

# OSN Days Ottawa

October 30th, 2018

Phil Robb

V.P. Operations, Networking

 THE **LINUX** FOUNDATION

# Networking is the fabric for Growth & Innovation Across Industries



Automotive

## Connected Cars

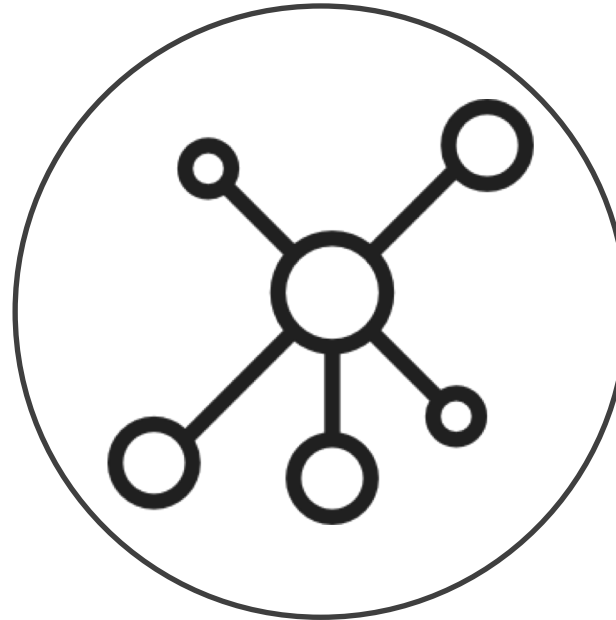
Connected cars market projected to reach  
USD \$219.21 billion by 2025\*



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\*\*\*\*

# Linux Foundation Leads Modern Networking Innovation



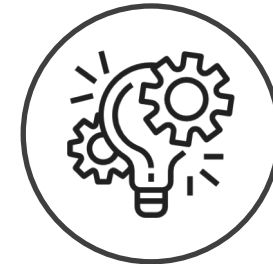
21

Open Source  
Networking Projects



10/10

Networking Vendors Active



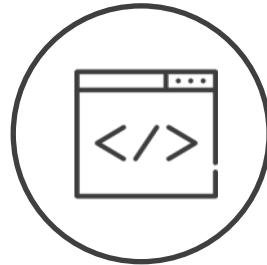
\$576 M

Shared Innovation



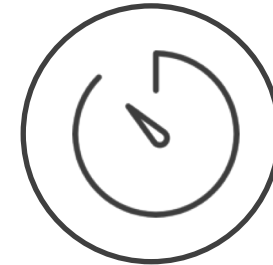
9/10

Most Important Projects



~70%

Global Subscribers  
Represented



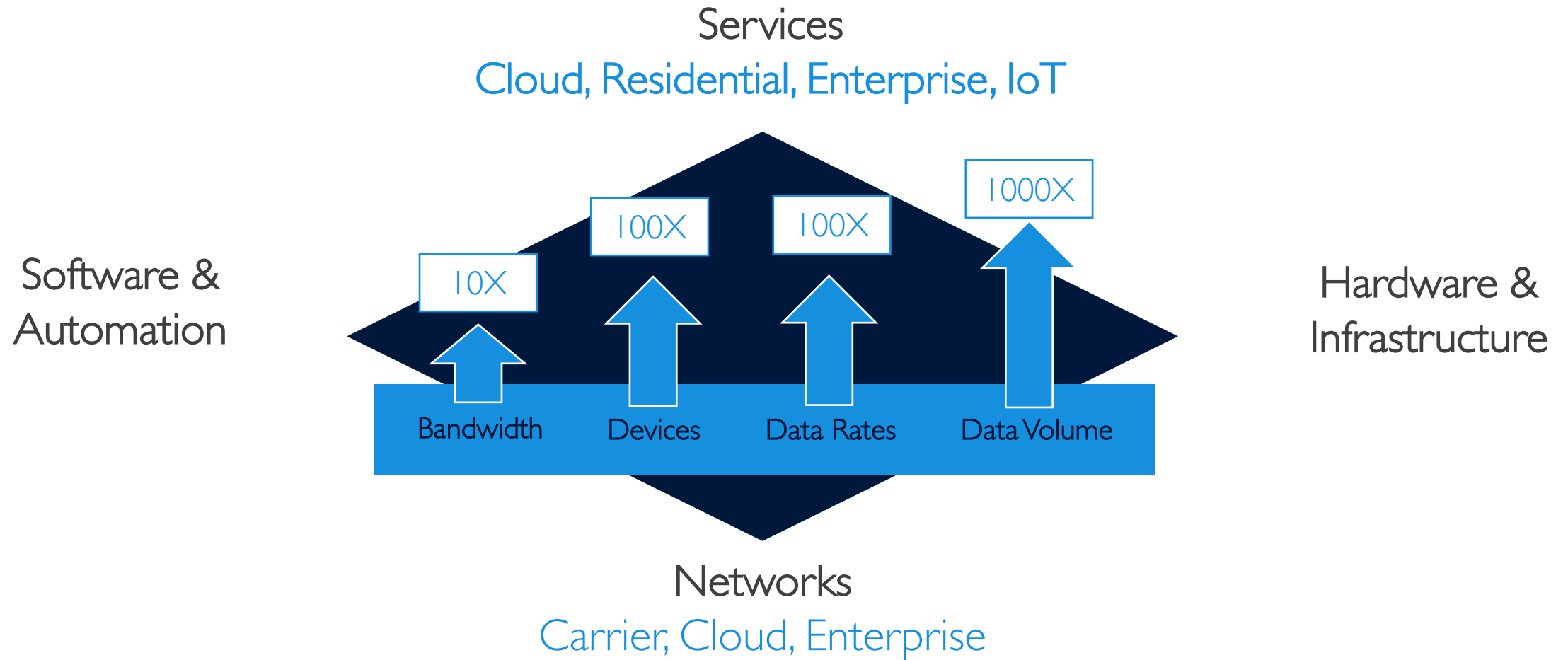
15 Minute

New Service Creation

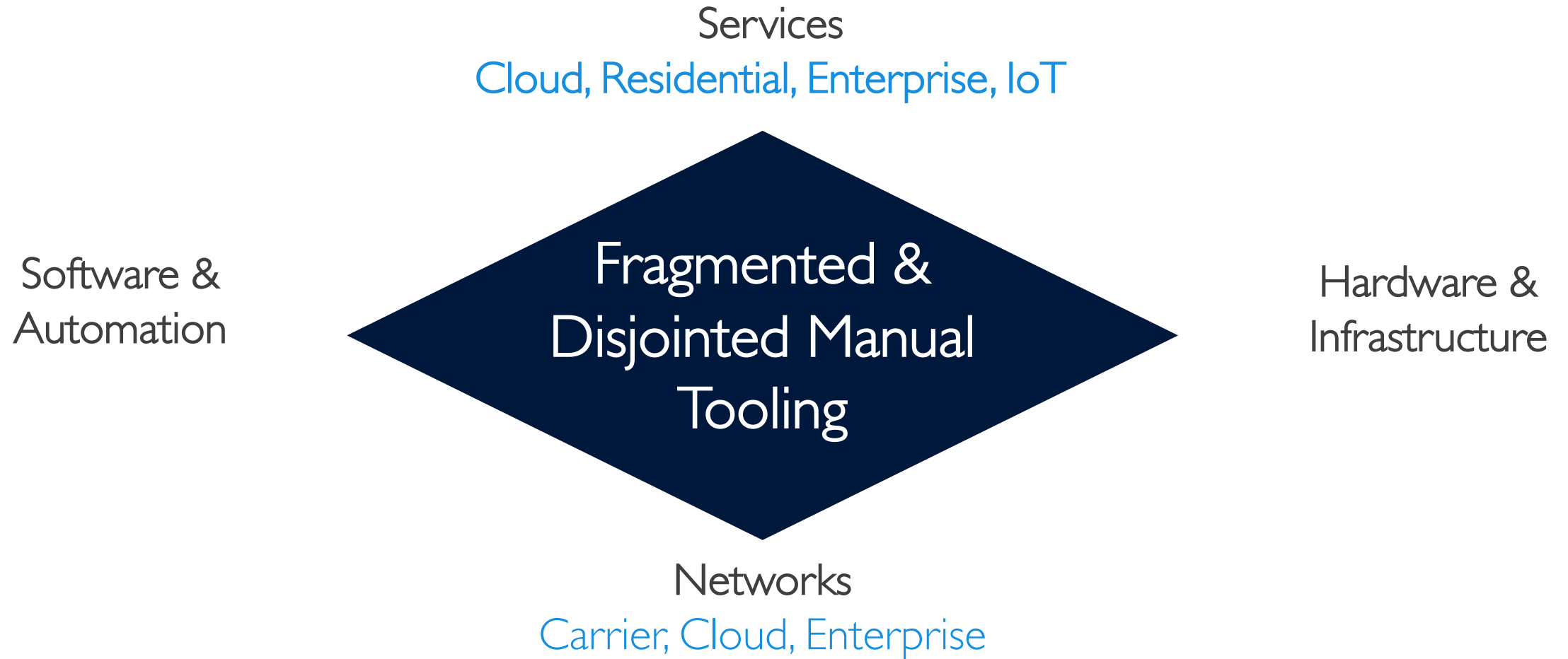
# The Challenge



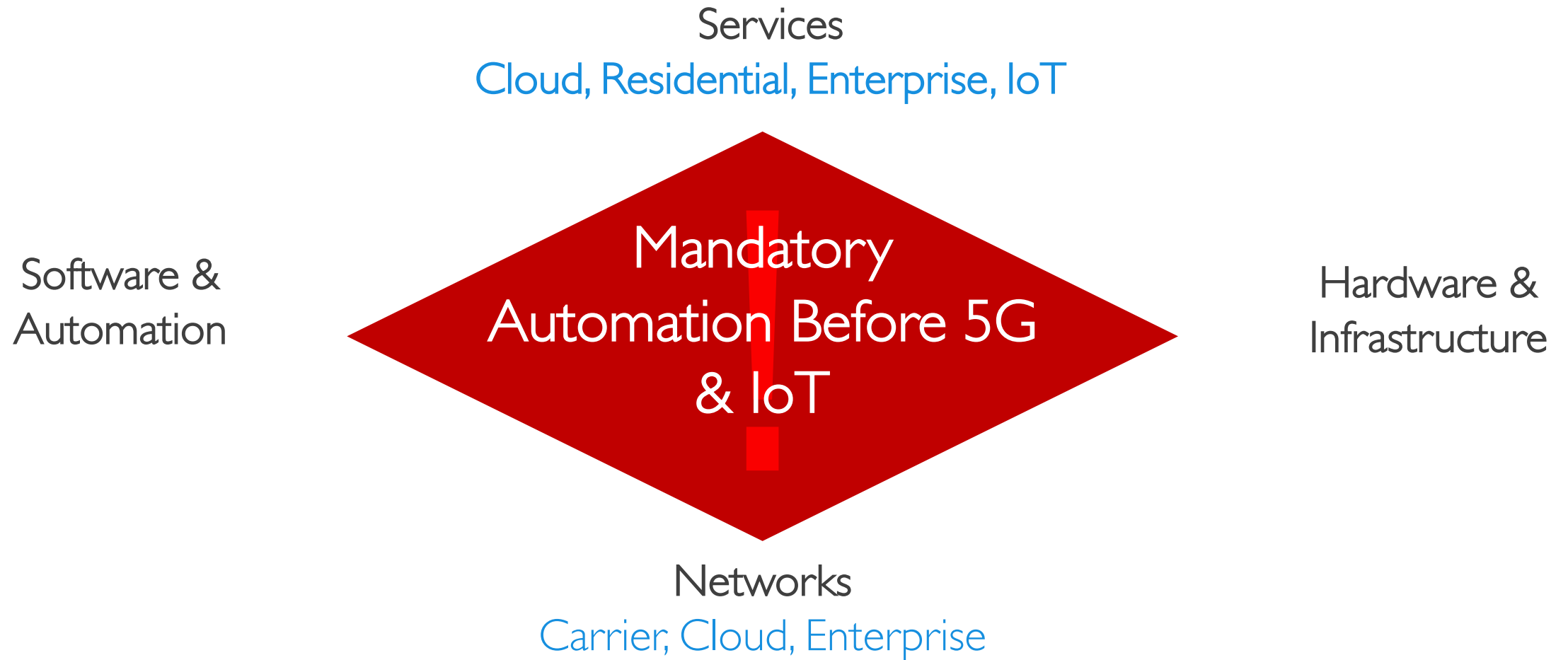
# Tsunami of Change Hitting Networks



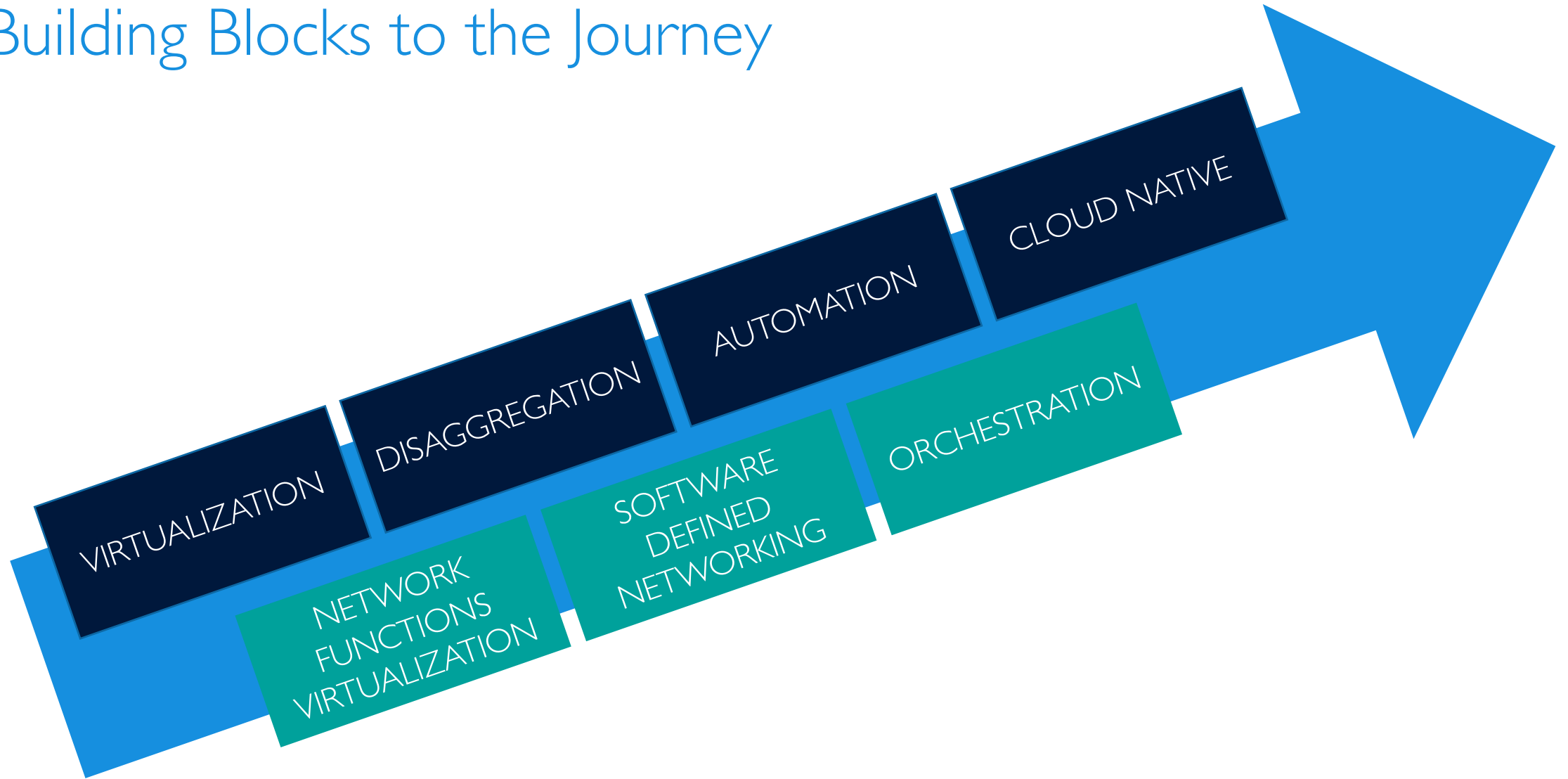
# Challenge: Automating Cloud, Network, & IOT Services



# Challenge: Automating Cloud, Network, & IoT Services



# Building Blocks to the Journey





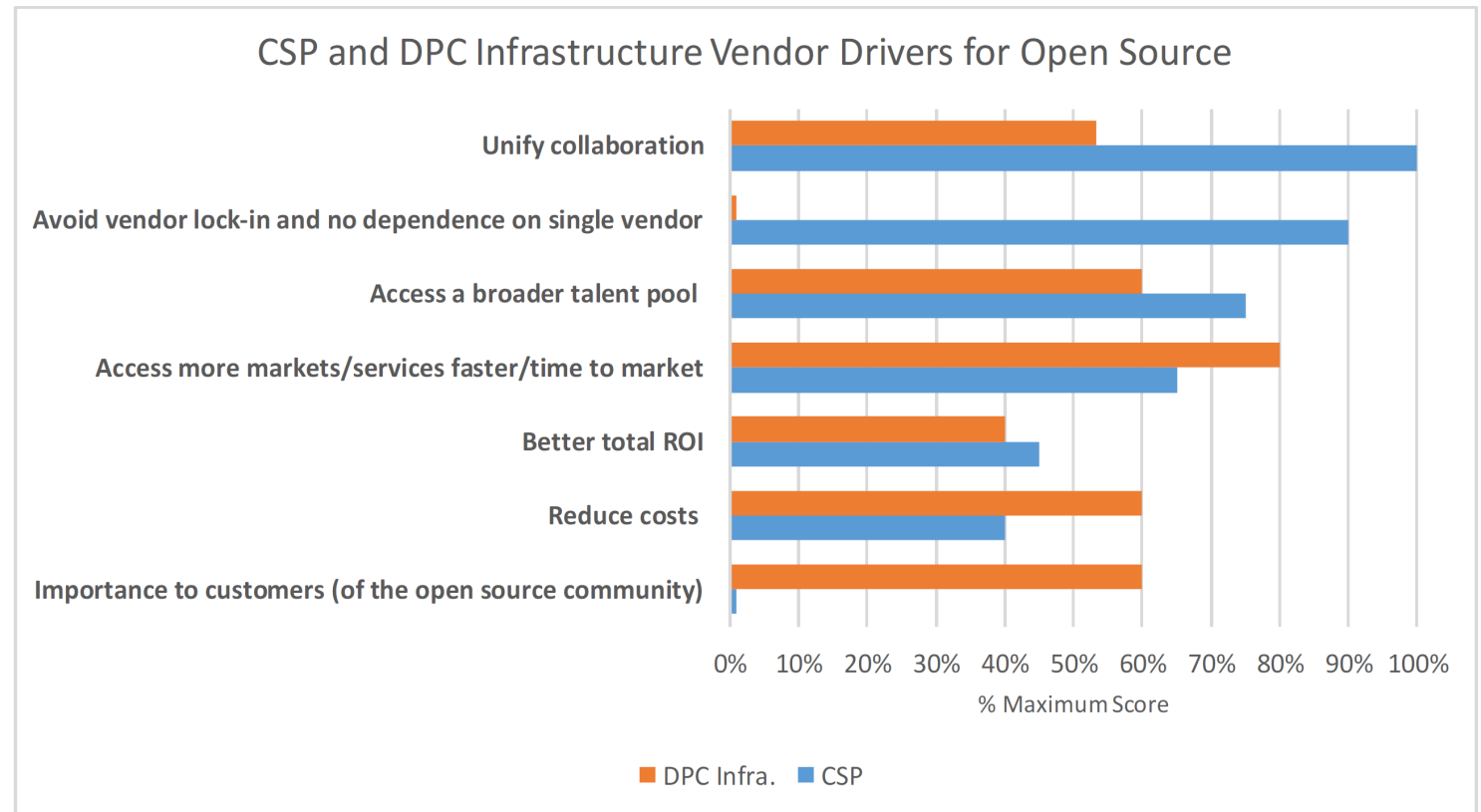
# How Does Open Networking Solve the Challenge?

# Revolution in the Networking Ecosystem



# 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



\$11B at Stake in Next 5 Years  
“Future Strategic Vendors  
Will Be Those Who Embrace  
Open Source”



Orange Plans '5G Plus  
Automation' RFP This Year  
“Orange plans to use ONAP  
as the single interface to all  
automated processes.”

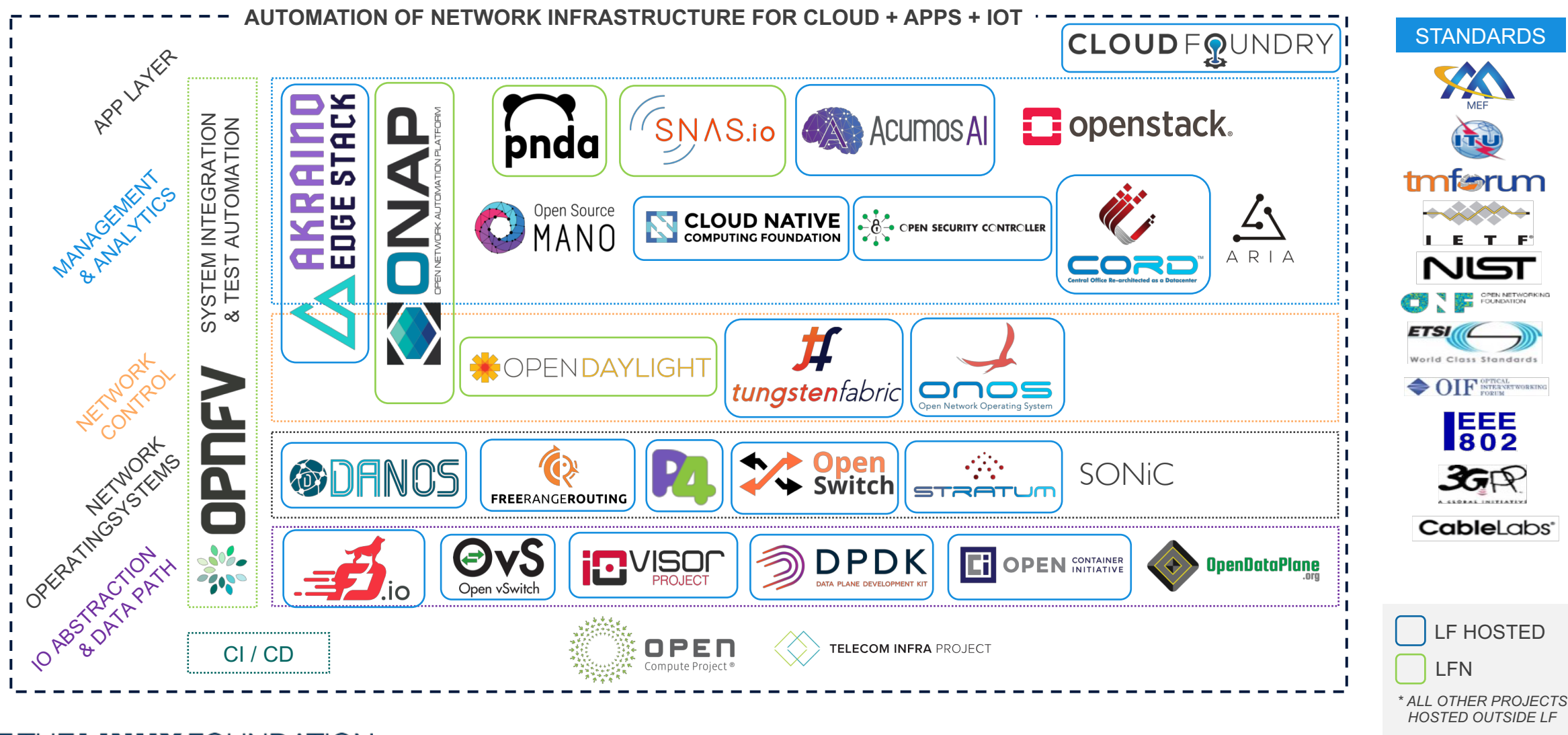


The LF is Changing the  
Fabric of Networking  
“bringing top networking  
vendors, operators,  
service providers, and  
users together.”





# 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.



# 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.





# Introducing LF Networking (LFN)

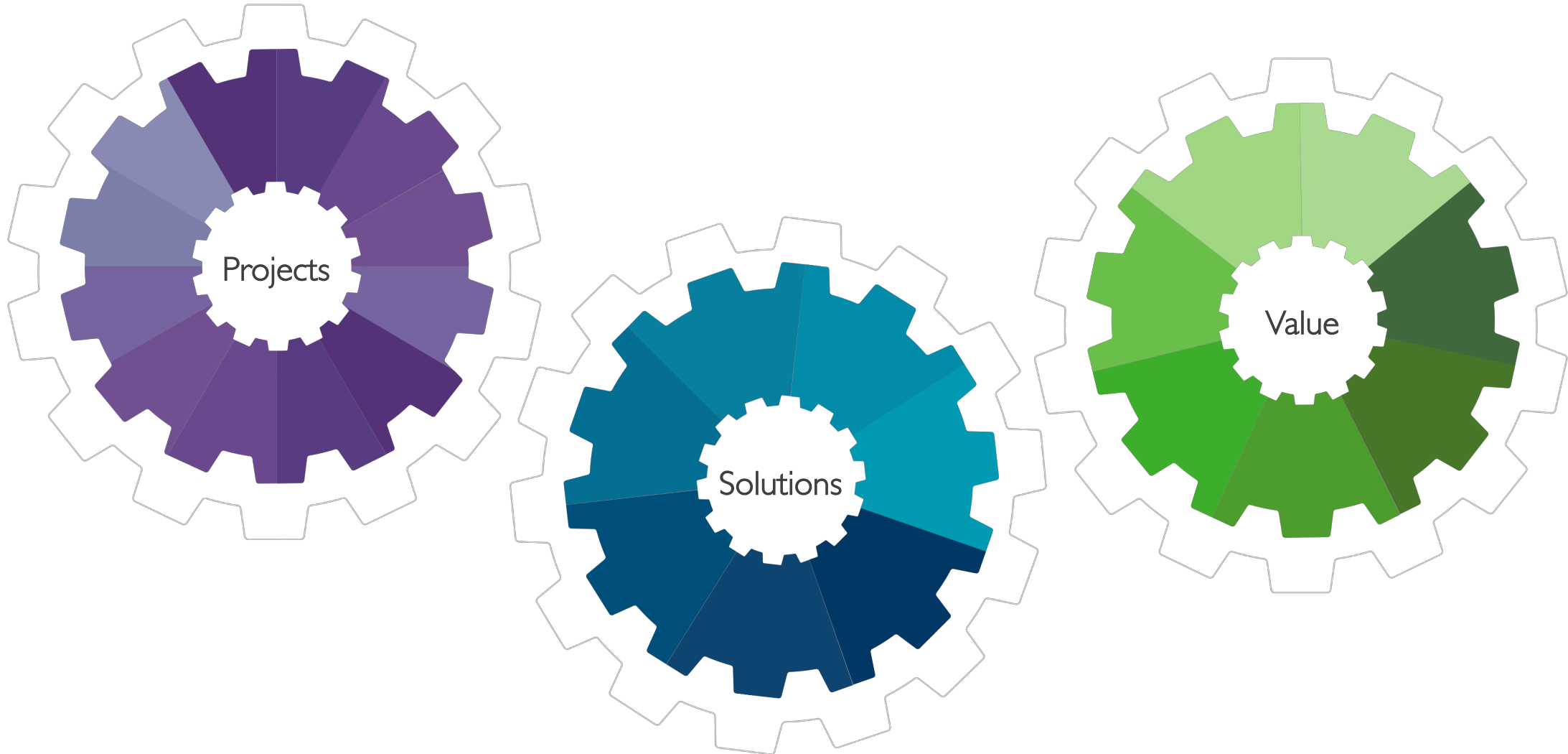
# LF NETWORKING

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



# LF Networking Milestone 100 Members in Under 100 Days

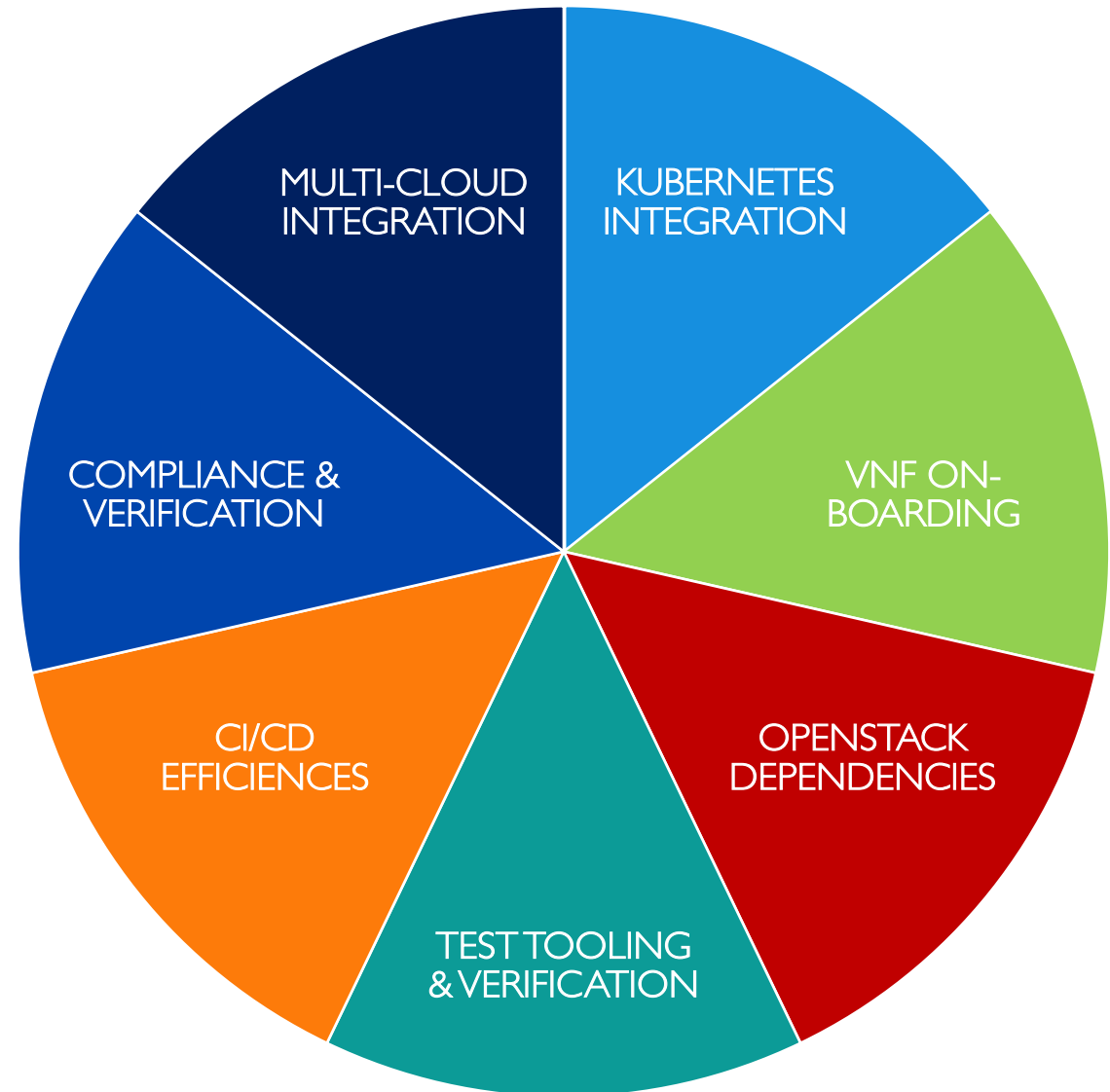
# LF Networking Drives X-Project Value, Ecosystem Growth





# LF Networking X-Project Collaboration Areas

Projects crossing boundaries to interoperate and create more value



# Harmonizing Open Source & Standards

Collaboration on external APIs



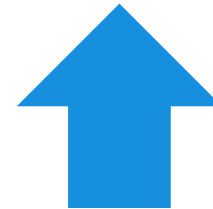
IPv6 Collaboration



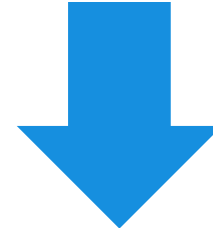
Co-located Plugtest/fest with  
ETSI in June 2018



THE **LINUX** FOUNDATION



Requires both top-down and  
bottom-up approaches to harness the  
differences and complementary  
features



Documentation of impact of on  
harmonizing open source and  
standards



Common Base Type Yang Models



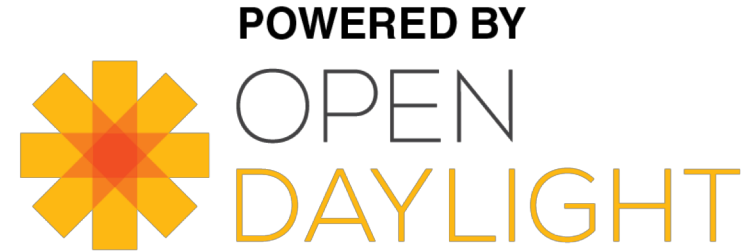
Also working with...



# Verification Programs

## Network Operator Benefits

- › Ensure baseline compliance and component interoperability
- › Validate specific features
- › Reduce integration and adoption risks
- › Accelerate deployments



# OS Networking: From Carrier & Cloud to the Enterprise

NEWS

## Gartner: Networking innovation in the cloud tops vendors

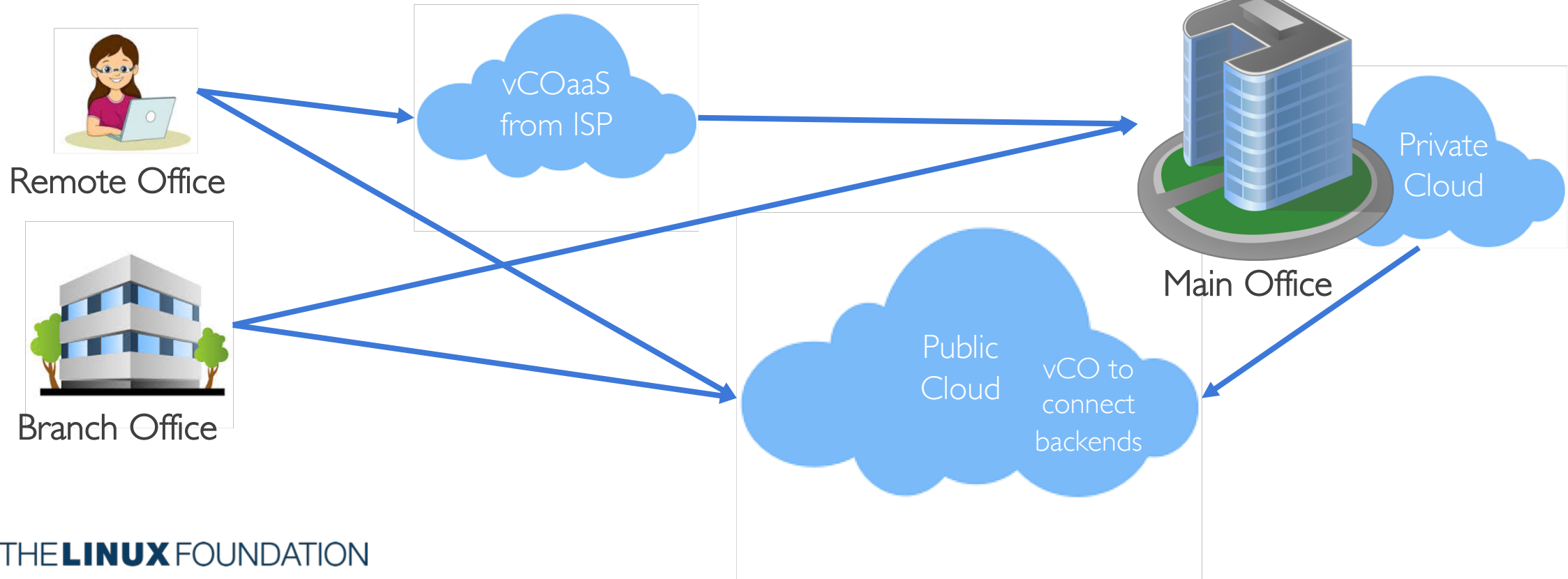
A Gartner report says enterprises waiting on vendors for networking innovation are missing out on the better technology coming from cloud providers.



SearchNetworking

Leading Use Cases:

- SD-WAN
- Virtual Central Office (vCO)
- DC Optimization



# 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/Service Onboarding & Design
- › Full Network Automation
- › Time To Market
- › Support Customer's Digital Transformation

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.”



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

# ONAP Deployment Updates



1. **Leading contribution**  
Successful transition from dominant role (ECOMP) to community-led project ONAP
2. **POC & deployment continue with ONAP**  
SDN & Virtualization journey. ONAP is a critical element of Cross Project transformation including AcumosAI, DANOS (NOS) and Akraino (Edge)
3. **CI/CD – ONAP**  
Pulling from ONAP into their internal environment



1. **VoLTE Trials** ongoing in Zhejiang province. CMCC built  $\alpha$  release including NFVO, did customization & contribution to Beijing release.
2. **Beijing Release** now aligned with China Mobile's enterprise requirements. (NFVO+/GVNFM products will be used for China Mobile pilot test)
3. **Cross Carrier ONAP** - Casablanca release for SOTN/SD-WAN including interconnection between ONAPs. (prototype pilot Vodafone, Huawei & CMCC)



1. **Demonstrate a complete VNF lifecycle management:** create VNF Descriptor, Validate Package, On-board and deploy commercial vMRF and vProbe
2. **Demonstrate how to automate network operation tasks** for SD-WAN and SDN network connectivity
3. **Opening first ONAP Open Lab** with 70+ users from operators, VNF vendors and academics
4. **Development of 3 external APIs** to ease integration with BSS (Order, Inventory, Catalog)

# ONAP Deployment Updates



1. Network-Cloud integration PoC of vCPE use case in CT lab
2. **ONAP Maturity test:** build up auto test environment and contribute on ONAP S3P tests.
3. **Development and deployment:** add intelligence and automation for agile provisioning and onboarding, introduce SO MSB A&AI into practice, and engage in Service Model definition



1. Driving modularity and pluggability of ONAP Components within Verizon SDN architecture. Contribute code with emphasis on SDC, SO, SDN-C, A/AI, DCAE and web scale evolution support
2. Striving for SO/VNFM ETSI MANO-compliant interface to external VNFM's
3. CI/CD enabled ONAP Verizon developer test bed and onboarding internal VNF's to validate platform and vendors to participate in the journey



1. Amsterdam Release in **production** since Q42017
2. Heavy focus on simplified deployment & OOM contribution
3. Expanding use cases across Carrier and Internal IT Data Center automation.

# ONAP Deployment Updates



**1.Lab:** Focus on SDC, A&AI, SO, DCAE.  
Vodafone sees ONAP as a crucial platform for standardization across various areas for Telco Cloud adoption

**2.POC:** ONAP based TM Forum Catalyst projects - Blade Runner, Automating Network As A Service, 5G Intelligent Service Operations - for the first time built on a common reference architecture of ONAP, TM Forum open-APIs and MEF-defined service payloads.

**3.On-Boarding:** Focus on SDC, Compliance & Verification(On-Boarding) of Resources and Services - an industry standard for On-Boarding at various levels



**1.Last Mile Enabler**  
Africa & Middle East

**2.POCs with ONAP**  
by modifying community vFW blueprint to separate PG and vFW\_SINC across two OpenStack regions connected by E-Line

**3.Demonstrated at MEF**  
Athens meeting on 4/19



**1.End to End POC and Demo**  
Leading ONAP and CORD test across network

**2.Testbeds and POC**  
Working with Vendor ecosystem to enable POCs for ONAP focusing on fixed and mobile use cases.

**3.Focus** on providing end-to-end, closed-loop automation to design, orchestrate, automate and manage new services



# ONAP Commercial Ecosystem – Early Leadership



1. NFV Orchestration Platform is a packaged software and services solution for end to end NFV service lifecycle management and orchestration. Offers a portfolio of modular capabilities that accelerate service design, virtualization and operation.
2. Addresses the full range of ONAP use cases: vCPE, SD-WAN + security, vEPC, vRAN, more
3. Foundation of Amdocs service portfolio addressing domain orchestration, mobile services orchestration and Enterprise services orchestration.



1. ONAP Startup  
Products, services, training (½ day, full day)
2. **Created ONAP all-in-one**  
Packaged ONAP and OPNFV in one Google Cloud VM for training labs; image can also be used as a “sandbox” for developers



1. Ericsson Orchestrator and Ericsson **Network Manager** both incorporate ONAP components
2. Delivering key technology to enable Network Slicing and VoLTE.
3. Ericsson is intimately involved in driving industry alignment between ONAP and ETSI-NFV.
4. ONAP improves time to market for Ericsson and for its operator customers

# ONAP Commercial Ecosystem – Early Leadership



1. **Service on Demand**
  - › Virtuora Network Controller collects E-line performance data
  - › Fujitsu microservice within ONAP manages threshold alarms to respond to needs such as add'l bandwidth
  - › Automatically resets to normal allocations when typical traffic patterns re-emerge



1. AIDO (design-time) and IES (run-time) commercial platforms based on ONAP
2. **E2E digital transformation** in progress with HKT
  - › Automating Mobile CloudVPN service
  - › Ties into backend operations systems
  - › Huawei is building a Digital Transformation service portfolio for Telcos around their ONAP-based AIDO/IES platforms



1. **ONAP on IBM Cloud Private** IBM Cloud Private is fully Kubernetes-based deployment for on-premise, bundled with capabilities from open source & IBM for core operational services<sup>1</sup>
2. **IBM Services for ONAP**  
Focus on SDN and NFV deployments & integrations worldwide, including work on ONAP for Operators. Services are augmented with IBM cloud and cognitive software and services

# ONAP Commercial Ecosystem – Early Leadership



1. Inocybe Open Networking Platform - Simplifying the build, test, manage and upgrade process for open networking software (ODL, OpenSwitch, ONAP)
2. Focusing on containerized distribution of SDN-C component of ONAP
  - Use cases: Traffic Engineering, Service Function Chaining, NFVi
3. Inocybe is building a business on open source—for major operators as well as packaged solutions for enterprises

## NETSIA

1. Netsia provides ONAP services and training.
2. Built custom UI in ONAP for RAN slicing with integration into DCAE and closed loop policy configuration
3. Working on full ONAP integration for leading service provider in Turkey.

Plus Several More in  
Q2/Q3 2018

# ODL Deployment Updates

## Caltech

1. Efficiently distribute big data
  - › Lead partner with CERN to share >200 petabytes of research data among global research institutions
2. Control data, without owning the network
  - › 13 Tier 1 sites, 160 Tier 2 sites and 300+ Tier 3 sites
  - › Multiple service providers with different bandwidths and capabilities.
  - › Across geographic/jurisdictional boundaries

## Tencent 腾讯

1. Support multiple apps for 500 Million monthly users
  - › One of the largest internet companies in the world
2. Using ODL since 2014
  - › Chosen for scalability and breadth of support for variety of physical and virtual infrastructure
  - › Like strong commercial ecosystem - require all vendors to work with ODL

## CenturyLink™

1. Enable fully virtualized IP core + residential rollout
2. Developed virtualized Broadband Network Gateway
  - › OpenStack
  - › OpenDaylight
  - › Intel software toolkits
  - › Intel-based white boxes

# ODL Deployment Updates



1. Bristol is Open smart city initiative
  - › Captures info on city energy , air quality and traffic flows, from a large number of sensors
2. ODL-based framework manages IoT traffic
  - › Portal converts networked data to show real-time pollution, journey times, energy efficiency, etc
  - › Bandwidth-on-Demand capabilities generate revenue for program from businesses such as the BBC

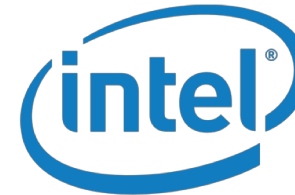


1. 800+ Million subscribers (99% of China), 2.2 M base stations
  - › Also provides cloud services to Enterprises
2. ODL - backbone of NovoNet
  - › Initially deployed in Cloud DCs and Packet Transport Networks for Enterprise customers
  - › Public cloud, virtual private cloud and telco integrated cloud (TIC) all on the same platform
  - › ONAP, OpenStack, VMware for orchestration



1. E-COMP initiative for next-gen carrier network
  - › Framework for SDN and NFV-based service delivery
2. ODL provides end-to-end control
  - › E-COMP provided key foundation for ONAP platform, ODL at core
  - › Equipment-agnostic ODL is the "global" controller; Nuage and others provide local control for specific segments

# ODL Commercial ecosystem



# FD.io Commercial Ecosystem



Allegro Packets  
Network Software

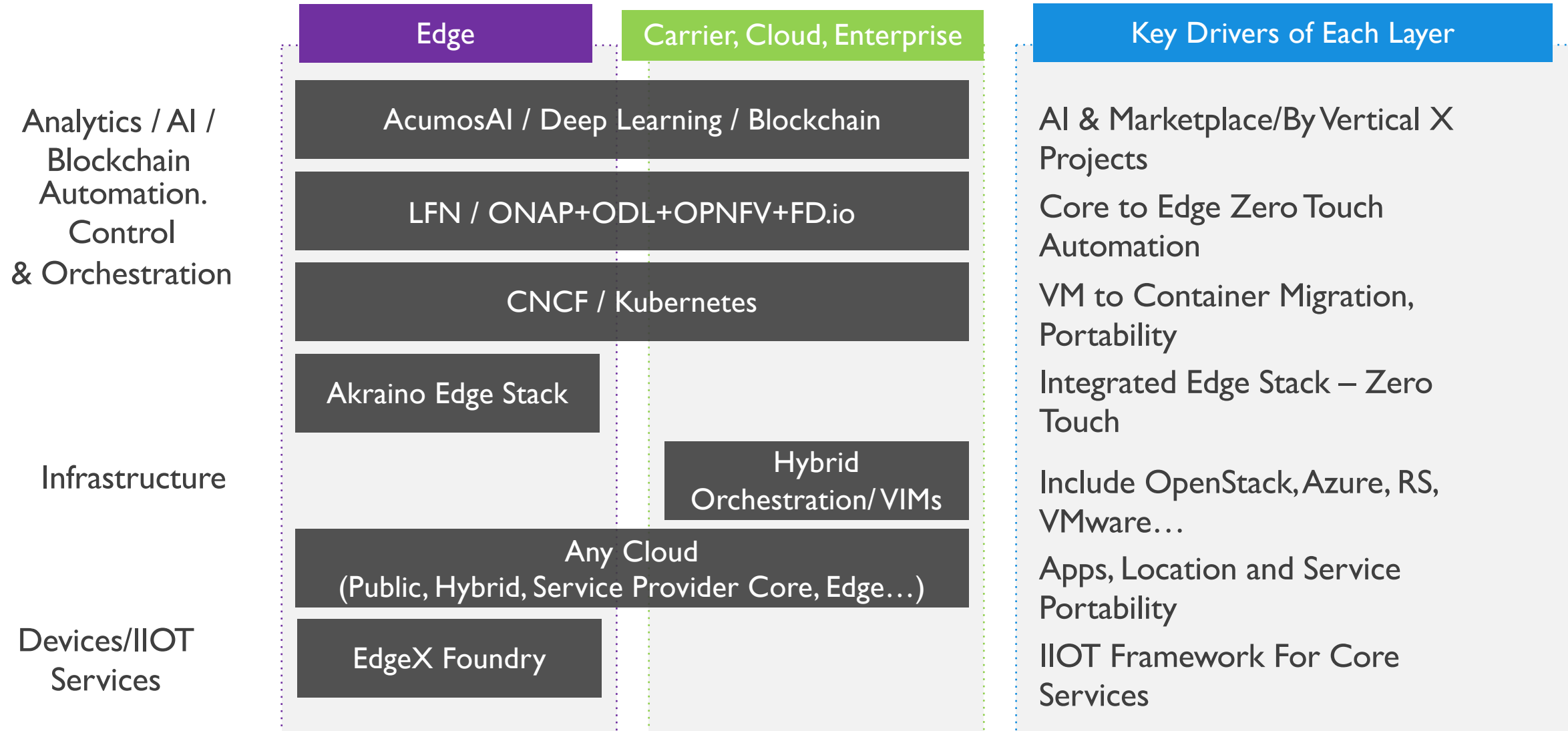


YANDEX  
MISSING

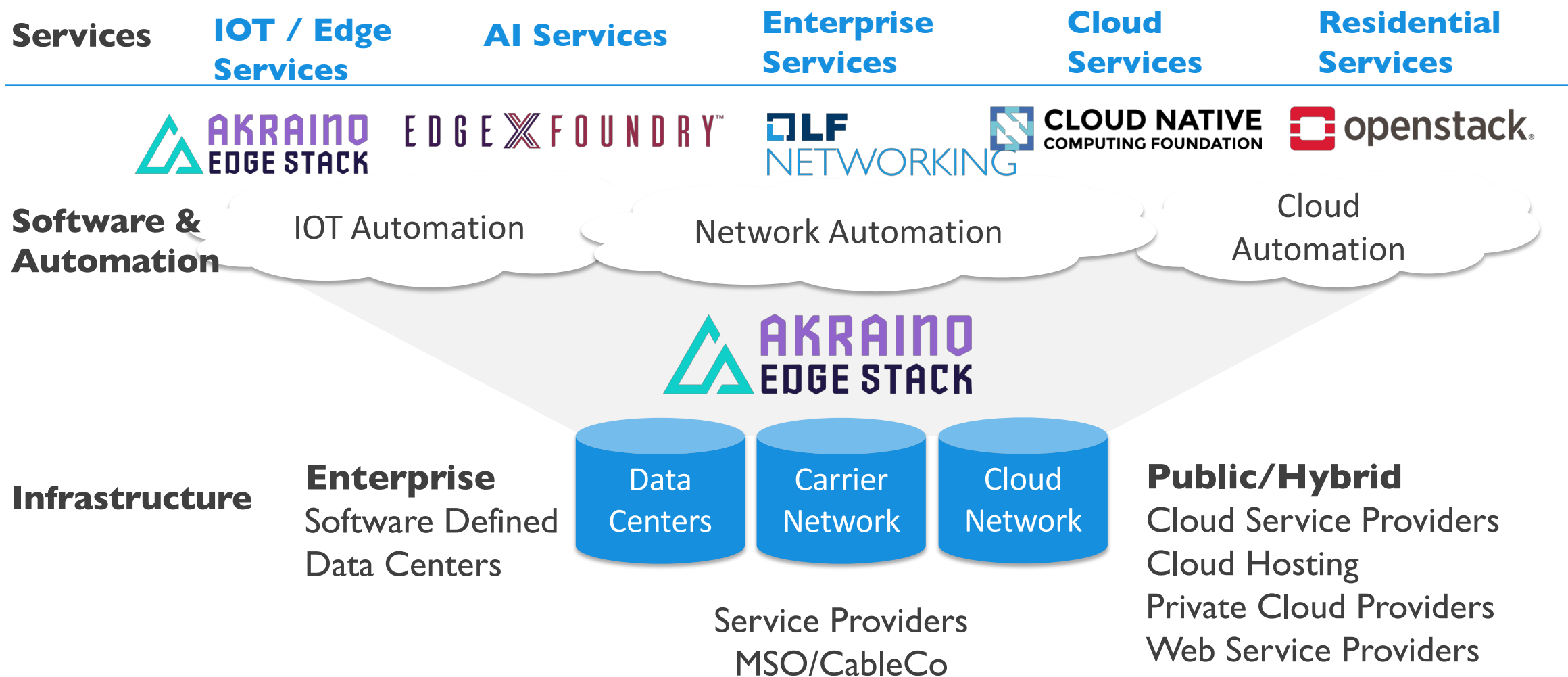
# Harmonization 2.0



# LF Path to Open Source Harmonization 2.0

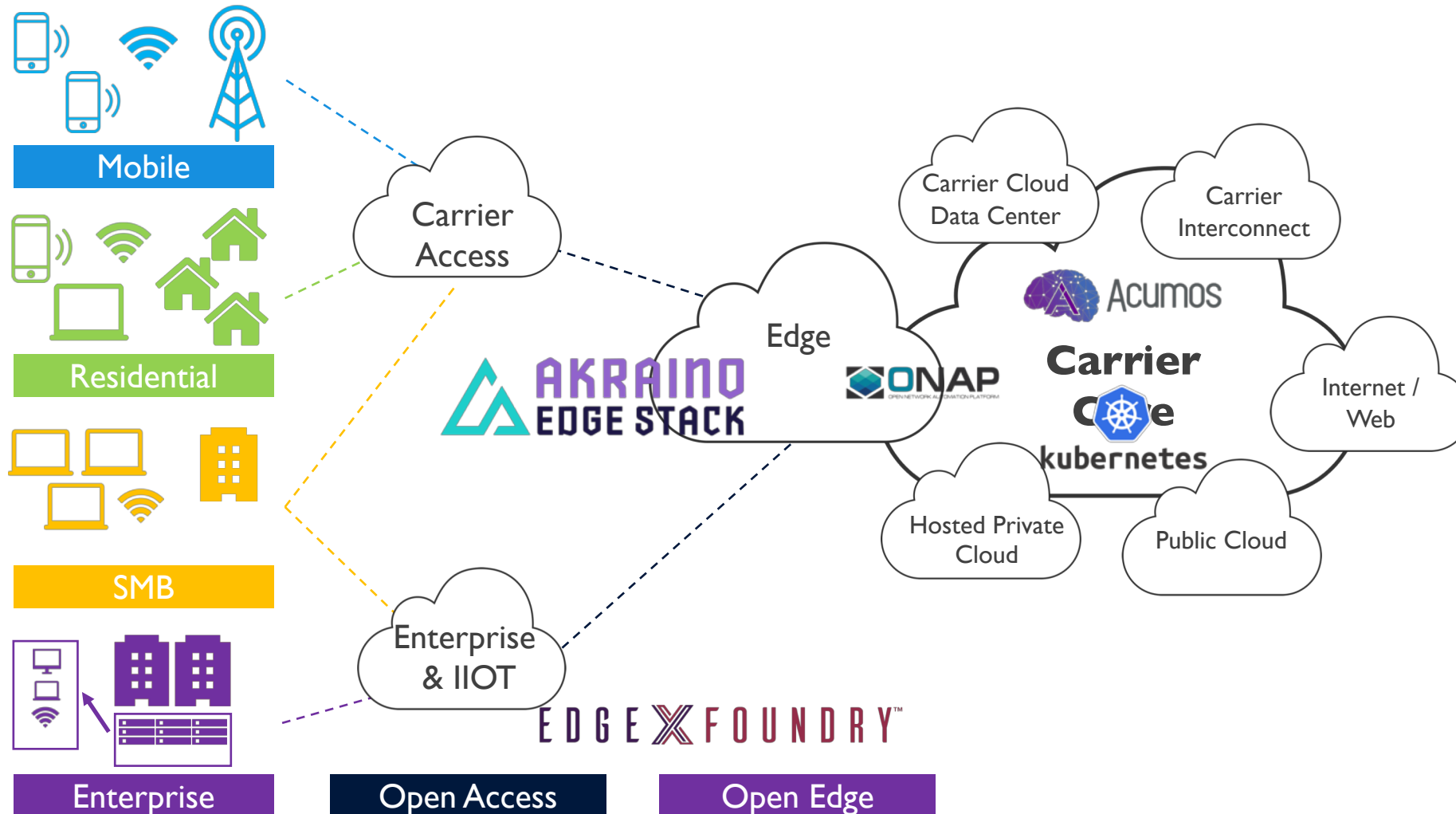


# Harmonization Engine



# Use Case: Cloud Bringing It All Together – LF Open Source Edge

## With Complementary Standards, Ref Arch and Ref Implementations



Standards for Edge



Ref Implementation



openEDGEcomputing



IoT, Gateway &  
Cloud Ref Arch

Other Edge Activities

# Open Networking Ecosystem Adoption

# Open Source Networking -- User Options



## DIY

Use variety of small OSS components to develop unique systems completely in-house

Little/no vendor involvement

## MIXED

OSS components & platforms + custom tooling for network differentiation

Several specialized solution providers work together as extensions of in-house teams

## PACKAGED OPTIONS

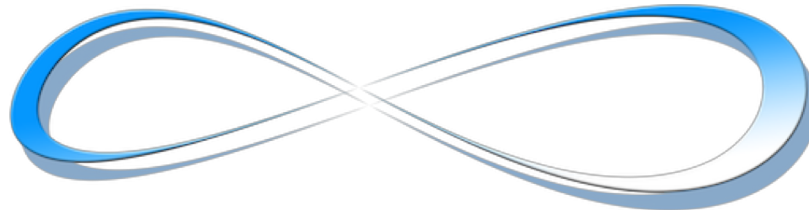
Tested, hardened products with support contracts

Traditional acquisition model with preferred vendors

# 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>

# 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](mailto:LFN-info@linuxfoundation.org)



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