OSN Days Tokyo

October 23, 2018

Heather Kirksey

VP, Ecosystem & Community

Linux Foundation

□ THE LINUX FOUNDATION

The Linux Foundation is creating the **greatest shared technology investment in history** by enabling open source collaboration across companies, developers, and users.

Today the Linux Foundation is much more than Linux

Security
We are helping global privacy and security through a program to encrypt the entire internet.

Networking
We are creating ecosystems around networking to improve agility in the evolving software-defined datacenter.

Cloud
We are creating a portability layer for the cloud, driving de facto standards and developing the orchestration layer for all clouds.

Automotive
We are creating the platform for infotainment in the auto industry that can be expanded into instrument clusters and telematics systems.

Blockchain
We are creating a permanent, secure distributed ledger that makes it easier to create cost-efficient, decentralized business networks.

Web
We are providing the application development framework for next generation web, mobile, serverless, and IoT applications.

Let's Encrypt — LF NETWORKING — CLOUD NATIVE COMPUTING FOUNDATION — AUTOMOTIVE GRADE LINUX — HYPERLEDGER — node JS

We are regularly adding projects; for the most up-to-date listing of all projects visit tlfprojects.org

What is LF's role in projects?

Governance and Membership	• Incorporation, Tax status, Bylaws, Member Agreements, Anti-trust, etc. • Ongoing business development and membership recruitment
Development Process	• Technical Decision Making • Project Life Cycle • Release Process
Infrastructure	• Custom infrastructure using open source best practices • Security and reliability
Ecosystem Development	• Marketing • Events • Training
IP Management	• Code Provenance • Trademark management • Legal defense and Collaboration

□ THE LINUX FOUNDATION

Linux Foundation and Networking

THE **LINUX** FOUNDATION

Networking is the fabric for Growth & Innovation Across Industries
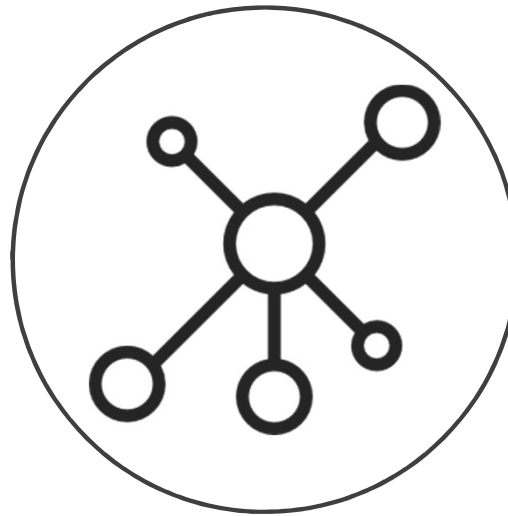
Automotive
Connected Cars
Connected cars market projected to reach USD $219.21 billion by 2025*

Retail
Connected Stores
82% of smartphone user say they consult their phones for in-store purchases***

Networking
Carrier, Cloud, Enterprise

Energy
Connected Homes
Global Smart Home Market to Exceed $53.45 Billion by 2022**

Agriculture
Connected Cows
Global Connected Cow and Farm Market Set to Exceed $10 Billion in 2021****

□ THE **LINUX** FOUNDATION

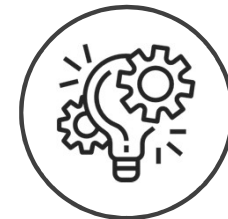# Linux Foundation Leads Modern Networking Innovation

21
Open Source
Networking Projects

10/10
Networking Vendors Active

$576 M
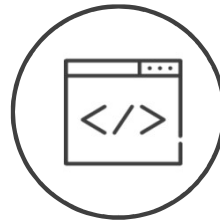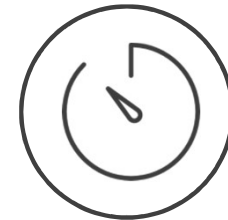Shared Innovation

9/10
Most Important Projects

~70%
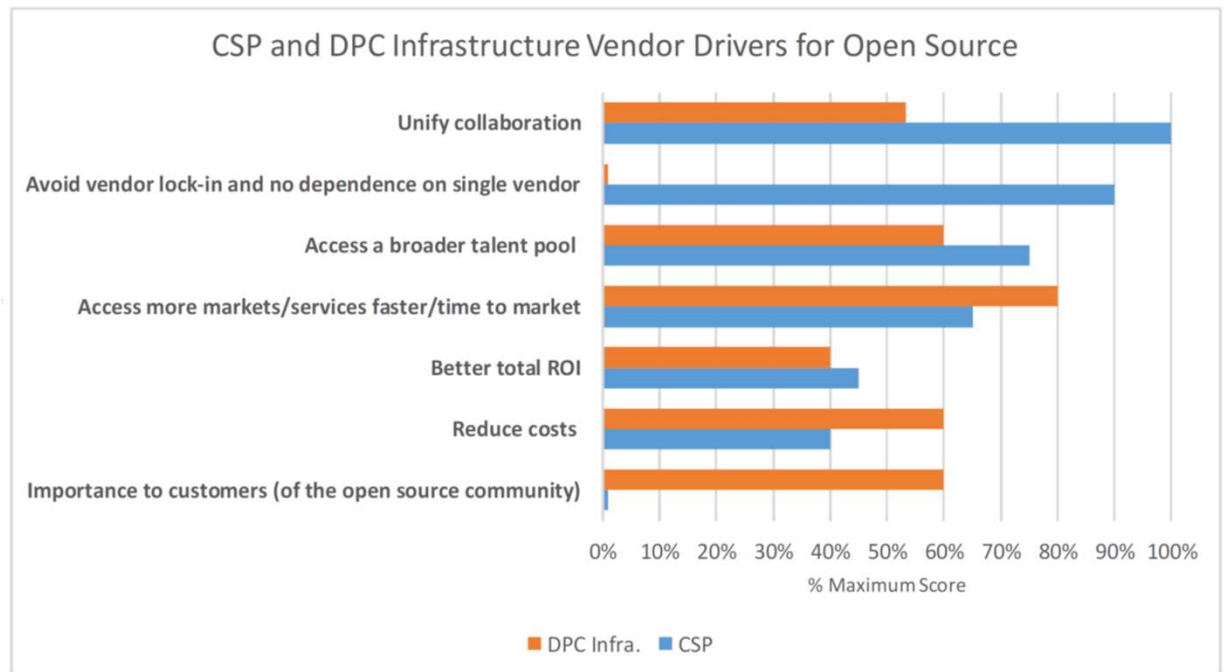Global Subscribers
Represented

15 Minute
New Service Creation

□ THE LINUX FOUNDATION

Revolution in the Networking Ecosystem

Proprietary

Vertically integrated, vendor-centric solutions to mix & match options at every level

Collaborative Design & Development

Vendors and users – instant feedback

Rapid, unified standards implementation

Shared development of basic capabilities - supply chain efficiency

New Strategic Vendor Profile

Broad, open portfolio

Focus on ecosystem interop - reduce integration time and risk
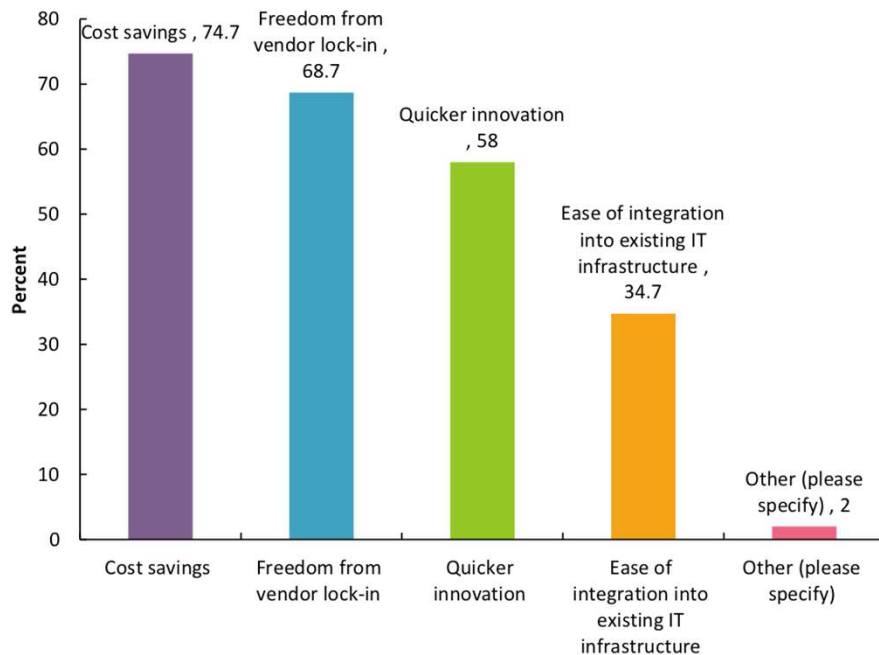
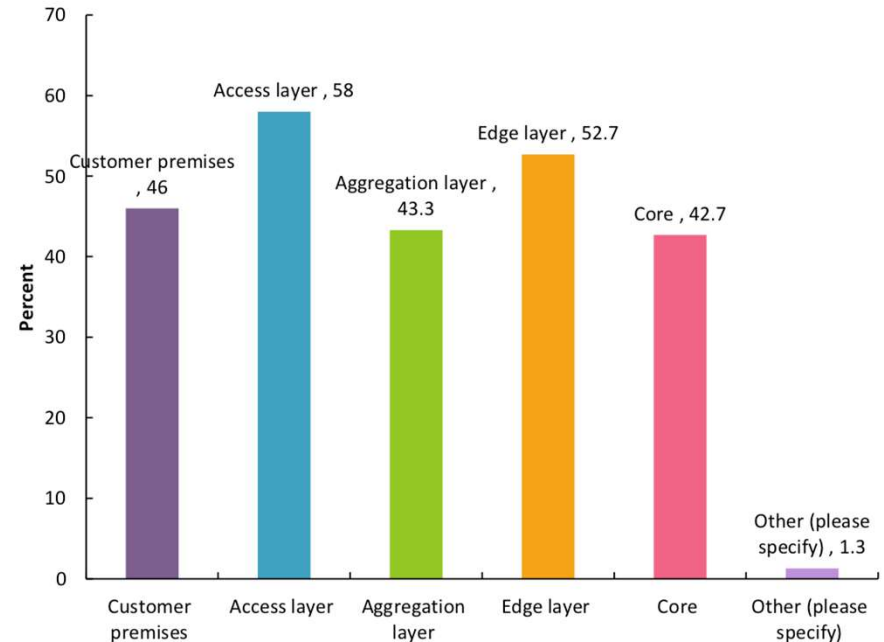Strong implementation services & support

Why Open Source Networking?

› Choose each element of your networking stack, with assured interoperability

› Improve efficiency & quality for development & implementation reduce risk & cost

› Deliver exactly the network services you need, as you need them

CSP and DPC Infrastructure Vendor Drivers for Open Source

- Unify collaboration
- Avoid vendor lock-in and no dependence on single vendor
- Access a broader talent pool
- Access more markets/services faster/time to market
- Better total ROI
- Reduce costs
- Importance to customers (of the open source community)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

% Maximum Score

■ DPC Infra. ■ CSP

Leading Surveys on Open Source & Networking

Motivators of Open Networking
End User Driven Innovation

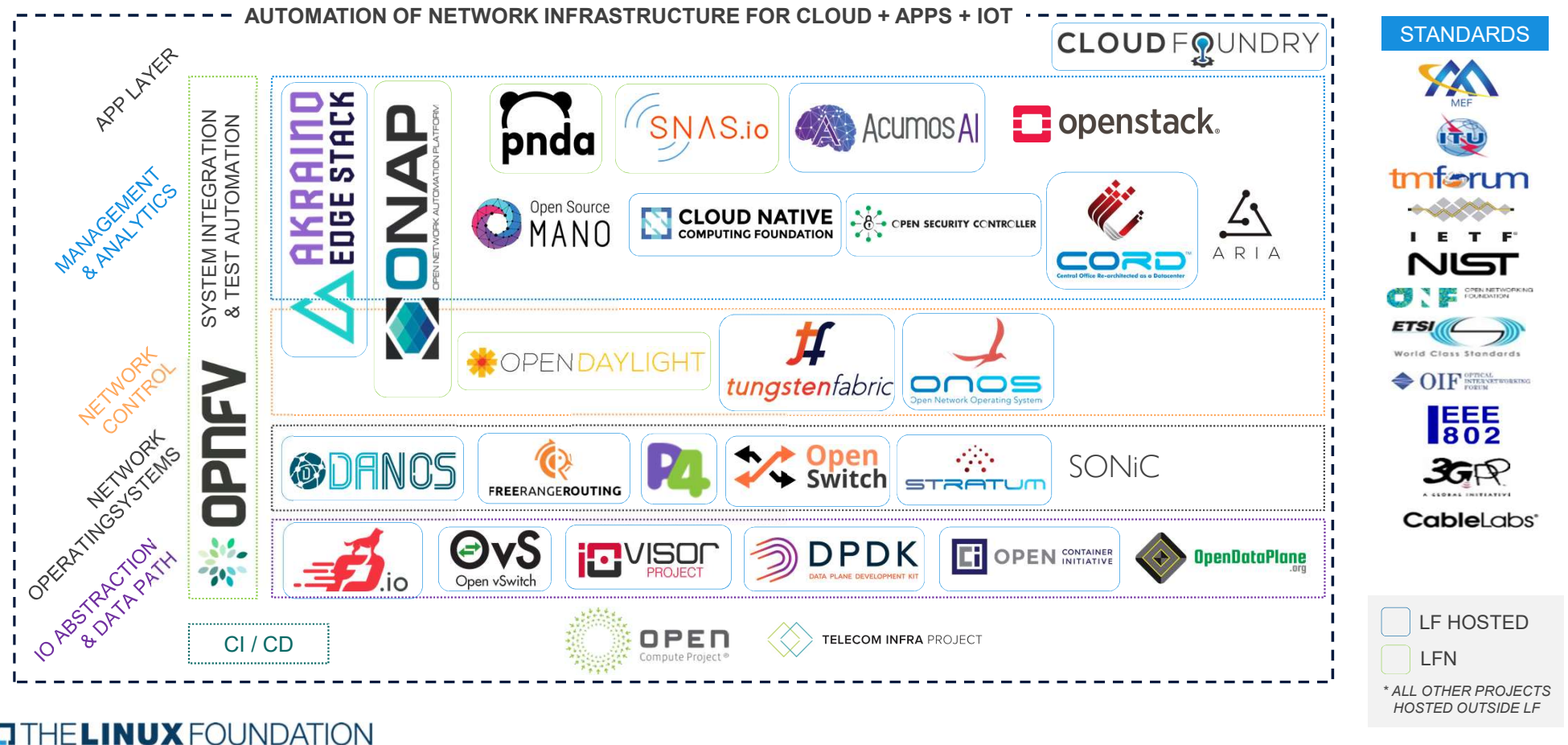**All Layers of Open Network**
Core to CPE, Edge & Access next

THE **LINUX** FOUNDATION

HEAVY READING

Report for Heavy Reading 2018 Open Networking Ecosystem Survey
Heavy Reading 2018 Open Networking Ecosystem Survey

Open Source Networking / SDO Landscape

Open Source Data Plane and NOS Projects

Rapid feature iteration independent of hardware lifecycle

What
Innovative features that may not exist in commercial offerings.

Why
NFV options enable near-instant delivery of new network services.

How Consume
May be OEM'd in commercial offerings, or implemented in white box environments

Open Source Control Plane Projects
The backbone of modern network management

What
Execute the detailed network requirements of larger orchestration and automation frameworks (ONAP, OpenStack, CORD).

Why
Assume multi-vendor, mixed P/V environments.

How Consume
Range of open source and/or packaged distribution options.

OPEN DAYLIGHT

tungstenfabric

onos
Open Network Operating System

Management Plane, Monitoring and Analytics Projects
Translate business layer intent to network - ensure healthy operations

What
Capture large amounts of real-time data, cut down weeks/months of big data stack integration effort for network analytics to *just 1 hour.*

Why
Cloud & carrier focus on network automation = **doubling** of investment in orchestration layer in the next 5 years.

How Consume
Multi-team design, implementation efforts

Open source platforms + custom development + integration services.

Acumos AI   AKRAINO EDGE STACK   CLOUD NATIVE COMPUTING FOUNDATION   CORD Central Office Re-architected as a Datacenter   ONAP OPEN NETWORK AUTOMATION PLATFORM

OPEN SECURITY CONTROLLER   Open Source MANO   pnda   SNAS.io
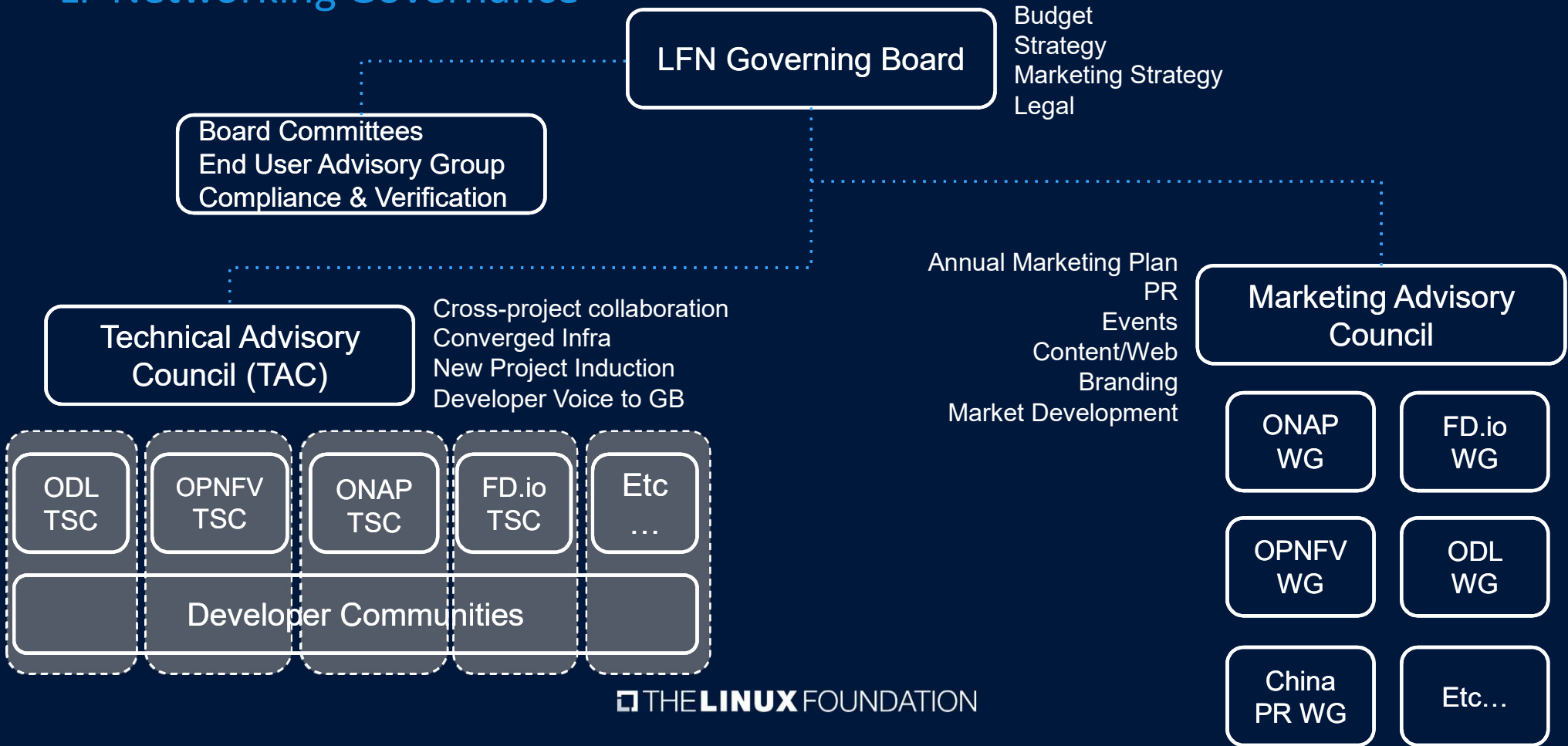
Introducing LF Networking (LFN)

LFNETWORKING

LF Networking (LFN) brings together seven top networking projects to increase harmonization across platforms, communities, and ecosystems.
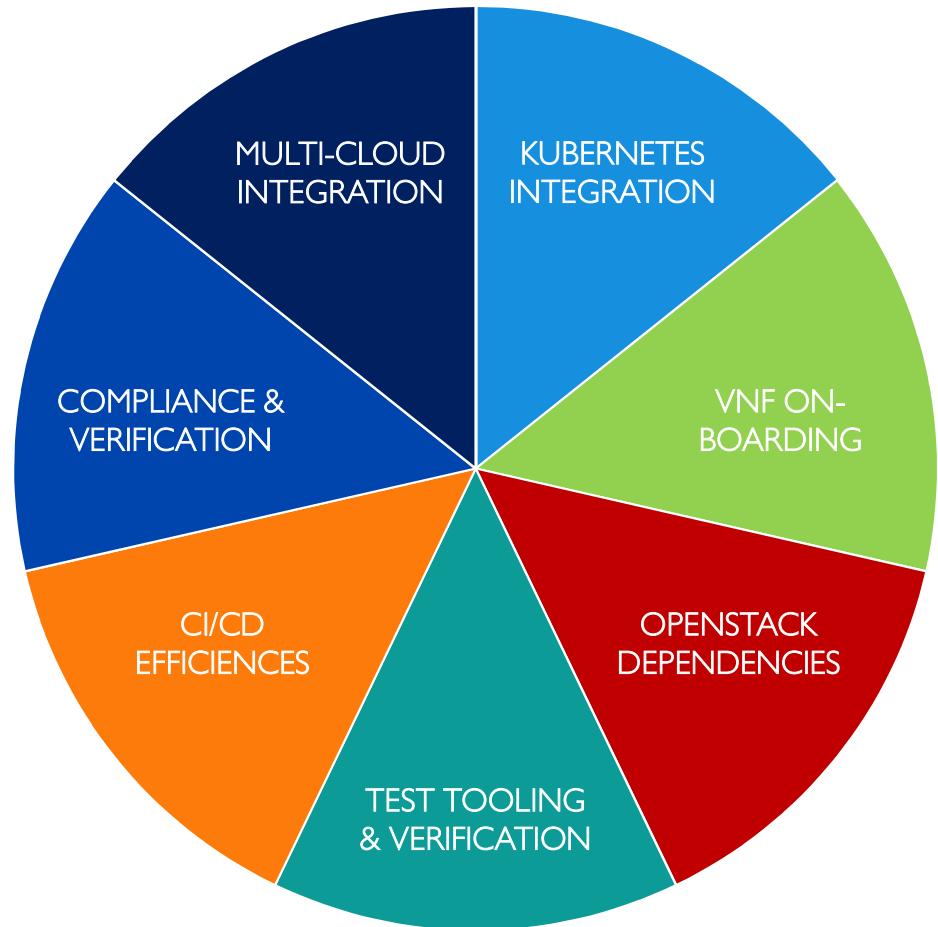
THE LINUX FOUNDATION

LF Networking Governance

LFN Governing Board

Budget
Strategy
Marketing Strategy
Legal

Board Committees
End User Advisory Group
Compliance & Verification

Technical Advisory Council (TAC)

Cross-project collaboration
Converged Infra
New Project Induction
Developer Voice to GB

ODL TSC	OPNFV TSC	ONAP TSC	FD.io TSC	Etc ...
Developer Communities				

Annual Marketing Plan
PR
Events
Content/Web
Branding
Market Development

Marketing Advisory Council

ONAP WG

FD.io WG

OPNFV WG

ODL WG

China PR WG

Etc...

THE **LINUX** FOUNDATION

LF Networking X-Project Collaboration Areas

Projects crossing boundaries to interoperate and create more value

MULTI-CLOUD INTEGRATION

KUBERNETES INTEGRATION

VNF ON-BOARDING

OPENSTACK DEPENDENCIES

TEST TOOLING & VERIFICATION

CI/CD EFFICIENCES

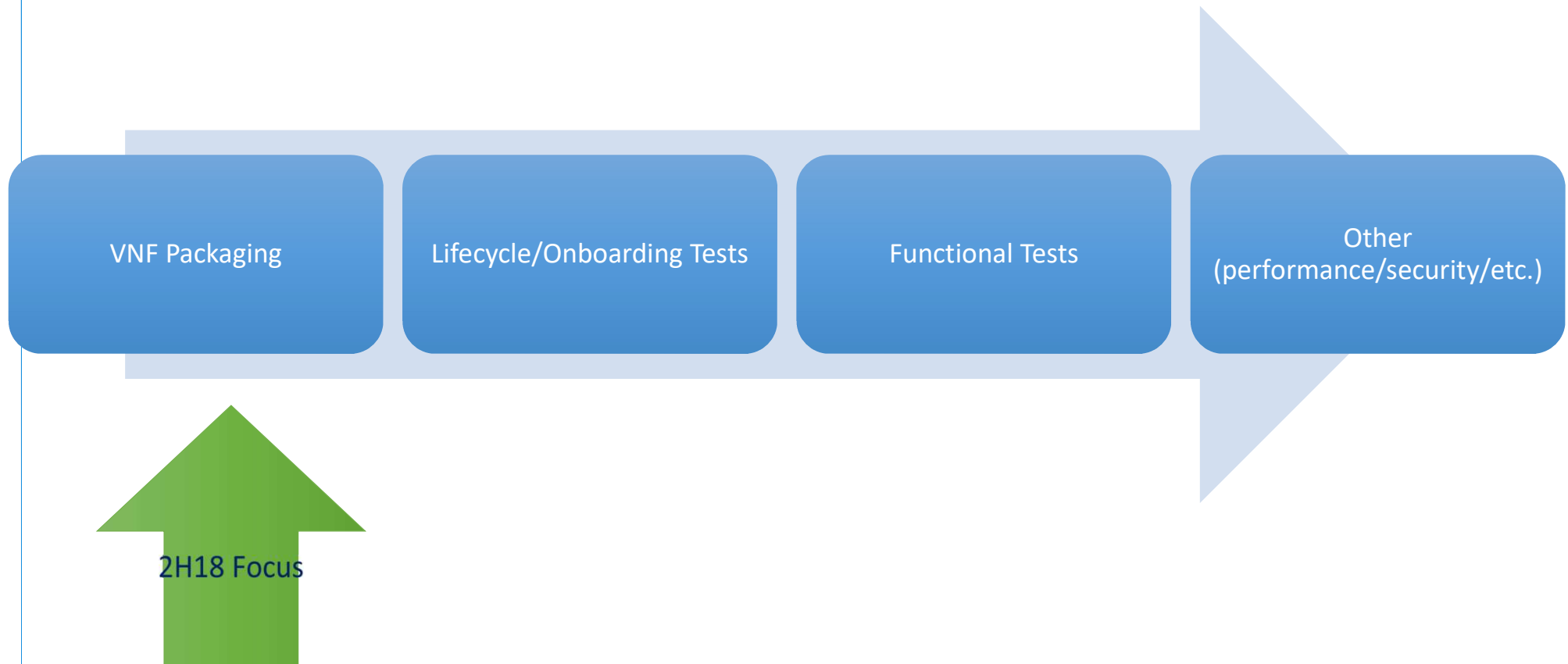COMPLIANCE & VERIFICATION

THE **LINUX** FOUNDATION

Recent News

THE **LINUX** FOUNDATION

20

LFN Project Initiatives & Milestones Further Enhance Cross-Stack Integration

- Compliance & Verification Program Expansion
- OSN Days
- OPNFV & ETSI: Joint Plugfest/Plugtest
- New ONAP PoC: Cross-Domain & Cross-Layer VPN
- Tungsten Fabric Carbide and 5.0.1
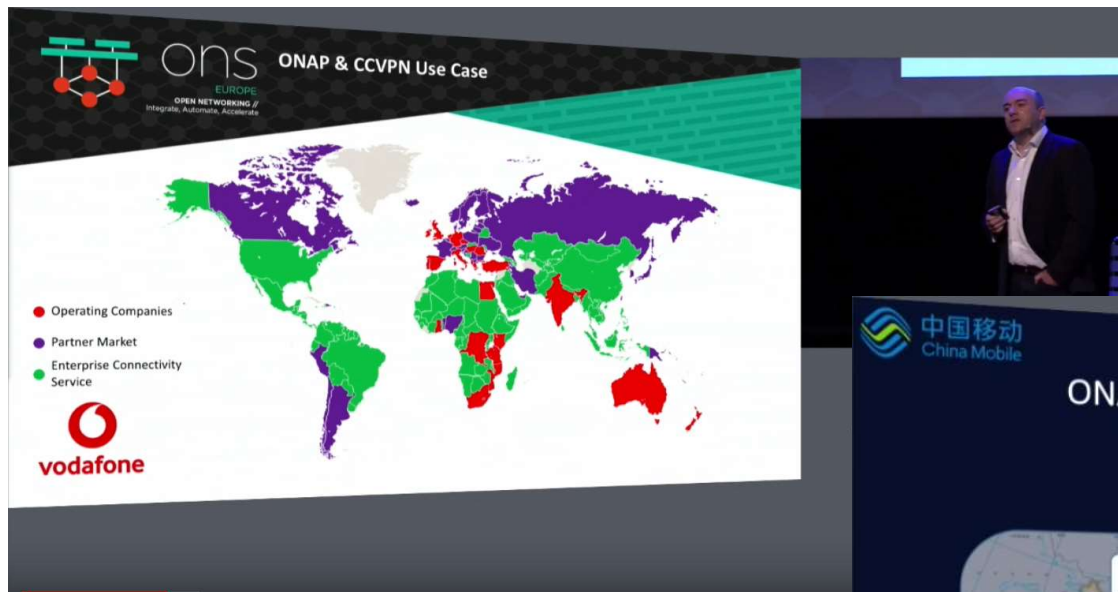- FD.io 18.07
- OpenDaylight Fluorine

Sources: Wikipedia & Techopedia
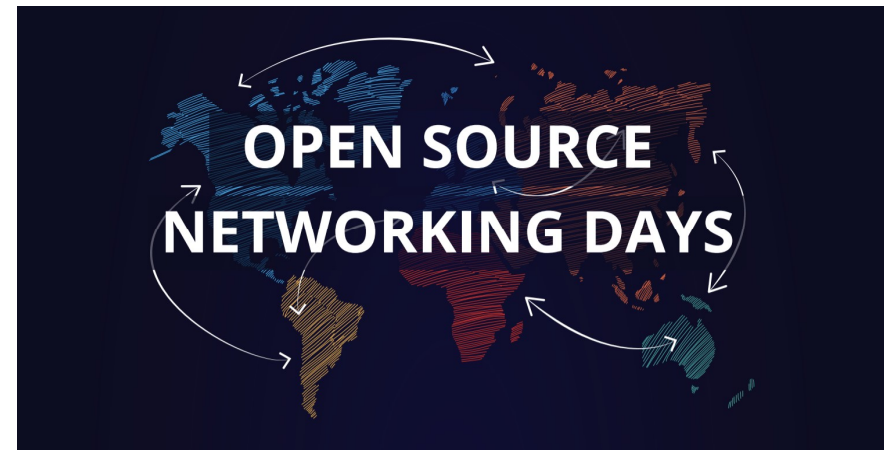
Continuum of VNF Compliance Testing

VNF Packaging	Lifecycle/Onboarding Tests	Functional Tests	Other (performance/security/etc.)

2H18 Focus

THE **LINUX** FOUNDATION

OVP- VNF Compliance Program Launch Timeline

August	September	October	November	December	January	February

Stable Draft

TSC Reviews

Community Approval

GB Vote

Workflow/ tooling

Website planning

Finalize Branding

Web/Tooling

Plugfest

Website Final

PR Launch

M4 Code Freeze

OPNFV Gambia

ONAP Casablanca

Program Definition

Approve Program Governance

Finalize 3rd Party Lab Governance

ONAP Test Case Development

VNFSDK Refactoring Work

Start documentation work

Technical Enhancements

Beta testing ONAP VNFs

Dovetail Integration

Go to Market

Vendor Outreach/Initial cohort recruitment

(Re)branding and website

Finalize Terms & Conditions

ONS EU: ONAP CCVPN Cross Layer VPN Service Demo
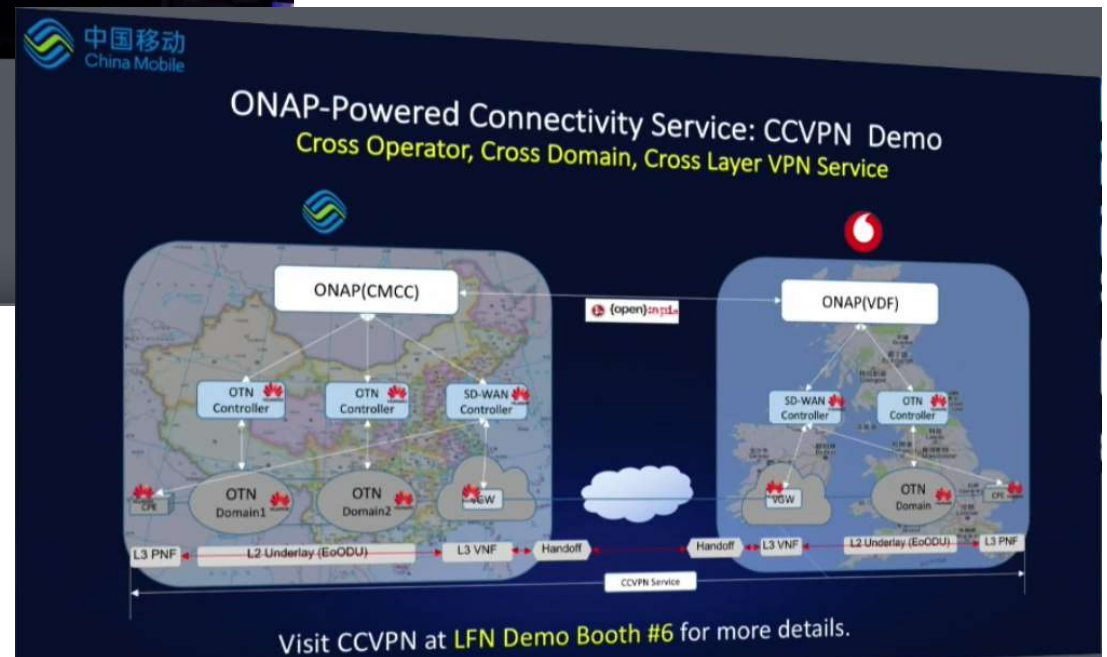
VCO Demo – ONS EU 2018

Cross-Community Open Source Collaboration

Ecosystem Partners

What is VCO?

- Cloud Native approach to deploying NFV closest to subscriber
- One of the Edge Blueprints as discussed in the community
- Based on OpenStack and Kubernetes
- Massive Scale => Large Number of sites

OPNFV SUMMIT

Virtual Central Office

JUNE 2017
BEIJING, CHINA

Define a cloud native approach for a virtualized central office leveraging NFV and open source technologies

Service Agility – End to End

Operational Efficiency

Improved Customer Experience

Lower Costs

- **>10,000 Central Offices in US Alone**
- **Primary Gateway to Customers for a Telco Operator**

COs Serve Residential Business & Mobile Customers

Telco CO - Traditional Status

- Closed, Rigid and Complex
- Variety of Access & Speeds
- Wide variety of hardware –
  - routers, switches, gateways, servers etc
- Lack of standard interfaces => lack of programmability

Telco COs -- Modernization

- Virtualization
- Reduction in CAPEX and OPEX by >30%
- Open and Flexible & Standardized
- Software Defined
  - Network
  - Orchestration
- Programmability

Telco COs - Cloud Native

- Fully Software Defined
- Further Reduction in CAPEX and OPEX
- Disaggregated and flexible
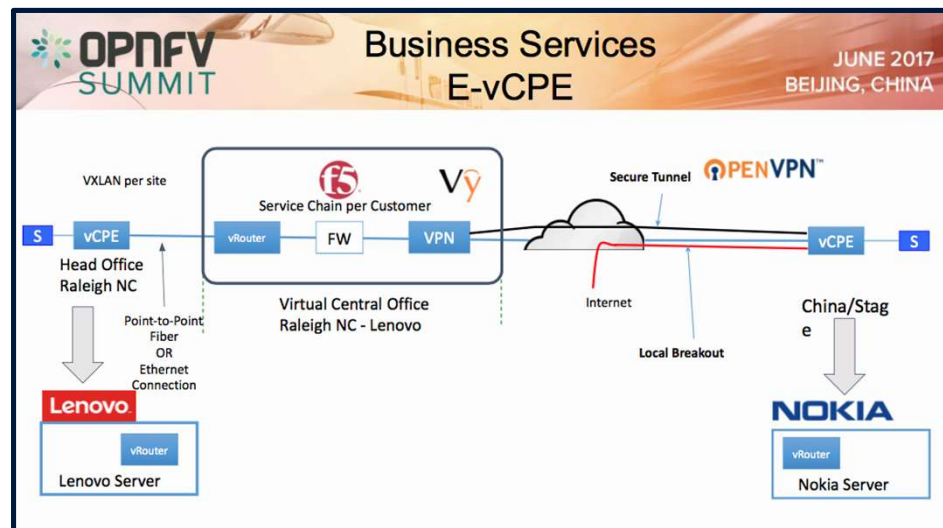- Massive Scale
- Edge Blueprint

VCO 1.0 Recap

- 2017 OPNFV Summit in Beijing: Phase I of the Project: Residential Services and Enterprise Business Services live on stage (vOLT, VNFaaS, BNG, etc)
- Generic blueprint for Central Office with open source components and OpenDaylight SDN controller
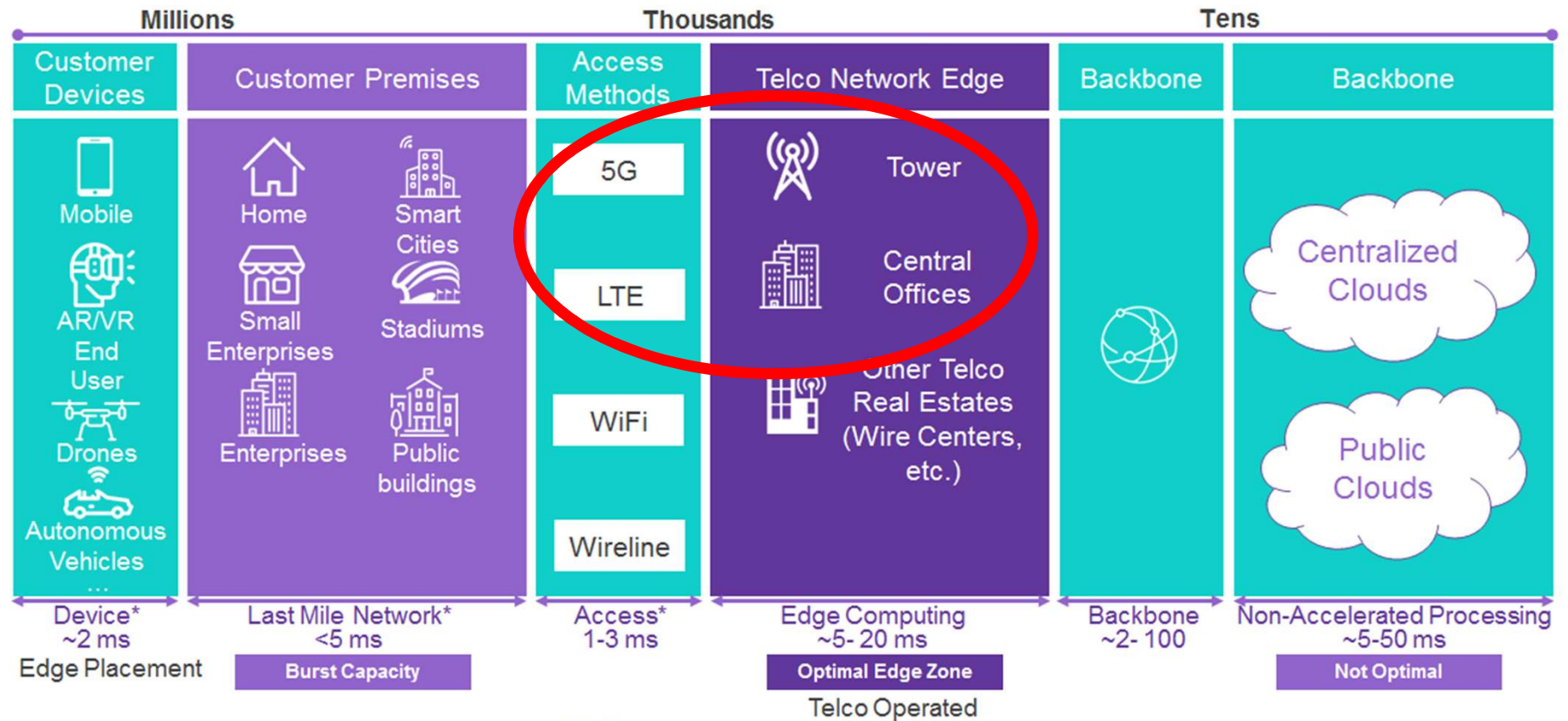- Focus on residential and enterprise VNF on-boarding and assurance

VCO 1.0

Residential
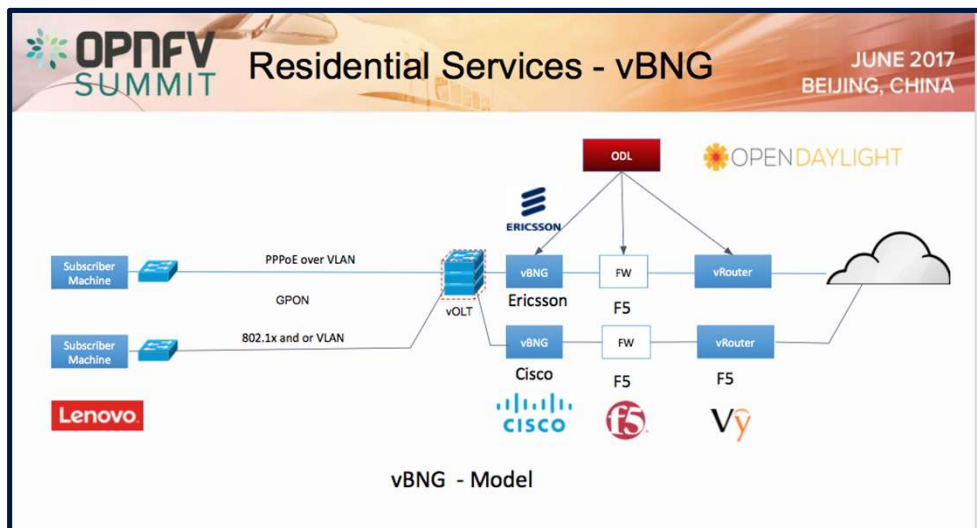
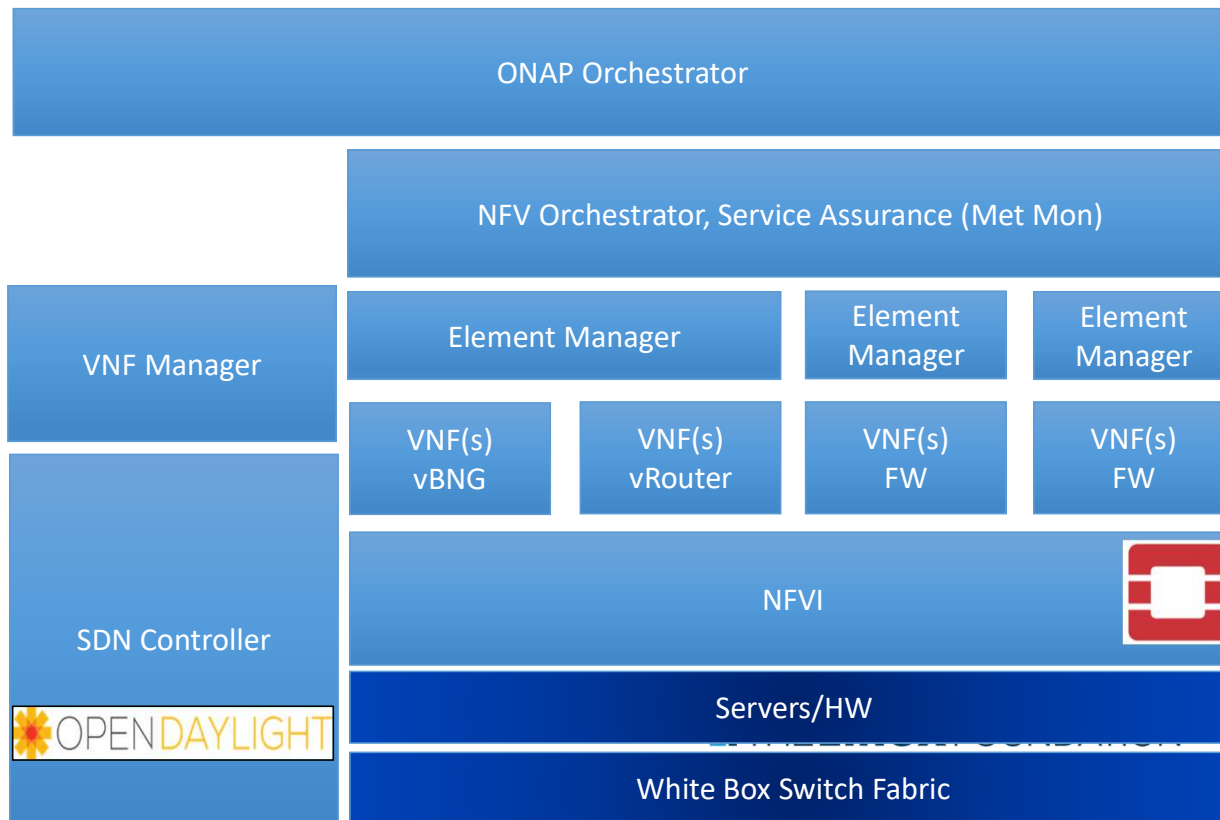## Business

VCO Enables the Mobile Edge

SOURCE: AKRAINO WIKI

Telecom Provider Requirements

› Massive Scale → "Distributed Hyperscale"
› Common deployment model for Data Center and CO locations
› OpenStack and/or Kubernetes
› Flexible and Agile
› LTE and 5G Radio with vEPC & NG-Core
› Centralized Management and Troubleshooting
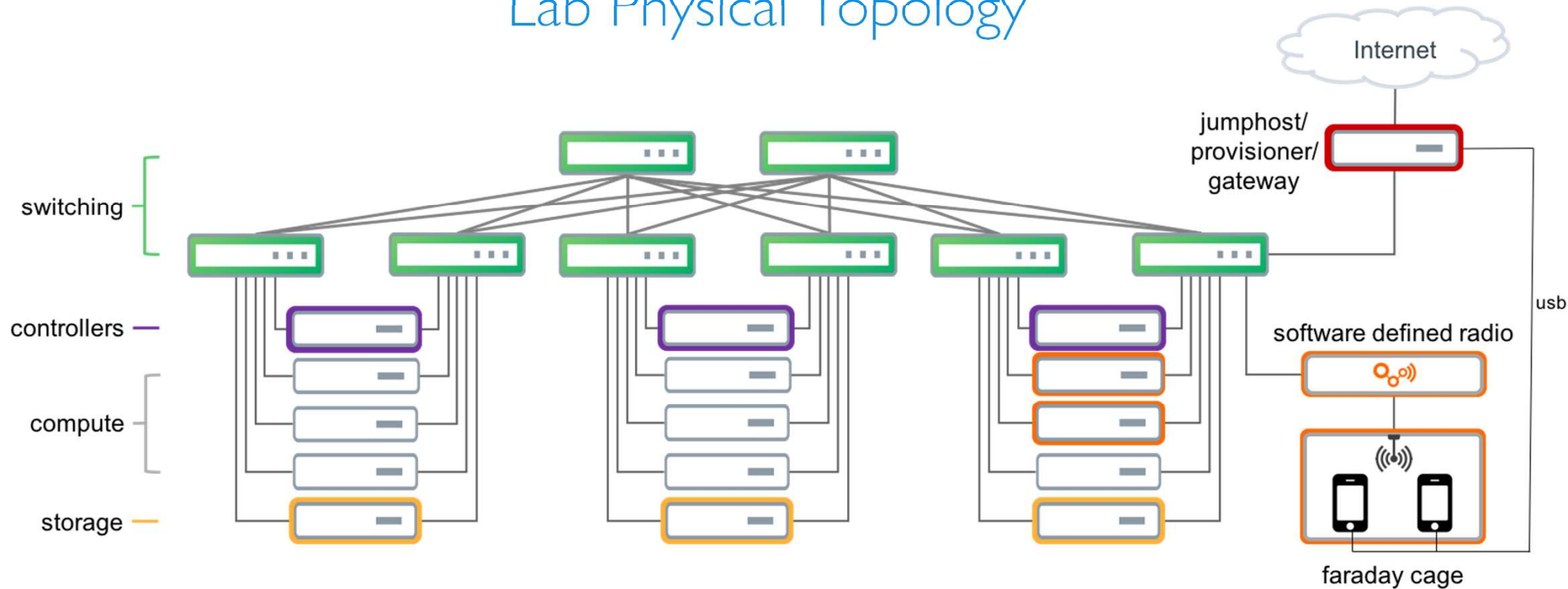› Service assurance - Metrics and Events
› End-to-End Orchestration

VCO Demo Checklist

› vRAN/CRAN for LTE
› vRAN LTE low layer split (RoE)
› vRAN LTE high layer split (F1-like)
› Low latency service
› Network slicing*
› Single LTE vEPC
› IMS and VoLTE*
› Ansible based orchestration
› Service assurance & monitoring
› Mix of bare metal, VMs, (containers*)

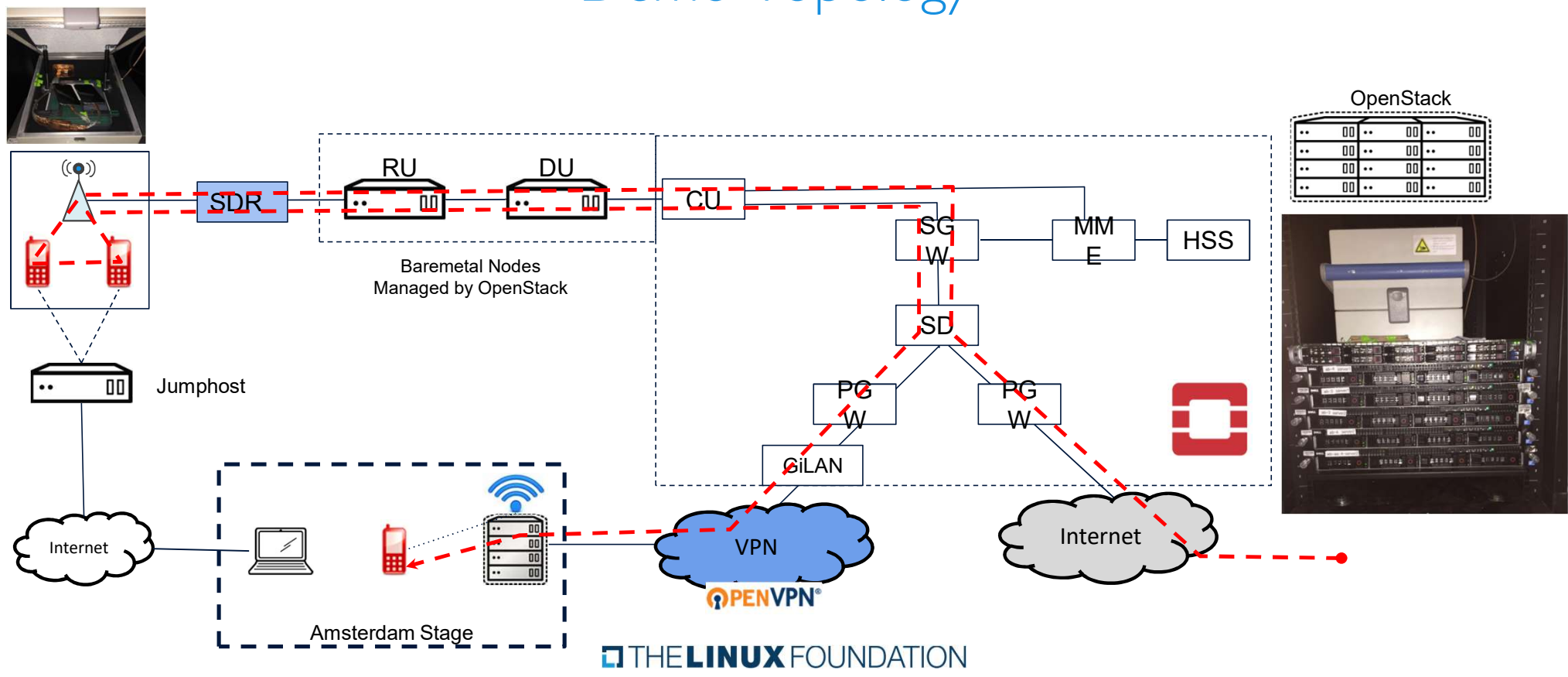* Goal for future VCO demo

VCO 2.0 Stack

ONAP Orchestrator

NFV Orchestrator, Service Assurance (Met Mon)

VNF Manager

Element Manager | Element Manager | Element Manager

VNF(s) vBNG | VNF(s) vRouter | VNF(s) FW | VNF(s) FW

SDN Controller

NFVI

Servers/HW

White Box Switch Fabric

34

Lab Physical Topology

switching

controllers

compute

storage

jumphost/
provisioner/
gateway

Internet

usb

software defined radio

faraday cage

Demo Topology

Baremetal Nodes
Managed by OpenStack

SDR

RU

DU

CU

SG
W

MM
E

HSS

SD

PG
W

PG
W

GiLAN

OpenStack

Jumphost

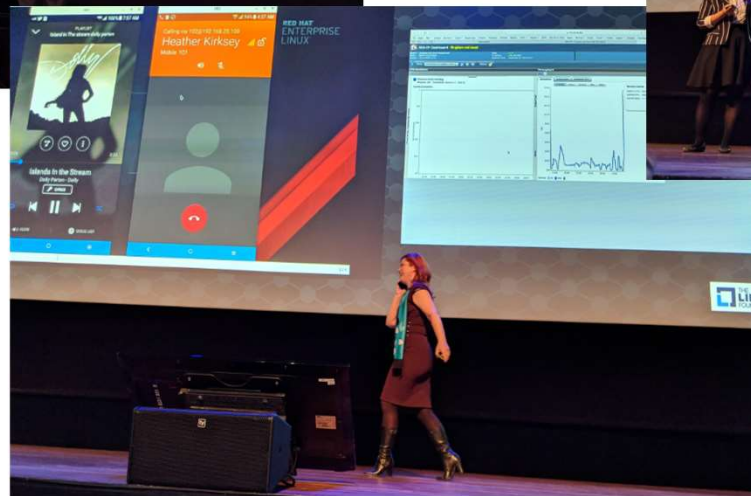Internet

VPN

Internet

OPENVPN®

Amsterdam Stage

THE **LINUX** FOUNDATION
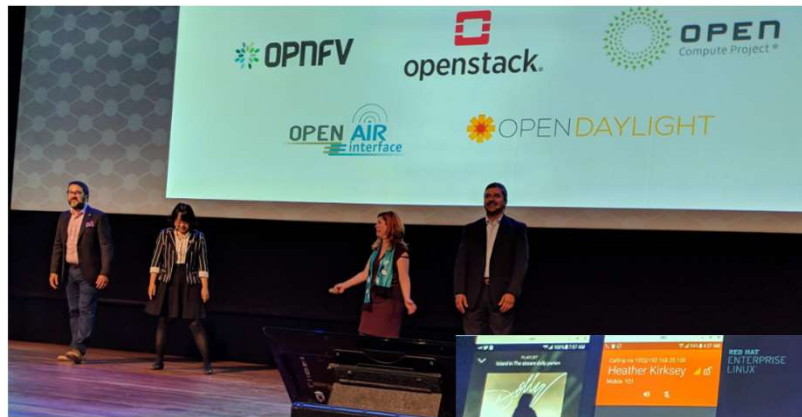
VCO Demo – Live Cross Atlantic Call on 5G Core
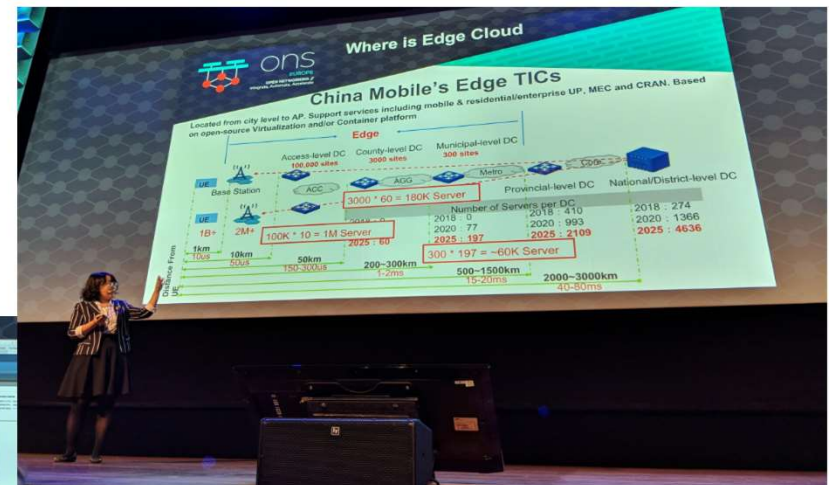
Looking Ahead – Get Involved!

› Join VCO Demo Mailing List: opnfv-vco@lists.opnfv.org

› Participate in Future Versions of VCO

› Participate in the Pharos Lab Program

› Work with LFN and OCP to host lab demo versions

› Join the OPNFV CRAN, Edge, Rocket projects

› Operationalize CI/CD, Automated Testing, Pharos Labs

› Define cross-project Cloud Native evolution

LF Extends Open Source software to RAN

The Linux Foundation Partners with ORAN Alliance to Collaborate on Open Source Software Development Fueling 5G

Collaboration between ORAN Alliance and The Linux Foundation signals further harmonization between open source software and open organizations

AMSTERDAM, Sept. 25, 2018 – The Linux Foundation, the nonprofit organization enabling mass innovation through open source, today announced it is partnering with the ORAN Alliance, a world-wide, carrier-led effort to drive new levels of openness in the radio access network of next generation wireless systems, to enable the creation of open source software compliant with ORAN architecture and interfaces.

The Linux Foundation will host a new project to facilitate development of open source software in tandem with the Alliance as it continues to drive standards and specify APIs and interfaces.

■ THE **LINUX** FOUNDATION

Participating in LF Networking

LF Networking (LFN) Projects Power Next Generation Orange Networks

Challenge
Full network automation, achieve full-benefits of SDN/NFV, retrain company for rapid evolution of software solutions

Solution
Actively participate in LFN Projects / incorporate into real use cases

Benefits
› Testing/Interop of NFV Architecture
› VNF/Servier Onboarding & Design
› Full Network Automation
› Time To Market
› Culture Change

Ambitious strategy includes 5G trials in France for 2018, and Orange aims to deliver an operational 5G network by 2020

Orange Plans '5G Plus Automation' RFP This Year

"Orange plans to use ONAP as the single interface to all automated processes."

LightReading

orange™

Critical components of Orange's next generation SDN/NFV initiatives to enable 5G, big data, AI and IoT network services.

THE LINUX FOUNDATION

Commercialization of Open Source

Engagement across the ecosystem and commercialization of products and services are required to create and sustain a vibrant ecosystem

› **Vendors:** Invest in the future by leveraging open source for non-differentiated R&D

› **Integrators:** Provide end-to-end integration and deployment solutions

› **Operators:** Consume, collaborate and help shape the supply chain

› **Developers:** Join projects, start projects, fail fast, lead, innovate, transform
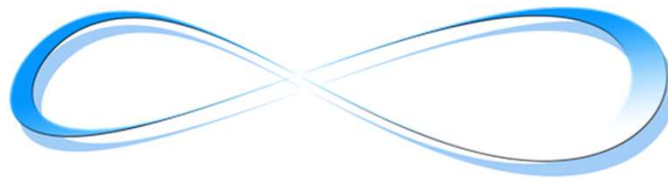
It Pays to Give Back

It is a competitive advantage for companies to allow developers to contribute.

"New research by Assistant Professor Frank Nagle, a member of the Strategy Unit at Harvard Business School, shows that paying employees to contribute to such software boosts the company's productivity from using the software by as much as 100 percent, when compared with free-riding competitors."

https://hbswk.hbs.edu/item/the-hidden-benefit-of-giving-back-to-open-source-software

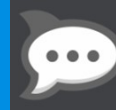# There are lots of ways to get involved!

Join TSC calls and subscribe to project mailing lists

Attend Hackfests, Plugfests and developer events

Contribute to release documentation

Provide your deployment feedback through the EUAG

Search for Open Bugs, or Report a New One, in the project JIRAs

Start or join a local OSN User Group Meetup

Define compliance and verification test cases

Review and submit code patches

Learn. Plan. Engage.

- › Join the Linux Foundation and LFN
- › Invest in your personnel
- › Participate in the technical communities
- › Take a training course

- › Follow best practices and develop your own
- › Empower yourself with knowledge
- › Begin Anywhere
- › LFN-info@linuxfoundation.org

□ THE LINUX FOUNDATION

Contact Us

The Linux Foundation

1 Letterman Drive

Building D, Suite D4700

San Francisco CA 94129

Phone/Fax: +1 415 7239709

www.linuxfoundation.org

General Inquiries

info@linuxfoundation.org

Membership

membership@linuxfoundation.org

Corporate Training
training@linuxfoundation.org

Event Sponsorship
sponsorships@linuxfoundation.org

THE **LINUX** FOUNDATION