Open Source Networking

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THE LINUX FOUNDATION
Open Source & Open Networking Vision
Open Source Development is Accelerating

23M+ Open Source Developers

41B+ Lines of Code

10,000+ New Versions per Day

64M+ Repositories on GitHub

1,100 New Projects a Day

Sources: Sourceclear, Sonatype, Github
The Linux Foundation Leads Open Source Momentum

Cloud

Cloud Foundry
CNCF
OCI
Xen Project

Embedded & IOT

AllJoyn/IoTivity
EdgeX Foundry
Zephyr Project
AGL
Dronecode
Yocto Project
Tizen

Hyperledger
ODPi
R Consortium

Blockchain, Data & Analytics

Linux
Node.js Foundation
OpenAPI
JS Foundation
Open Mainframe
Open Project
MAMA
Let’s Encrypt!
CII

Platforms

Cloud Native Computing Foundation
kubernetes

Networking

OpenDaylight
OPNFV
ONAP
CORD/ONOS
FRR
OvS, IO Visor
PNDA, SNAS.io
OpenSwitch, OSC
FD.IO, DPDK

* Few examples only
LF Open Source Networking - Carriers, Cloud, Enterprises

8/10
Most Important Projects

10/10
Networking Vendors Active

55%
Global Subscribers represented

$576 M
Shared Innovation

15 min
New Service Creation
Disaggregation of Networking Components *(Trials)*

Production-Ready Components *(Early Deployment)*

Production-Ready End-to-End Solutions *(Scaled Deployment & Harmonization)*

**The Linux Foundation**

1876-2013

2013-14

2016

2017+
Vision: Automating Cloud, Network, & IOT Services

Services

Cloud Services  Residential Services  Enterprise Services  IOT Services

Software & Automation

Infrastructure

Fragmented & Disjoint Manual Tooling

Enterprise
Software Defined Data Centers (SDDC)

Data Centers  Carrier Network  Cloud Network

Service Providers
MSO/CableCo

Public/Hybrid
Cloud Service Providers
Cloud Hosting
Private Cloud Providers
Web Service Providers
Vision: Automating Cloud, Network, & IOT Services

Mandatory Automation before 5G

- **Cloud Services**
- **Residential Services**
- **Enterprise Services**
- **IOT Services**

Software & Automation

Infrastructure

- **Data Centers**
- **Carrier Network**
- **Cloud Network**

- Enterprise
  - Software Defined Data Centers (SDDC)

- Public/Hybrid
  - Cloud Service Providers
  - Cloud Hosting
  - Private Cloud Providers
  - Web Service Providers

- Service Providers
  - MSO/CableCo
The 5G and IOT Impact to Network

Services

Cloud Services  Residential Services  Enterprise Services  IOT Services

Software & Automation

1000X Data Volume  100X Data Rates

10X Bandwidth

1/5th Latency

Source: Ericsson

Infrastructure

Enterprise
Software Defined
Data Centers (SDDC)

Public/ Hybrid
Cloud Service Providers
Cloud Hosting
Private Cloud Providers
Web Service Providers

Data Centers
Carrier Network
Cloud Network

Service Providers
MSO/CableCo
Vision: Automating Cloud, Network, & IOT Services

Services
- Cloud Services
- Residential Services
- Enterprise Services
- IOT Services

Software & Automation
- Cloud Automation
  - Cloud Foundry + CNCF

Open Network Automation
- ONAP+ODL+OPNFV

Infrastructure
- Data Centers
- Carrier Network
- Cloud Network
- Service Providers
  - MSO/CableCo
- Public/Hybrid
  - Cloud Service Providers
  - Cloud Hosting
  - Private Cloud Providers
  - Web Service Providers
Market Disruption & Open Source Innovation

VENDOR A, B, C

Services
- Features/Service
- Mgmt & Ops

Software
- Control software
- Operating System

Infrastructure
- Control Plane CPU
- Fabric Silicon
- Data Plane Silicon

Market Disruption
- Virtual Functions
- Software-Defined
- Disaggregation

Open Source Projects
- Services/WL/Apps
- Orch/Mgmt
- Control Plane SW
- Network OS
- Control Plane CPU
- Leaf Spine Architecture
- Data Plane Acceleration
- Data Plane ASIC
- Data Plane Server
- Optical
Open Source Networking Landscape

- Application Layer / App Server
- Network Data Analytics
- Orchestration, Management, Policy
- Cloud & Virtual Management
- Network Control
- Operating Systems
- IO Abstraction & Data Path
- Disaggregated Hardware

Product, Services & Workloads

Automation of Network + Infrastructure + Cloud + Apps + IOT

Linux Foundation Hosted
Outside Linux Foundation

Standards

Cloud Foundry
Cloud Native
Open Source MANO
ARIA
ONAP
SnAAS.io
OpenStack
OpenDaylight
FRR
OpenSwitch
OpenContainer Initiative
Telecom Infra Project
OCE
CableLabs
ONF
ITU
MEF
NIST
IEEE 802
OIF
Linux Foundation Framework, Governance, Control
Bringing the best of both worlds together

› 2+ years of Deployment Maturity at AT&T
› Comprehensive: Design + Orchestration + Control + Policy + Analytics
› Model-based design enabling self-serve capabilities for instantiation and closed loop automation

Based on extensions & integration with OpenDaylight & OPNFV

- Open TOSCA model
- Most Advanced Open Source Process & tool chain
- Architected for ease of VNF insertion (SDK)
ONAP: The Business Value
Accelerate Services with Network Automation

End User Value
1. Faster Services on Demand including 4G, 5G & Business/Enterprise solutions
2. Elimination of manual steps/errors/time
3. Design, Agility & Automation enabler for 5G

Open Source Ecosystem Value
1. Harmonized shared investment in technology across Major Carriers globally
2. Neutral platform that will foster innovation on top of SDN/NFV eg Services, Virtual Functions, 5G Apps, IOT ecosystem

At Inception, ONAP enables up to 38% of Global Subscribers
ONAP Tipping Point: 55% of Global Subscribers, 50+ Members
ONAP: Architecture Value
Design, Execute and Operate – Network Automation

1. Active and Available Inventory
2. Application Controller
3. Data Collection, Analytics, and Events
4. Design Studio
5. Service Orchestrator
6. Network Controller
7. Policy Framework
8. Portal
9. Virtual Network Function SDK
10. Virtual Function Controller
11. Modeling

Service Provider Stack
- Residential & Business Products/Services
- Orchestration, Management, Policy, Services
- Control Plane SW
- Network OS
- Control Plane CPU
- Leaf Spine Architecture
- Data Plane Acceleration
- Data Plane ASIC
- Data Plane Server
- Optical

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ONAP Initial Architecture

Operational Functions
- Dashboard OA&M
  - Operation Administration & Maintenance
- Data Collection & Analytics
- Controllers
- Service Orchestrator
- Common Services, Data Movement, Access Control & APIs
- E – Services
- BSS / OSS
- Big Data
- External Data Movement & APIs

Design Functions
- ONAP Portal
- ONAP Controller
- ONAP Portal
- Operational Functions
- Recipe/Engineering Rules & Policy Distribution
- Service Design & Creation
- Policy Creation
- Analytic Application Design
- VNFs / Applications
- Networking
- Compute
- Storage

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ONAP Architecture Baseline Amsterdam (Release 1, Q417)

**Run-time**
- External API Framework
- A&AI
- Service Orchestration
- Policy Frmwk
- SDN-C
- Controller driver
- Cloud/VIM driver
- DCAE
- APP-C
- VF-C
- OpenStack
- VMware
- RackSpace
- Azure
- VNFM
- EMS
- VNFs

**Design-time**
- Portal Framework
  - Usecase UI
  - ONAP CLI
- SDC
- VNF SDK
- CLAMP
- Dashboard OA&M (VID)
- Common Services
  - DMaaP
  - CCSDK
  - Logging
  - App. Auth. Framework
  - Microservice Bus
  - Multi-VIM/Cloud
  - Controller driver
  - Cloud/VIM driver

**External components**
- Integration
- University
- VNF Validation Program
- VNF Requirements
- Modeling (Utilities)

**ONAP CLI Integration**
- CLAMP
- sVNFM/EMS driver
- APP-C
- VF-C
- DCAE
- Multi-VIM/Cloud
- Controller driver
- Cloud/VIM driver
- OpenStack
- VMware
- RackSpace
- Azure
- VNFM
- EMS
- VNFs

**THE LINUX FOUNDATION**

- ONAP Operations Manager

- Policy Frmwk
- SDN-C
- Controller driver
- Cloud/VIM driver
- DCAE
- APP-C
- VF-C
- OpenStack
- VMware
- RackSpace
- Azure
- VNFM
- EMS
- VNFs
ONAP now the De-Facto Automation Platform for Carriers

Global Subscribers

- 28% Untapped, for now
- 55%
- 17%

Additional Wireless Subscribers (In Pipeline)

- Model driven service design
- Multivendor VNF and PNF support
- MultiVIM/Cloud
- Cross WAN DCI underlay and overlay network support
- Workflow driven service orchestration
- Multiple ONAP controllers support
- Closed loop automation with data collection, data analytics and policy
ONAP Executive Metrics: YTD as of Sep 2017

ONAP Community Growth and Diversity

Wiki Membership

ONAP is creating the largest shared technology investment in Open Source Networking @ LF

Source:
Press releases, JIRA, Gerrit, Git.
ONAP-ONAP Implementation in LSO Framework

End-to-End Network-as-a-Service
Key Takeaways: ONAP

› Automation is a must before 5G and IOT

› ONAP is becoming the de-facto Automation Platform
  › Global end user participation (55% subs covered)
  › Top 10 vendors & SI active
  › Vibrant community of 1100+ developers

› ONAP is leading the Industry effort on Harmonization across Open Source & Standards – starting with MEF
Cross-Community CI: Faster Integration Upstream

- Facilitate development & integration of open source components
- System level integration testing & creation of NFV Ref Platform

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Announcing OPNFV Euphrates

- Containers Support with Kubernetes orchestration engine & containerized OpenStack
- Carrier-grade network visibility and service assurance framework
- Cross-community Continuous Integration (XCI)
- Extensive new set of test tools for NFVI/VIM, VNFs and network services (eg SampleVNF, NFVbench)
- Improvements in testing, VNF-onboarding, performance and security

https://www.opnfv.org/software