CLOUD OPEN SOURCE RESOURCES

_____

The information provided below provides detailed description of some of the open source software used in the Cloud Industry that supports the standards described in IEEE 2301. We do not endorse any of the software listed and they are provided here to give an overview of the industry open source landscape. This material is used for reference purposes only.

Any open source software interested in being listed on this site can submit their request to https://standards.ieee.org/content/ieee-standards/en/about/contact/index.html indicating that they would like to be reviewed for inclusion in the IEEE 2301 open source software listing.

_____

The Cloud ecosystem is dynamic. Implementations emerge out of community groups, industry forums, and open source organizations. These group produce software before a standard is defined. Many of those implementations are open: the code is publically accessible for all to read which means that the APIs are understood, the file formats are well specified, and the configuration parameters are defined. Some of these systems have become de facto industry standards.

In other words, open source and standards look very different, but both are often two sides of the same coin. The common use case model usually defines the standards during the process of creating software products, and the standard is made available to all as it matures. In this manner, the community need is served with more efficiency and less duplication.
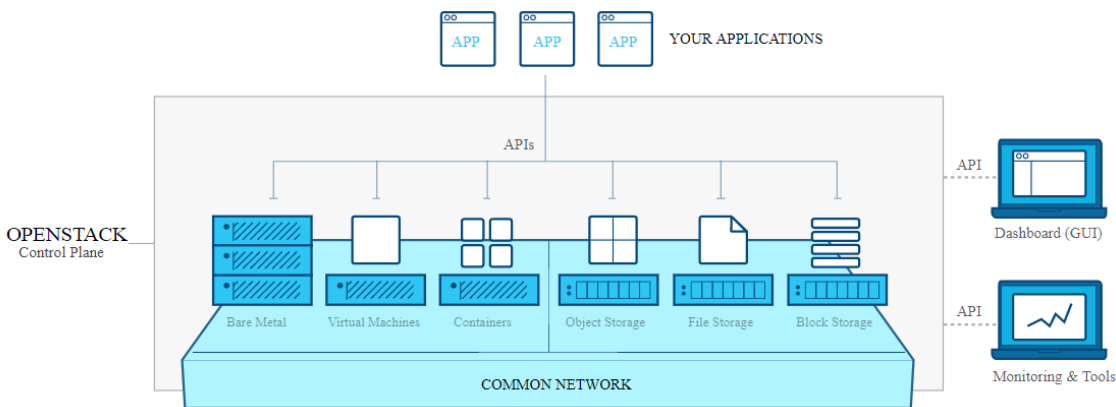
Open source for the cloud includes a large number of software stacks, including virtualization of the infrastructure and containers. Some cloud players use extensively several kinds of open source software to provide services at blistering speed.

1.1 OpenStack

The OpenStack Foundation promotes the global development, distribution and adoption of open infrastructure. OpenStack is one of the open source cloud provisioning Infrastructure as a Software (IaaS). In a data center, compute, storage, and networks are controlled through OpenStack using a dashboard or open APIs.

There are several projects involved in open stack. Nova Compute controls the compute resource such as CPU/memory allocation. Storage, is managed using projects like Swift and Cinder, networks are controlled using Neutron, operating system images are managed using Glance, Keystone is used for security, Ceilometer is used for logging/monitoring, and Heat is used for orchestration. Other projects for containers, big data, key management, DNS, etc. are also part of the large open stack ecosystem. The diagram below shows the basic components of the open stack architecture. More details about open stack can be found at https://www.openstack.org/software/. Conformance to OpenStack's API and formats helps realize inter-operable cloud with data and image portability. As a cloud operating system, it can control a large pool of resources and share them efficiently with programming interfaces.

What is OpenStack?

1.2 Docker

As the world moves from virtualization to containers, there are several container standards that are currently emerging. Docker is one of the container engines. Docker is used to build, ship, and run distributed applications in the cloud using containers by managing applications every step of the way, from build to ship.
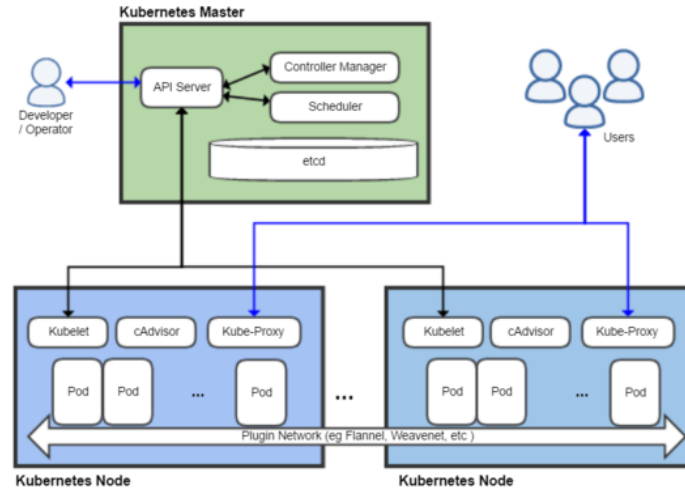
Using containers allows a developer to package an application with all of the parts and ship it all out as one package. Docker uses the Linux Kernel features like namespaces and control groups to create containers on top of an operating system and provides a lightweight environment to run application code. The figure below shows one representation of Docker architecture. More details about Docker can be found here: https://docs.docker.com/engine/docker-overview/

Of particular interest is the distribution interface which is used in the above diagram for interfacing with the registry:

- HTTP API v2: https://github.com/docker/distribution/blob/master/docs/spec/api.md

1.3 Kubernetes

Kubernetes is an open source software stack for automating deployment and scaling and managing containerized applications. Some of the Kubernetes features are horizontal scaling, self-healing, automated rollout and roll back, service discovery, load balancing, batch execution, and storage orchestration. Kubernetes has master-slave architecture which has a control plane to manage the operations and nodes where the actual user applications will run. A typical Kubernetes architecture is shown below. More details can be found here: https://kubernetes.io/

In addition to Kubernetes, Apache Mesos or its variant and Docker Swarm are also used for cloud container orchestration. The decision to choose which orchestration engine is based on the case to case basis depends on the business scenarios.

1.4 Linux Foundation

This foundation claims supports open source ecosystem at large scale, supporting resources and also promoting brands. Under Linux foundation there are several other foundations like Cloud Native Computing Foundation (CNCF), Cloud Foundry Foundation, Deep learning Foundation for AI/ML, and Xen project incubated Unikraft Unikernel Project. In networking space projects like ONOS, ONAP, OpenNFV, are used for telecom segment. Detailed list of Linux foundation project are available here https://www.linuxfoundation.org/projects/. Also under the Linux Foundation the projects such as the Open Cloud Initiative can be found.

1.4.1 Open Container Initiative (OCI)

Also under the Linux Foundation the projects such as the Open Container Initiative can be found. Open Container Initiative (OCI), which is created to address the governance structure in the container world, so that various container providers can work together and create portable containers. There are two specifications in OCI which are runtime specifications for bundle file systems on disks and also image specifications for packing and unpacking images which can run in all container run times. This will help application portability among various providers. This open standard is helping not only the open source community but also the large cloud providers to adopt to the common framework and help users migrate applications seamlessly across the various clouds. See http://opencontainers.org for more information. Also, one can look at the GitHub repository to see more details about the specifications of run time and image:

- Run Time Specification: https://github.com/opencontainers/runtime-spec/blob/master/spec.md

- Image Specification: https://github.com/opencontainers/image-spec/blob/master/spec.md

1.4.2 Cloud Native Computing Foundation (CNCF)

As more and more containers come into the cloud, the Linux Foundation has created an entity called "Cloud Native Computing Foundation" (CNCF) (https://www.cncf.io/) to address the cloud native world. Kubernetes is one of the graduated projects in CNCF. There are few projects which address the standards needed for cloud containers and their portability among various vendors' software stacks. Container Network Interface (CNI) and Container Storage Interface (CSI) –- will address some of those specifications which can be found here:

CNI: https://github.com/containernetworking/cni/blob/master/SPEC.md

CSI: https://github.com/container-storage-interface/spec/blob/master/spec.md

1.5 Cloud Foundry Foundation

Cloud Foundry is one of the software platforms to help build and scale applications in both private and public cloud. As decoupling the application from the infrastructure, the platforms are available to the developers and need to only concentrate on the application development aspects of it. Interoperable in nature cloud foundry may can work with various tools and container frameworks in general. More details on this can be found here: https://www.cloudfoundry.org/

1.6 Kantara Initiative

The Kantara Initiative is an industry consortium and professional trade association dedicated to advancing technical & legal innovation and trust framework operations related to digital identity management and data privacy. Developing initiatives including: Identity Relationship Management, User Managed Access, Identities of Things (IoT device identity), and Minimum Viable Consent Receipt. More details can be found here: https://kantarainitiative.org/

1.7 BlockChain Standards

Several block chain technologies are emerging and one of them is HyperLedger, a cross industry collaborative effort, hosted under Linux foundation. Blockchain helps distributed ledgers and smart contracts and allowing the creation of crypto currencies. More details on this can be found here: https://www.hyperledger.org/. Ethereum is another Blockchain stack and more details on this can be found here: https://www.ethereum.org/foundation

1.8 Apache Foundation

Some of the software solutions like Hadoop, Spark, Flink, Kafka, Cassandra, etc. are hosted under Apache. In the category of cloud there are projects like CloudStack, Mesos, and Ignite which are also hosted under Apache. More details on apache can be found here: http://www.apache.org/

1.9 (Data transfer Project DTP)

The open-source Data Transfer Project, which will enable consumers to transfer their data directly from one service to another. The goal is to import and export data using common APIs among any cloud providers. It is mainly powered by adaptors which handle data models for transferring data with strong privacy and security for standards. More details on this can be found here: https://github.com/google/data-transfer-project

1.10 Open compute project

Hardware related project from open source world which can reimage, scale and be flexible for any IT infrastructure design for data centers or cloud. This project includes server designs, storage building blocks, mounting systems, energy efficiency, etc. More details on this can be found here: https://www.opencompute.org/

1.11 Open 19 Foundation

In similar line of open compute another foundation called Open 19 Foundation, help to optimize data center and edge solutions. This community also may collectively solves the data center problems from component supplies to system integrators. More details on this can be found here: https://www.open19.org/foundation/

1.12 Cloud Security Alliance

This is a very large area to address on various aspects of the cloud security. Cloud Security Alliance promotes the security practices in cloud computing world for secure cloud operations and helps develop standards. More details on this can be found here: https://cloudsecurityalliance.org/

1.13 OpenFog Consortium

The OpenFog consortium is a consortium of high tech industry companies and academic institutions across the world aimed at the standardization and promotion of fog computing in various capacities and fields. Its stated aim is to create a framework for efficient & reliable networks and intelligent endpoints combined with identifiable, secure, and privacy-friendly information flows between clouds, endpoints and services based on open standard technologies. More details on this can be found here: https://www.openfogconsortium.org/

1.14 Open Connectivity Foundation

The Open Connectivity Foundation is an industry group whose stated mission is to develop specification standards, promote a set of interoperability guidelines, and provide a certification program for devices involved in the Internet of Things. More details on this can be found here: https://openconnectivity.org/

1.15 Storage Networking Industry Association

Another organization that develop standards to advance storage and Information Technology is Storage Networking Industry Association (SNIA). Some of the projects under SNIA include Cloud Storage technologies, Data protection, Software Defined Storage, Storage Security, etc. More details on this can be found here: https://www.snia.org/