State of Open Source Networking & Edge

5G+Cloud+AI+Edge+IOT
& Implications on Vertical Industries

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The Linux Foundation
1. Open Networking, Edge & IOT are critical in the new normal across vertical industries

2. Open Compliance, Standards + OSS Harmonization & Use Case driven deployments gaining traction

3. Edge is the next Cloud
Open Industries

“Open-Sourcification”

Telecom at the forefront
+
Automotive
+
Motion Pictures
+
Fintech
+
Public Health
+
Energy

Software-defined vertical industries: transformation through open source

How open collaboration enables user-centered innovation, achieving faster development cycles, time to market, and increased interoperability and cost savings.

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5G and Edge Critical in the Next Battle, a new normal!

Edge is 4X the Size* of Cloud Market!

“As businesses and governments establish their own new normal, **5G and Edge computing** will be necessary to deliver the automation, performance and cognitive insight required by many industries—including manufacturing, healthcare, energy and utilities, among others. Telecom operators will need to embrace open ecosystems to externalize innovation and accelerate new services.”

[Forbes](http://www.chetansharma.com/publications/edge-internet-economy/)

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[Statista](https://www.statista.com) how VR and AR will be used in 2025

Image: Statista
Technology Disruption, enabled by Open Source

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

Forbes

VIRTUALIZATION

DISAGGREGATION

SOFTWARE DEFINED NETWORKING

ORCHESTRATION

AUTOMATION

CLOUD NATIVE
Why Open Networking & Edge

“From Cost Savings to Market Adoption”

Top Reasons
Market Creation, Adoption Acceleration & Collaboration

Source: LF Edge Community Survey, Sept 2020
Open Networking (5G & Automation), Edge & IOT are critical in the new normal across vertical industries

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Edge is the next Cloud
Beyond Code
POC to Production

Open Compliance & Verification
Open Interop & Testing
Open Training & Certification

Leading Open Interop & compliance
LF Networking’s Anuket (OPNFV + CNTT)
LF Edge’s Akraino Blueprints
SDO or OSS

Is it Standards OR Open Source?

“Harmonize” was a hot word 3 years ago

Unification well beyond Standards - now Open Source communities, Markets, Verticals are taking direction from the LFN playbook

Linux Foundation Projects are harmonized with Standards
End to End Open Source Software Collaboration

- Carrier Access
- Mobile
- Residential
- SMB/ROBO
- Enterprise & IIOT
- Enterprise
- User Edge
- Service Provider Edge
- Core & Cloud

Network Functions & Apps
- VNFs
- CNFs
- magma Core

Management Orchestration & Analytics
- ONAP
- OpenDaylight
- kubernetes
- DPDK

Network Control
- OpenAir Interface
- tungsten fabric
- openstack

Infrastructure
- Google, Microsoft, AWS, IBM, Huawei, Alibaba, Baidu, Tencent

* Sample projects only
End to End Open Source Software Collaboration

Open Source Core Wireless Networks
5G, Network Slicing, CCVPN, ZTP, Closed loop automation, VoLTE, vIMS, vCPE, nomadic broadband..

Open Compliance & Verification
Standardized NFVI + VNF/CNF onboarding, Reference Implementation

Multi-Cloud & Hybrid deployment of Telecom Services

eg Google, Microsoft, AWS, IBM, Huawei, Alibaba, Baidu, Tencent..

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Edge Applications

New Vertical Industries Enabled by Edge

New Applications

New Revenue

New Use Cases

Source: 451 Research
**LFN Accelerating Community Collaboration**

**New Member Growth in 2020**

- **Global Deployments & Commercial Products**: 20%
- **ONAP Frankfurt**: 2020
- **Developer Engagement**: Share of voice Q1 2020 (up 5% Y/Y)
- **Training Enrolments**: 7+ LFN courses, 28,000+
- **Dedicated, Operated & Shared, XaaS**: Regional Data Centers
- **Distributed Devices and Systems**: Buildings / Factories / Smart Homes
- **User Edge**: MCU-based devices, Embedded compute, Smartphones, PCs, ruggedized IoT gateways and servers in accessible to semi-secure areas
- **Service Provider Edge**: Server-based compute at Telco Network and Edge Exchange Sites
- **Access Edge**: Servers in secure on-prem data centers, MDCs
- **Regional Edge**: Servers in traditional cloud data centers
- **Last Mile Networks**: On-Prem Data Center Edge
- **LOCATIONS**
  - Access Networks
  - Aggregation Hubs/COs
  - Regional Data Centers
  - Centralized Data Centers

**Research and Reports**

**State of the EDGE**

**Stage 1: At Large Projects**
- Baetyl, Open Horizon, Secure Device Onboard

**Stage 2: Growth Projects**
- EVE, Fledge, Home Edge, State of the Edge

**Stage 3: Impact Projects**
- Akraino Edge Stack, EdgeX Foundry

**LF Edge Projects**
LF Edge Projects

Stage 1: At Large Projects
Baetyl, Open Horizon, Secure Device Onboard

Stage 2: Growth Projects
EVE, Fledge, Home Edge, State of the Edge

Stage 3: Impact Projects
Akraino, EdgeX Foundry

Distributed Devices and Systems
- MCU-based devices
- Embedded compute
- Smartphones, PCs, ruggedized IoT gateways and servers in accessible to semi-secure areas

Buildings / Factories / Smart Homes
- Servers in secure on-prem data centers, MDCs

Last Mile Networks
- Server-based compute at Telco Network and Edge Exchange Sites
- Server-based compute at Regional Telco and Direct Peering Sites
- Servers in traditional cloud data centers

User Edge
- Dedicated, Operated

Service Provider Edge
- Shared, XaaS

LOCATIONS
- Aggregation Hubs/COs
- Centralized Data Centers
- Regional Data Centers

Access Networks
- Access Edge
- Regional Edge
Akraino R4 Blueprints – To be approved

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- Applications
  - IIoT – Predictive Maintenance
  - ELIOT IOT GW/uCPE
  - IEC - Type I
  - Micro-MEC

- Infrastructure
  - 5G MEC - Enterprise
  - The AI Edge – Security, Autonomous Vehicle, Federated Learning
  - ICN Private 5G
  - Network Cloud Family
  - Telco Appliance - Radio Edge
  - Connected Vehicle
  - IEC - Type 2-S

- LOCATIONS
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- Access Edge
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Edge Use Cases Driving Open Source Projects

- Radio Edge Cloud, Network/Telco Cloud + Connected Vehicle, AR Classroom, Enterprise Edge Cloud Automation Blueprints, Private LTE, Public Cloud Edge
- Building Automation, Industrial process control, Smart Cities - Water, Retail
- IIoT - Predictive Mtce & condition based monitoring - Turbines, Transformers, pumps. Tensorflow ML/AI for Edge Apps
- Anomaly detection, Surveillance
- IIoT: DevOps at Scale for on-prem devices with partial connectivity
- SMB/ROBO
Observations

1. **Network is even more important in the new world!** End Users (Enterprises, Governments, Countries) have a vast array of open options using “infra/software” right near their premises.

2. **Open Source Collaboration (beyond code) is the way to go.** Driven by faster innovation, security and time to revenue & deployment Use Cases.

3. **Edge is new Cloud** and is enabled with technologies like 5G+Cloud+AI+IOT.
What’s Next

› Upcoming LF Events: ONEEF (Open Networking & Edge Executive Forum, March 10-12)
  › https://events.linuxfoundation.org/open-networking-and-edge-exec-forum/