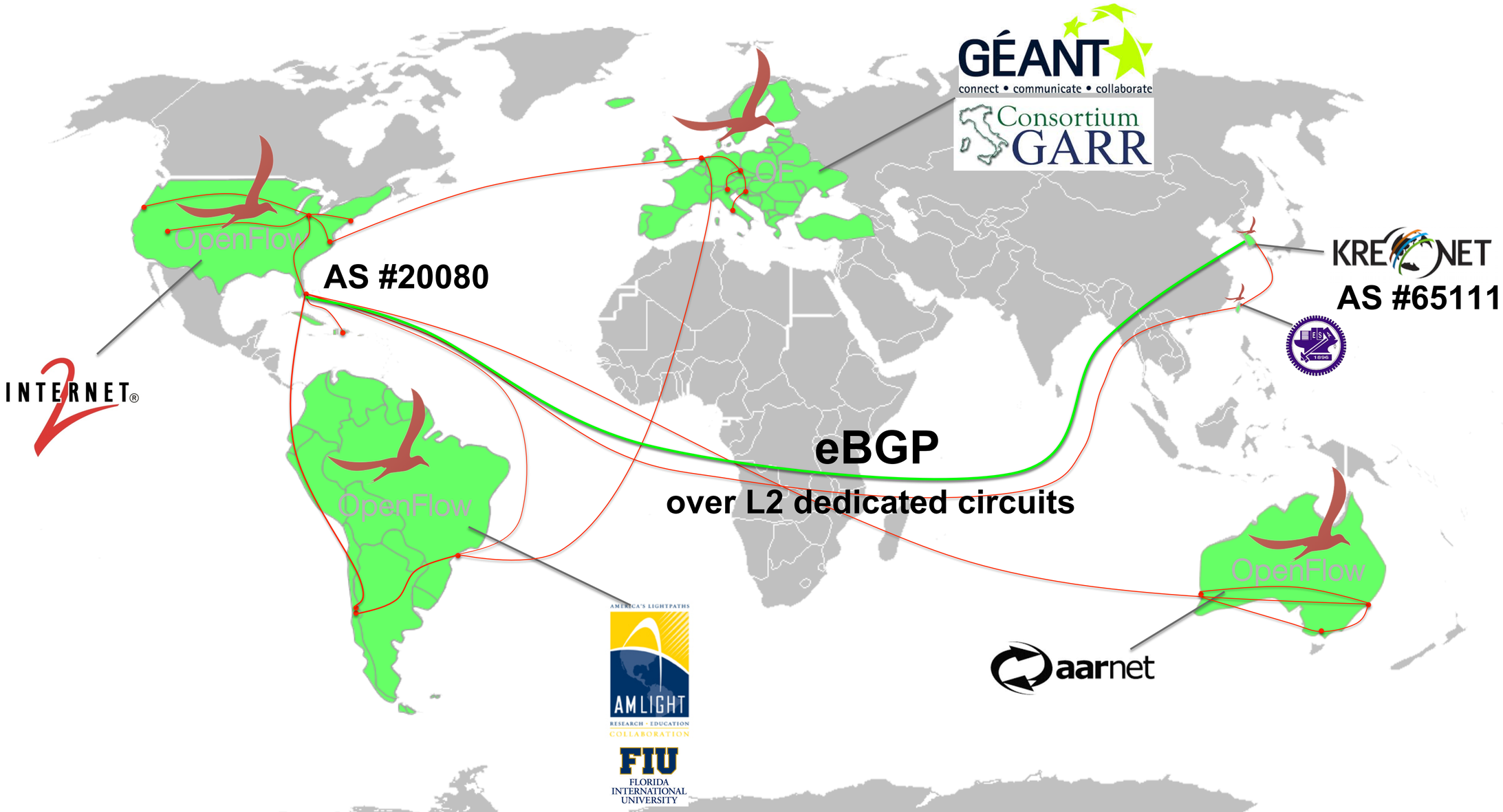
How the testbed works?



Enabling network innovation with new apps

Castor

- Provides L2/L3 connectivity for SDXs
- Developed and deployed in AARNET

SDN-IP

- Transforms a SDN into a transit IP network
- SDN AS uses BGP to communicate with neighbors
- L3 connectivity without legacy routers
- Deployed by AmLight, Internet2 (upgrading), KREONET, NCTU

SDX L2/L3

- Provides L2/L3 connectivity for SDXs
- Developed and deployed by GEANT

VPLS

- L2 broadcast overlay networks on demand
- Ready to be deployed on AmLight

CORD Field Trial @ AT&T

- Announced by John Donovan @ ONS2016
- Positive feedback from the first 10 users
- Now moving to 100, 1000 users

Deployments, next steps

Requirements

What RENs ask for

- A simple solution that works
- Layer 0/1: Lambda allocation / OTN
- Layer 2: Connect multiple end-points
- Layer 3: Internal and International BGP Peering

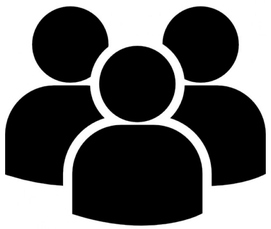
What SPs ask for

- All above..
- Yang, NetConf support
- Simplify / reduce CAPEX/OPEX in Access and Metro Networks

As always…

- HA, High performances,
- Being “Carrier Grade”

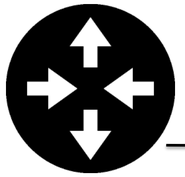
Deployments: Action Plan



Ability for both Users and Operators
to allocate end-to-end resources.

Orchestrator

CORD



- International peering
- L3 circuits and best-effort

Layer 3

SDN-IP / SDX-L3 / Castor

OpenFlow switches

Broadcast L2 networks on demand

Layer 2

VPLS / SDX-L2

Optical circuits in the Core and for Users

Layer 0 /1

Packet-Optical

CORD / ONOS Applications

Conclusions

Summary

- *ONOS and CORD* (soon) *are out as Free, Open Source Projects*

- Over 60 OpenFlow switches, 12 institutions connected across 5 continents
- ONOS applications validated: SDN-IP, SDX-L2/L3, Castor
- CORD Field Trial @ AT&T

Insights

- Everyone wants the same, simple solution – L2+L3, possibly virtualization and P.O.
- Key to scale: bring Agile methodologies and software development inside Operators
- Vendors need to improve the OF support and guarantee resources isolation

Future work

- From field trial to production (this is happening at AmLight!)
- More RENs and International XPs want to deploy
- Commercial Operators field trials
- Test OF 1.3 multi-table pipelines support
- Support multi-layer apps (i.e. packet-optical, network virtualization, VPLS)
- Focus on stability, performances and scalability

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