LINUX FOUNDATION

Guide to the Open Cloud

Open cloud projects profiled

A Linux Foundation publication
January 2015

www.linuxfoundation.org

Introduction

The open source cloud computing landscape has changed significantly since we published our first cloud guide in October 2013.

This revised version adds new projects and technology categories that have since gained importance, and in some cases radically change how companies approach building and deploying an open source cloud architecture.

In 2013, many cloud projects were still working out their core enterprise features and furiously building in functionality. And enterprises were still very much in the early stages of planning and testing their public, private or hybrid clouds–and largely at the orchestration layer.

Now, not only have cloud projects consistently (and sometimes dramatically) grown their user and developer communities, lines of code and commits over the past year, their software is increasingly enterprise-ready. And enterprise use, in turn, has advanced beyond testing to deployment at the orchestration layer and on up the stack.

This advancing maturity of the software, combined with increasing enterprise cloud adoption, has created a growing interest in and demand for open source solutions from cloud service providers and companies alike.

Witness, for example, the plethora of OpenStack distributions announced from new and existing service providers such as HP, IBM, Mirantis, Rackspace and Red Hat that create viable competition for Amazon Web Services.

See also the rise of Linux container technology with the advent of Docker and its emerging ecosystem. You will be hard pressed to find an enterprise Linux distribution that isn't yet working on Docker integration and touting its new container strategy. Even VMware vSphere, Google Cloud Platform, and Microsoft Azure are rushing to adapt their cloud platforms to the open source Docker project.

This rapid pace of innovation and resulting disruption of existing platforms and vendors can now serve as a solid case study for the role of open source software and collaboration in advancing the cloud.

Other components of the cloud infrastructure have also followed suit, hoping to harness the power of collaboration. The Linux Foundation's OpenDaylight project, for example, had grown to include 290 contributors and 44 member companies in the past year to advance software-defined networking.

Similarly, the newly announced Open Platform for Network Functions Virtualization Project (OPNFV), also a Linux Foundation Collaborative Project, will look to accomplish rapid progress for an open source NFV platform that already has broad support from many of the most influential telecom companies.

The open source cloud is evolving quickly and it's fueling dramatic enterprise innovation

and growth across industries. If 2014 was the year that enterprises started executing on their cloud strategies, then 2015 will be the year that enterprise developers and applications begin a wholesale migration to the cloud and companies take another step toward delivering web-scale IT.

Underlying this trend is Linux, which remains the go-to choice for the cloud, with 75 percent of enterprises reporting that they use Linux as their primary cloud platform, according to our 2014 Enterprise End User Trends Report.

What follows is a snapshot of some of the projects that form the basis of this cloud computing revolution today.

The purpose of this paper

At each level of the cloud stack–starting with a kernel on bare metal and advancing through orchestration and management, on up to the application layer–enterprises face a host of options and thus difficult decisions as to which components will best meet their own unique needs.

The purpose of this paper is to serve as a starting point for users considering which projects to use in building and deploying their own open clouds.

By engaging with our members in the tech industry and organizing CloudOpen conferences in North America and Europe, ApacheCon, and developer conferences such as MesosCon for projects such as Apache Mesos, we keep track of the many projects, technologies and companies that are driving the cloud.

This paper is a curated list of profiles that aims to distill this knowledge into a useful guide. It is by no means a comprehensive list of all cloud-related open source software. Neither does this paper attempt to predict which projects will continue to be relevant in the long term.

Given the track record of these projects, however, and the larger trends in cloud and open source adoption, we believe these projects have the attributes of open cloud technologies that will continue to drive innovation in enterprise IT in the coming year and beyond.

What is the Open Cloud?

The projects on this list can all be safely defined as part of the open source cloud. While some in the cloud industry assert that an open API constitutes an open cloud project, we disagree.

To us, and to most in the open source community, the open cloud means:

- Every component, from the software to the APIs used by application developers, is open to vendors and customers alike.
- The project is released under an open source license approved by the Open Source Initiative (OSI) which guarantees full and unrestricted access to its codebase. Examples include the GPL used by the Linux kernel or an alternative such as the Apache or MIT licenses.
- An active and diverse community of users and contributors support the project.

Why is the Open Cloud Important?

Open cloud projects have made great progress over the past few years in an effort to build an enterprise alternative to large proprietary public clouds that are open at every level of the stack.

This is important in order to realize the vision of a truly portable cloud that allows interoperability between cloud providers and private cloud infrastructure.

But much work remains to ensure that this next generation computing platform remains as free and open as the technology on which it is built. By paying attention to these significant projects, using them and–importantly–contributing back upstream, you can help accelerate technological innovation and benefit in the process.

Companies that use and participate in open source cloud projects enjoy all of the same advantages as those involved in pioneering open source projects such as Linux:

- Improved code quality of the underlying cloud infrastructure
- Increased security with the ability to find and fix vulnerabilities
- Visibility into every layer of the infrastructure
- Code access in order to add features and influence the direction of the technology
- Insurance against lock-in through portability to other platforms
- Lower cost through shared development
- And more.

Profile Methodology

The open cloud is flourishing, with new projects forming at a steady pace to innovate and fill in the gaps as cloud infrastructure and web application deployment practices evolve.

The number of new Docker-related orchestration and management projects founded in the past year alone, for example, could fill several pages of this report.

To be most helpful, we've limited the list to less than 10 projects in each category including hypervisor and container; cloud operating systems; Infrastructure as a Service; Platform as a Service; provisioning and management; storage; and software-defined networking and network functions virtualization.

Projects were selected for the list based on their relevance to the open cloud, their relative maturity and their relative visibility. More specifically, benchmarks for consideration included:

- The project's origins
- Age of the project
- Number of contributors
- Number and frequency of commits
- Diversity of contributions
- Exposure
- Demonstrated enterprise use
- Expert opinions from within the open source community.

All profile data, with the exception of lines of code, was collected from public sources, including project websites and source code repositories and was fact-checked with each project.

Estimates for lines of code are courtesy of Open Hub, and licensed under the Creative Commons Attribution 3.0 Unported license.

Please note that a project's omission isn't a judgement on its quality or prospects. There are simply too many projects to include all of the viable alternatives. As technology evolves, so does the list and we welcome input from the community. Several projects that weren't included last year, for example, have been added.

We've also added SDN and NFV as a new category to pay attention to in the coming year due to the increasing maturity of the projects.

Although it's still very early days in open source networking, forward-thinking companies have already begun to assess the potential of these projects and plan for future deployments.

Also new to the paper this year is an interesting development in the open cloud arena: the promise of lightweight cloud operating systems tailored to web applications, mobile and embedded systems and specialized use cases.

While this is still an emerging area, the technology is sound and promises to lay the foundation for an even larger cloud ecosystem around mobile computing and the Internet of Things.

All profile information in this report is also available online in the Linux.com open cloud directory at **www.linux.com/directory/open-cloud**.

Profiles

Hypervisor and container

Docker.io	
Description	Docker automates the deployment of applications inside a lightweight Linux container.
History	Docker was written and released by dotCloud in 2013.
Website	www.docker.com
Key Contributors	Citrix, Docker (formerly dotCloud), Google, Kickstarter, Microsoft, Red Hat
Commercial Support	Docker
Project License	Apache 2.0
Primary Programming Language	Go (88%)
Lines of Code	149,584
Key Users	Baidu, eBay, Gilt, Google, Microsoft, New Relic, Rackspace, Spotify, Yandex, Yelp

KVM

Description	KVM is a lightweight hypervisor that was accepted into the Linux kernel in February 2007.
History	KVM was originally developed by Qumranet, a startup that was acquired by Red Hat in 2008. In 2013 the Open Virtualization Alliance, a Linux Foundation Collaborative Project, began an initiative to increase awareness and adoption of KVM.
Website	www.linux-kvm.org/page/Main_Page
Key Contributors	HP, IBM, Intel, NetApp, Red Hat
Commercial Support	HP, IBM, Red Hat
Project License	GPL
Primary Programming Language	C (95%)
Lines of Code	13,400,298
Key Users	HP, IBM, Illumos, Red Hat Enterprise Linux, SmartOS, SUSE Linux Enterprise Server, Ubuntu

Linux Containers (LXC)

Description	Lightweight virtual machines enabled by functions within the Linux kernel, including cgroups, namespaces and security modules. Userspace tools coordinate kernel features and manipulate container images to create and manage system or application containers.
History	The effort to develop container functionality in the upstream Linux kernel began in 2006. Userspace tools to manage containers, including Lxc and libvirt-lxc (both initially developed at IBM), quickly appeared. LXC 1.0, released in February 2014, is the first production-ready version of the LXC toolset.
Website	linuxcontainers.org
Key Contributors	Canonical, IBM, Oracle
Commercial Support	Canonical
Project License	LGPLv2.1+
Primary Programming Language	C
Lines of Code	48,048
Key Users	Canonical, Debian, Heroku, Oracle, SUSE

Xen Project	
Description	Xen is a cross-platform software hypervisor that runs on BSD, Linux and Solaris.
History	Xen was originally written at the University of Cambridge by a team led by Ian Pratt. It became a Linux Foundation collaborative project in 2013.
Website	www.xenproject.org
Key Contributors	Amazon, AMD, Cavium, Citrix, Intel, Linaro, NSA, Oracle, SUSE, Verizon
Commercial Support	Citrix, Oracle
Project License	GPL
Primary Programming Language	C (84%)
Lines of Code	495,280
Key Users	Alibaba, Amazon, Citrix, GlobalLogic, Google, IBM Softlayer, Oracle, Rackspace, SUSE Linux, Verizon

Cloud Operating Systems

Apache Mesos	
Description	Mesos is an open source cluster management tool also described as an operating system kernel for the data center.
History	It began as a UC Berkeley research project, which was adopted commercially by Twitter. It became a top-level Apache Foundation project in 2013.
Website	mesos.apache.org
Key Contributors	Mesosphere, Twitter
Commercial Support	Mesosphere
Project License	Apache 2.0
Primary Programming Language	C++
Lines of Code	130,762
Key Users	AirBnB, Atlassian, eBay, Hubspot, Netflix, PayPal, Twitter

CoreOS

Description	A lightweight Linux distribution designed for running large-scale cluster deployments. Applications run inside of containers to isolate them from the operating system.
History	Founded by Alex Polvi, Brandon Phillips and Michael Marineau in 2013.
Website	coreos.com
Key Contributors	CoreOS
Commercial Support	CoreOS, Inc.
Project License	Apache 2.0
Primary Programming Language	Go
Lines of Code	300,000
Key Users	Deis, MemSQL, ModCloth, Rackspace

OSv

Description	OSv is an open source cloud operating system designed to run a single application on top of a hypervisor.
History	Released in 2013 by former KVM developers and co-founders of Cloudius Systems, the project's closed beta was released in late 2014.
Website	osv.io
Key Contributors	Cloudius Systems
Commercial Support	Cloudius Systems
Project License	BSD-2-Clause "FreeBSD"
Primary Programming Language	C, C++
Lines of Code	361,109
Key Users	NA

Note: *Other projects in the early stages include Red Hat's Project Atomic, which emerged in 2014 as a lightweight Linux distribution based on RHEL for running Docker containers; and MirageOS, a cloud operating system for building lightweight network applications on top of the Xen hypervisor.*

Infrastructure as a Service

Apache CloudStack

Description	CloudStack is an open source IaaS platform with Amazon Web Services (AWS) compatibility.
History	CloudStack was originally created by Cloud.com (formerly known as VMOps), a startup that was purchased by Citrix in 2011. In April of 2012, CloudStack was donated by Citrix to the Apache Software Foundation.
Website	cloudstack.apache.org
Key Contributors	Citrix, Clogeny, Cloudera, McAfee (Intel), Schuberg Philis, ShapeBlue, Solidfire
Commercial Support	Citrix
Project License	Apache 2.0
Primary Programming Language	Java (75%)
Lines of Code	1,577,071
Key Users	Alcatel Lucent, British Telecommunications, CenturyLink, Datapipe, Edmunds.com, Fujitsu, IBM (Softlayer), Nokia, NTT, Orange, TATA Communications, TomTom, Verizon, WebMD, Zynga

Eucalyptus

Description	Eucalyptus is an open-source IaaS platform with AWS compatibility.
History	Eucalyptus began as a research project at UC Santa Barbara. It was commercialized in January 2009 and acquired by HP in 2014.
Website	www.eucalyptus.com
Key Contributors	HP
Commercial Support	HP
Project License	GPLv3
Primary Programming Language	Java (54%)
Lines of Code	1,542,831
Key Users	AppDynamics, MemSQL, Mosaik Solutions, NASA, Nokia

OpenNebula

Description	OpenNebula is an open-source IaaS platform for on-premise and public cloud services.
History	OpenNebula began as a research project in 2005 authored by Ignacio M. Llorente and Rubén S. Montero. Publicly released in 2008, development today is via the open source model.
Website	www.opennebula.org
Key Contributors	OpenNebula Systems (formerly C12G Labs)
Commercial Support	ClassCat, Inovex, Netways, OpenNebula Systems, Terradue
Project License	Apache 2.0
Primary Programming Language	C++ (32%), Ruby (26%), Javascript (20%)
Lines of Code	268,262
Key Users	Akamai, BBC, Blackberry, CentOS, China Mobile, Deutsche Post ESA, Produban - Santander Bank

OpenStack

Description	OpenStack is an open source IaaS platform.
History	In July of 2010, NASA and Rackspace joined forces to create the OpenStack project, with a goal of allowing any organization to provide cloud services similar to those available from public cloud providers.
Website	www.openstack.org
Key Contributors	Cisco, HP, IBM, Mirantis, NEC, Rackspace, Red Hat, SUSE
Commercial Support	Aptira, Canonical, Cisco, CloudScaling, EasyStack, eNovance, HP, IBM, Metacloud, Mirantis, Oracle, Piston, Rackspace, Red Hat, SUSE, SwiftStack
Project License	Apache 2.0
Primary Programming Language	Python (71%)
Lines of Code	2,334,355
Key Users	Bluehost, Canonical, CERN, Cisco, GoDaddy, HP, HubSpot, IBM, Intel, PayPal, SUSE, Wells Fargo

Platform as a Service

Apache Stratos

Description	Apache Stratos is an open source enterprise PaaS framework that helps run Apache Tomcat, PHP, and MySQL applications.
History	Developed by middleware company WSO2, Stratos became an Apache project in 2013 and reached top-level status in May 2014.
Website	stratos.apache.org
Key Contributors	Cisco, Citrix, Indiana University, SUSE, WSO2
Commercial Support	WSO2
Project License	Apache 2.0
Primary Programming Language	Java
Lines of Code	465,806
Key Users	Cisco, WSO2

Cloud Foundry

Description	Cloud Foundry is an open source PaaS for managing application deployment and ongoing operations. Cloud Foundry provides extensible support for deploying many programming languages and runtimes as Linux containers across cloud infrastructures.
History	Cloud Foundry was developed within VMware, and launched on April 2011. Pivotal became the steward of Cloud Foundry in 2012, and collaborated with the open source ecosystem to make Cloud Foundry a community-driven standard cloud platform. Cloud Foundry became a Linux Foundation Collaborative Project in December 2014.
Website	cloudfoundry.org
Key Contributors	Canonical, CenturyLink, IBM, Intel, Pivotal, VMware
Commercial Support	ActiveState, AppFog (CenturyLink), HP, IBM, Pivotal
Project License	Apache 2.0
Primary Programming Language	Ruby (32%), Go (30%), Java (11%), JavaScript (8%)
Lines of Code	777,316
Key Users	AT&T, Baidu, BNY Mellon, Cisco, Monsanto, NTT Communications, Rakuten, SAP, Verizon

Deis

Description	Deis is an open source PaaS that builds upon Docker and CoreOS to provide a lightweight PaaS with a Heroku-inspired workflow.
History	Deis was written by OpDemand and released in 2013.
Website	deis.io
Key Contributors	OpDemand
Commercial Support	OpDemand
Project License	Apache 2.0
Primary Programming Language	Python and Go
Lines of Code	56,736
Key Users	Pylon, ShopKeep, SOFICOM

OpenShift Origin

Description	OpenShift Origin is the upstream open source project for Red Hat's Platform as a Service (PaaS) offering. OpenShift is a platform where developers and teams can build, test, deploy, and run their applications.
History	The OpenShift technology came from Red Hat's 2010 acquisition of start-up Makara (founded in May 2008). OpenShift was announced in May 2011 and open-sourced in April 2012.
Website	openshift.redhat.com/app
Key Contributors	Red Hat
Commercial Support	Red Hat
Project License	Apache 2.0
Primary Programming Language	Ruby (64%)
Lines of Code	759,310
Key Users	Boeing, Cisco, FICO, PayPal

Note: *Flynn is also a new Docker and CoreOS-based PaaS, currently in pre-production beta.*

Provisioning and Management Tool

Ansible

Description	Ansible is open source cloud automation software for application deployment and configuration management on multi-tier architectures.
History	AnsibleWorks (now Ansible Inc.) was founded in 2012 by Red Hat veterans Said Ziouani and Michael DeHaan. Ansible 1.0 was released in 2013.
Website	www.ansible.com
Key Contributors	Ansible Inc., Rackspace, Suncorp
Commercial Support	Ansible Inc.
Project License	GPLv3
Primary Programming Language	Python (90%)
Lines of Code	70,638
Key Users	Atlassian, Care.com, EA, Evernote, GoPro, Motorola, NASA, Spotify, Twitter, Verisign, Weight Watchers

Chef

Description	Chef is a configuration-management tool, controlled using an extension of Ruby.
History	Released by Chef Software (formerly Opscode) in January 2009.
Website	www.chef.io/chef/
Key Contributors	Chef Software
Commercial Support	Chef Software
Project License	Apache 2.0
Primary Programming Language	Ruby (92%)
Lines of Code	136,135
Key Users	Disney, Etsy, Facebook, GE, Nordstrom, Riot Games, Splunk, Yahoo

Juju

Description	Juju is a service orchestration management tool.
History	Juju was released by Canonical as Ensemble in 2011 and then renamed later that year.
Website	juju.ubuntu.com
Key Contributors	Canonical
Commercial Support	Canonical
Project License	AGPL
Primary Programming Language	Go (75%)
Lines of Code	360,464
Key Users	Canonical, Cisco, HP, IBM, Intel, Microsoft, NEC, Yahoo! Japan

Kubernetes

Description	Kubernetes is an orchestration and management tool for Docker container clusters.
History	Developed by Google and released as open source in 2014, Kubernetes is in pre-production beta.
Website	github.com/GoogleCloudPlatform/kubernetes
Key Contributors	Docker, Google, IBM, Microsoft, Red Hat, VMWare
Commercial Support	Google
Project License	Apache 2.0
Primary Programming Language	Go (91%)
Lines of Code	127,826
Key Users	CoreOS, Docker, Google, IBM, Microsoft, Mesosphere, Red Hat, SaltStack, VMWare

ManageIQ

Description	ManageIQ is a hybrid cloud management tool to manage services running on cloud and virtualization platforms.
History	Developed as a proprietary system by ManageIQ, which was acquired by Red Hat in 2012, it is the upstream community of Red Hat's CloudForms offering and was released as open source in June, 2014.
Website	manageiq.org
Key Contributors	Booz Allen Hamilton, Chef, CiRBA, Navteca, Synnefo, Red Hat
Commercial Support	Red Hat
Project License	Apache 2.0, GPL
Primary Programming Language	Ruby (84%)
Lines of Code	1,204,584
Key Users	Booz Allen Hamilton, Cox Automotive, Navteca, Synnefo

oVirt

Description	oVirt provides a complete management system, via web, command-line or APIs, for virtualized servers with advanced capabilities for hosts and guests.
History	Red Hat first announced oVirt as part of its emerging-technology initiative in 2008, then re-launched the project in late 2011 as part of the Open Virtualization Alliance, a Linux Foundation Collaborative Project.
Website	www.ovirt.org
Key Contributors	Cisco, HP, IBM, Intel, NetApp, Red Hat, SUSE
Commercial Support	Red Hat, UDS Enterprise, Wind River
Project License	Apache 2.0, GPL
Primary Programming Language	Java (62%)
Lines of Code	1,038,304
Key Users	Alterway, Brussels Airport, IT-Novum, JProfiler, Nimbus Concept, Nieuwland Geo-Informatie

Puppet

Description	Puppet is a configuration-management tool, controlled using a domain-specific language.
History	Founded by Luke Kanies in 2005.
Website	www.puppetlabs.com
Key Contributors	Puppet Labs
Commercial Support	Puppet Labs
Project License	Apache 2.0
Primary Programming Language	Ruby (98%)
Lines of Code	366,869
Key Users	CERN, Cisco, Citrix, GitHub, Intel, NetApp, New Relic, NYSE, Oracle, PayPal, Racksapce, Red Hat, Salesforce, Twitter, Verizon

Salt

Description	Salt is an open source tool for data center automation, cloud orchestration, server provisioning, and configuration management.
History	Salt was written by Thomas Hatch and first released in 2011.
Website	www.saltstack.com
Key Contributors	Saltstack
Commercial Support	Saltstack
Project License	Apache 2.0
Primary Programming Language	Python (91%)
Lines of Code	208,756
Key Users	Adobe, HP, LinkedIn, Photobucket, Rackspace, Samsung

Vagrant	
Description	Vagrant is an open source configuration management tool for virtual development environments.
History	Vagrant was written in 2010 by Mitchell Hashimoto and John Bender.
Website	www.vagrantup.com
Key Contributors	Changepoint, Hashicorp, Reaktor, SUSE, VMWare
Commercial Support	Hashicorp
Project License	MIT
Primary Programming Language	Ruby (79%)
Lines of Code	56,234
Key Users	BBC, DISQUS, Expedia, Mozilla, Nokia, O'Reilly

Note: *Companies such as Airbnb, Apple and Twitter use Mesos frameworks including Apache Aurora, Chronos and Marathon to help manage batch jobs or scheduling on a Mesos cluster.*

Storage

Apache Cassandra	
Description	Cassandra is a highly scalable, eventually consistent, distributed, structured key-value store.
History	Cassandra was developed at Facebook and released as open source in 2008.
Website	cassandra.apache.org
Key Contributors	DataStax
Commercial Support	Cubet Technologies, DataStax, Impetus Technologies, Instaclustr, ONZRA, Palomino, Sohum, URimagination, Workware Systems
Project License	Apache 2.0
Primary Programming Language	Java (96%)
Lines of Code	245,182
Key Users	Apple, Constant Contact, CERN, Comcast, eBay, GitHub, GoDaddy, Hulu, Instagram, Intuit, Netflix, Reddit, The Weather Channel

Ceph

Description	Ceph is a distributed object store and file system.
History	Ceph was originally created by Sage Weil for a doctoral dissertation in 2004. In 2012, Weil and others formed Inktank to deliver professional services and support. Red Hat acquired Inktank in 2014.
Website	ceph.com
Key Contributors	Red Hat
Commercial Support	Red Hat
Project License	LGPL
Primary Programming Language	C++ (70%)
Lines of Code	572,783
Key Users	CERN, Cisco, Deutsche Telekom, DinCloud, DreamHost

CouchDB

Description	CouchDB is a distributed document database system.
History	Created in 2005 by Damien Katz, who self-funded it for two years before releasing it as an open source project supported by Katz's company CouchOne. It became an Apache project in 2008 and the first stable version was released in 2010.
Website	couchdb.apache.org
Key Contributors	Couchbase, IBM Cloudant
Commercial Support	Couchbase, IBM Cloudant
Project License	Apache 2.0
Primary Programming Language	Javascript (55%), Erlang (34%)
Lines of Code	254,067
Key Users	Couchbase, dotCloud, IBM Cloudant

GlusterFS

Description	GlusterFS is a scale-out NAS file system.
History	GlusterFS was originally developed by Gluster Inc., then by Red Hat after its 2011 purchase of Gluster.
Website	www.gluster.org
Key Contributors	Red Hat
Commercial Support	Red Hat
Project License	GPL 3
Primary Programming Language	C (93%)
Lines of Code	1,485,967
Key Users	Brightcove, Cutting Edge, Intuit, Picture Marketing

MongoDB

Description	MongoDB is a high performance document database.
History	Created by former DoubleClick employees who later co-founded 10gen (Now MongoDB Inc.) in 2007. They released the software as open source in 2009.
Website	www.mongodb.com
Key Contributors	Gameplay, MongoDB Inc., SourceForge, Stripe
Commercial Support	MongoDB, Inc.
Project License	Apache 2.0 and AGPL 1.0
Primary Programming Language	C++
Lines of Code	649,261
Key Users	ADP, Bosch, City of Chicago, Crittercism, Expedia, Forbes, MetLife, Otto, and The Weather Channel

Redis

Description	Redis is an open source key value cache and store.
History	Written by Salvatore Sanfilippo and Pieter Noordhuis.
Website	redis.io
Key Contributors	Pivotal, Redis Labs
Commercial Support	Pivotal
Project License	BSD
Primary Programming Language	C (66%)
Lines of Code	121,023
Key Users	Hulu, Microsoft, Pinterest, Redis Labs, Twitter, Viacom

Riak CS

Description	Riak CS is an open source storage system built on top of the Riak key-value store.
History	Riak CS was originally developed by Basho and launched in 2012, with the source subsequently released in 2013.
Website	basho.com/riak-cloud-storage
Key Contributors	Basho
Commercial Support	Basho
Project License	Apache
Primary Programming Language	Erlang (93%)
Lines of Code	29,206
Key Users	Best Buy, Boundary, Bump, Queep, Rovio

Swift	
Description	Swift is a highly available, distributed, eventually consistent object store. It's developed as part of the OpenStack project but can be used independently.
History	Swift was created in 2010 by Rackspace, which contributed the code to create OpenStack Object Storage.
Website	wiki.openstack.org/wiki/Swift
Key Contributors	HP, Intel, Rackspace, Red Hat, SwiftStack
Commercial Support	Swiftstack
Project License	Apache 2.0
Primary Programming Language	Python
Lines of Code	90,739
Key Users	Comcast, Disney, eBay, HP, IBM, Mercado Libre, NTT, Rackspace, Time Warner Cable, Vimeo, Wikipedia

Software-defined Networking, Network Functions Virtualization

OpenContrail	
Description	OpenContrail is an open source software-defined networking project that provides all the necessary components for network virtualization including an SDN controller, virtual router, analytics engine, and published northbound APIs.
History	Juniper Networks released its Contrail code library for open source development in 2013.
Website	opencontrail.org
Key Contributors	CertusNet, Cloudwatt, Codilime, ENovance, IPNett, Nokia, Piston, TCP Cloud, Semihalf Embedded Systems
Commercial Support	Cloudscaling, CloudStack, IBM, Juniper Networks
Project License	Apache 2.0
Primary Programming Language	C++
Lines of Code	382,317
Key Users	Cloud Dynamics, Gencore Systems, Mirantis, Scalr, Ubuntu

OpenDaylight

Description	OpenDaylight is an open source platform for network programmability to enable SDN and NFV. The software components include a fully pluggable controller, interfaces, protocol plug-ins and applications.
History	Founded in 2013 by industry leaders and hosted as a Linux Foundation Collaborative Project, OpenDaylight had two software releases in 2014.
Website	www.opendaylight.org
Key Contributors	Brocade, Cisco, Inocybe, NEC, Noiro Networks, Pantheon, Radware, Red Hat
Commercial Support	ADVA Optical, Brocade, Calient, Ciena, Cisco, Cyan, Dell, Extreme Networks, HP, IBM, Inocybe, Meru, Microsoft, Midokura and Oracle
Project License	EPL-1.0
Primary Programming Language	Java
Lines of Code	1,904,823
Key Users	NA

Open vSwitch

Description	Open vSwitch is an open source virtual switch designed to enable massive network automation while still supporting standard management interfaces in distributed computing.
History	Released as open source in 2009 by Nicira, which was acquired by VMware in 2012.
Website	openvswitch.org
Key Contributors	VA Linux, VMware
Commercial Support	Citrix (XenServer), VMware (NSX)
Project License	Apache 2.0
Primary Programming Language	C
Lines of Code	222,591
Key Users	Apache CloudStack, Citrix, KVM, OpenNebula, openQRM, OpenStack, oVirt, Proxmox VE, VirtualBox

Note: *ONOS (Open Networking Operating System) is an experimental distributed SDN operating system released as open source in December 2014 and hosted by the nonprofit Open Networking Lab (On.Lab). Key Contributors include AT&T, Ciena, Ericsson, Fujitsu, Huawei, Intel, NEC, NSF, and NTT Communications.*

Flannel (formerly Rudder) is an emerging open source SDN project under development by CoreOS that creates an overlay network to allow an IP subnet to be assigned for each virtual machine for use with Kubernetes, regardless of the cloud provider.

The Linux Foundation promotes, protects and standardizes Linux by providing unified resources and services needed for open source to successfully compete with closed platforms.

To learn more about The Linux Foundation or our other initiatives please visit us at www.linuxfoundation.org