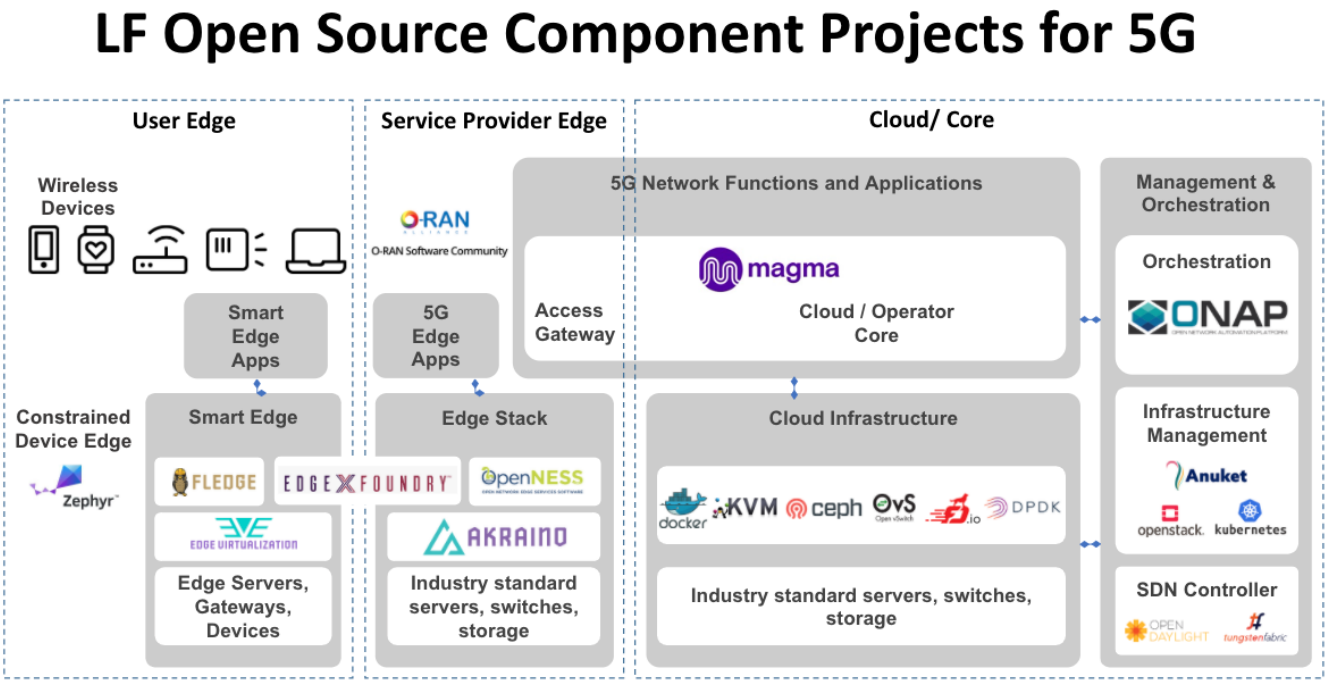
5G Super Blueprint Diagram Architecture & Projects



Open Source Component Projects identified for the LF Networking 5G Super Blueprint End to End architecture

Not seeing your project? Please email bwick@linuxfoundation.org to see where your project may be able to fit in.

Linux Foundation Open Source Component Projects

Magma Open Converged 4G/5G Core Network

Magma provides open, cloud native 5G network functions, using Kubernetes reference architecture, and conformant with the Linux Foundation Edge Akraino blueprints. The Magma Open 5G Core Network is deployed in operational environments today and designed to support end-to-end use cases with scalability and robustness. Magma moved under neutral governance in the Linux Foundation and released initial 5G Core Network Stand Alone capabilities in February 2021. The initial use cases to be supported by Magma include Fixed Wireless Access, Private 5G Network + Slicing, and Mobile Broadband. More information on Magma is available at https://www.magmacore.org.

Open Network Automation Platform (ONAP)

ONAP provides policy driven, real-time orchestration, automation, end-to-end lifecycle management, and service assurance of network services. This includes fully automated deployment and scaling of network functions, lifecycle management (design, deploy, configure, scale, orchestrate, update, retire), and Fault, Configuration, Accounting, Performance, and Security (FCAPS) functionality. ONAP supports network slicing capabilities, including Communication Service Management Function (CSMF), Network Slice Management Function (NSMF), and Network Slice Subnet Management Function (NSSMF). ONAP provides a capability to orchestrate, manage, and automate the Magma 5G Core. ONAP will also manage network slicing when this capability is supported by the Magma 5GC Core. More information is available at https://www.onap.org.

OpenNESS Edge Multi-Cluster Orchestrator (EMCO)

EMCO is an intent based orchestration engine for cloud native network functions (CNF) and cloud native applications (CNA). It can be used to register Kubernetes clouds, onboard CNFs and CNAs for edge computing use cases, create network services/composite applications, and orchestrate them based on intent. EMCO can also be used for Day 0 configuration of these services or applications. In addition, EMCO includes features such as service mesh configuration, SDE-WAN, and more to simplify deploying and managing applications on edge clouds. EMCO can supplement ONAP for cloud native workloads. More information is available at https://www.openness.org/docs/doc/building-blocks/emco/openness-emco.

Anuket

Anuket is a new Linux Foundation project merging previous Open Platform for Network Function Virtualization (OPNFV) and Cloud iNfrastructure Telco Taskforce (CNTT) efforts. Anuket is creating a common reference architecture for the NFVI, or the network cloud layer, and includes development of common infrastructure models, reference architectures, reference implementations, and compliance and verification programs for industry-wide testing. Reference implementations of cloud infrastructure for telecommunications industry are based on OpenStack (for virtual network functions or VNFs) and Kubernetes (for cloud native network functions or CNFs). More information is available at https://www.anuket.io.

OpenDaylight

OpenDaylight (ODL) is an open source Software Define Networking (SDN) controller and platform for network automation. ODL provides a service abstraction layer and supports networking protocols to communicate with, configure, and control underlying network devices, ports, interfaces, and other network functionality. The core components of ODL are included in ONAP as the SDN Controller project to configure and manage datacenter connectivity, physical network functions, radio, and external controllers. In this manner, the US GOV OPS open 5G architecture utilizeds ODL primarily as a network automation layer. More information is available at https://www.opendaylight.org

Tungsten Fabric

Tungsten Fabric (TF) is an open source Software Define Networking (SDN) controller and platform for network and security orchestration, which may be implemented within a network domain. TF can be integrated with OpenStack, Kubernetes, or other network orchestration stacks to expose network interfaces and instantiate network and security policies. TF is specifically designed to work in cloud native networks, and may be deployed in either cloud or service provider edge environments, with use cases for 5G and Internet of Things (IoT). In the open 5G architecture, TF may be used as a datacenter SDN controller for the overlay network. In this manner, TF complements ODL's role as a global network automation layer. More information is available at https://tungsten.io.

Kernel Virtual Machine (KVM)

KVM provides a core virtualization infrastructure based on Linux. More information is available at https://www.linux-kvm.org.

Ceph

Ceph is an open source storage interface solution to enable distributed data storage solutions and management. Ceph may be used with both OpenStack or Kubernetes. More information is available at https://ceph.io.

Open vSwitch (OvS)

OvS is an open virtual switch to enable network automation capabilities and supporting standard management interfaces and protocols. OvS forms the datapath element of the software defined network and is commonly programmed by SDN controllers. More information on OvS is available at https://www.openvswitch.org.

Fast Data Project (FD.io)

FD.io is an open source project providing data plane acceleration for virtual routing, switching, and other functions, written to operate on a variety of standard industry compute platforms to enable high-performance real-time, network I/O and package processing. FD.io's Vector Packet Processing (VPP) offers up to two orders of magnitude greater packet processing throughput. In the open 5G architecture, FD.io can be used to speed up packet processing intensive operations. More information on FD.io is available at https://fd.io.

Data Plane Development Kit (DPDK)

DPDK is an open source project consisting of libraries to accelerate packet processing workloads running on a wide variety of CPU architectures. DPDK enables performance-sensitive applications as required for 5G to be supported in virtualized and cloud environments. Amongst others, DPDK's core innovations are around enabling user mode packet processing using polling mode as opposed to kernel mode processing using interrupts. DPDK will play a role similar to that of FD.io in the open 5G architecture; in fact, DPDK and FD.io can be used together to provide an even greater benefit, where FD.io can be run in user mode through DPDK. More information on DPDK is available at https://https://www.dpdk.org/.

Open Radio Access Network (O-RAN)

The O-RAN alliance is creating specifications for open, interoperable 5G RAN architecture and standards, compatible with 3GPP standards. The O-RAN Software Community (O-RAN-SC) is the open source software for RAN. More information on O-RAN is available at https://www.o-ran.org and https://wiki.o-ran-sc.org.

LF Edge Akraino Integrated Cloud Native (ICN) Blueprint

The Akraino ICN blueprint is a Kubernetes-based software stack to provide a telco-grade edge platform, including features to address security and performance requirements for telecommunications and 5G use cases. There are three different flavors of ICN: A) MICN that focuses on SD-WAN, EdgeXFoundry, and several edge computing applications, B) Private LTE/5G over CBRS blueprint that uses Magma to create an end-to-end 5G network using the CBRS frequency band along with local breakout to edge computing applications, and C) Multi-Tenant Secure Cloud Native Platform that introduces Kata containers to ICN for improved security. Use of an open source neutral platform allows network function vendors to verify and validate functionality and interoperability using an open source neutral platform. The ICN blueprint leverages OpenNESS and EdgeXFoundry, discussed below. More information on the ICN Blueprint is available at https://www.lfedge.org/projects/akraino / https://wiki.akraino.org/display/AK/ICN.

OpenNESS

OpenNESS is an edge computing software platform to enable developing, onboarding, and management of applications and network functions at the edge. OpenNESS abstracts the complexity of network edge software, facilitating the development of edge applications. OpenNESS is designed to support 5G applications, and provides Application Function (AF) microservice and REST-based interfaces to interact with the 5G Control Plane, and Application Programming Interfaces for orchestration. More information on OpenNESS is available at https://www.openness.org/.

EdgeXFoundry

EdgeXFoundry is a vendor neutral, interoperable edge software platform interfacing with devices, sensors, actuators and other IoT objects and can be leveraged to support site specific requirements for Industrial IoT applications. EdgeXFoundry provides four micro service layers, which can be deployed across multiple compute nodes, from the physical device to edge computing resources. The four service layers are Device Services, Core Services, Supporting Services, and Application Services. The set of micro services provide capabilities for monitoring devices, sending instructions, collecting data, and moving data for storage, aggregation, analysis, and control. In 5G use cases, IoT gateways can be employed with 5G backhaul to edge computing and application resources at the enterprise or service provider edge and deliver data to enterprises and cloud systems. EdgeXFoundry may run on the ICN stack at the service provider edge, or the EVE virtualization platform at the smart device edge on user premises. More information is available at https://www.edgexfoundry.org / https://wiki.edgexfoundry.org.

Edge Virtualization Engine (EVE)

Edge virtualization platform for enterprise smart device edge, outside of physically secure, centralized data facility. Provides an open, standard architecture with standard APIs for users to control and have visibility to on-premises device operations. EVE components include a hypervisor running directly on bare metal, an edge container runtime allowing applications to run in either virtual machines or containers, and a hardened root-of-trust implementation for security. Service layers for EdgeXFoundry and Fledge may run on top of EVE to support enterprise Industrial IoT requirements. More information is available at https://www.lfedge.org/projects/eve / https://wiki.lfedge.org/display/EVE/EVE/.

Fledge

Fledge is an open source framework for industrial edge focused on critical operations, predictive maintenance, situational awareness, and safety. Fledge integrates modern Industrial IoT technology with the cloud and existing “brown field” systems such as Distributed Control Systems (DCS), Program Logic Controllers (PLC) and Supervisory Control and Data Acquisition (SCADA) systems. Fledge works closely with Project EVE, which provides system and orchestration services and a container runtime for Fledge applications and services. More information is available at https://www.lfedge.org/projects/fledge / https://fledge.iot.readthedocs.io/en/latest.

Zephyr

Zephyr is an open source, real time, secure and safe Real Time Operating System (RTOS) for constrained devices with limited memory and processing capabilities. The Zephry RTOS supports multiple hardware architectures and small footprint devices. The Zephyr code base is auditable to support safety certifications. Zephyr supports Bluetooth Low Energy (BLE), Wiu-Fi, 802.15.4, IPv4, IPv6, IPv6 over Low Power Wireless Personal Area Networks (6LoWPAN), Constrained Application Protocol (CoAP), Ethernet, Universal Serial Bus (USB), and Thread. Zephyr devices can be interconnected to the open 5G architecture via IoT gateways with 5G backhaul, or via 5G capable smart device edge user equipment. More information is available at https://zephyrproject.org / https://docs.zephyrproject.org/latest.