Hyperledger Bevel Documentation

Release 0.10.0

Hyperledger Bevel

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What is Hyperledger Bevel?

Hyperledger Bevel is an automation framework for delivering consistent production ready DLT networks on cloud based infrastructures, enabling teams to deliver without the need to architect the solution from scratch.

Hyperledger Bevel provides 3 key features:

- Security: Bevel provides a secure environment for DLT development. Bevel has best practices of key management and other security features available by default.
- Scalability: Bevel has a scalable network implementation, a user can easily scale the environment and resources according to his/her needs.
- Acceleration: Bevel will help in providing a blockchain solution that drives acceleration up to deployment providing an oppourtunity to participate in those deliveries and drive more services.

It is an accelerator for all the developers to be able to use a DLT network right away. So with Hyperledger Bevel, users are able to create a DLT environment and know that it is something that will continue to be used as project management.

CHAPTER 1

Introduction

At its core, blockchain is a new type of data system that maintains and records data in a way that allows multiple stakeholders to confidently share access to the same data and information. A blockchain is a type of Distributed Ledger Technology (DLT), meaning it is a data ledger that is shared by multiple entities operating on a distributed network.

This technology operates by recording and storing every transaction across the network in a cryptographically linked block structure that is replicated across network participants. Every time a new data block is created, it is appended to the end of the existing chain formed by all previous transactions, thus creating a chain of blocks called the blockchain. This blockchain format contains records of all transactions and data, starting from the inception of that data structure.

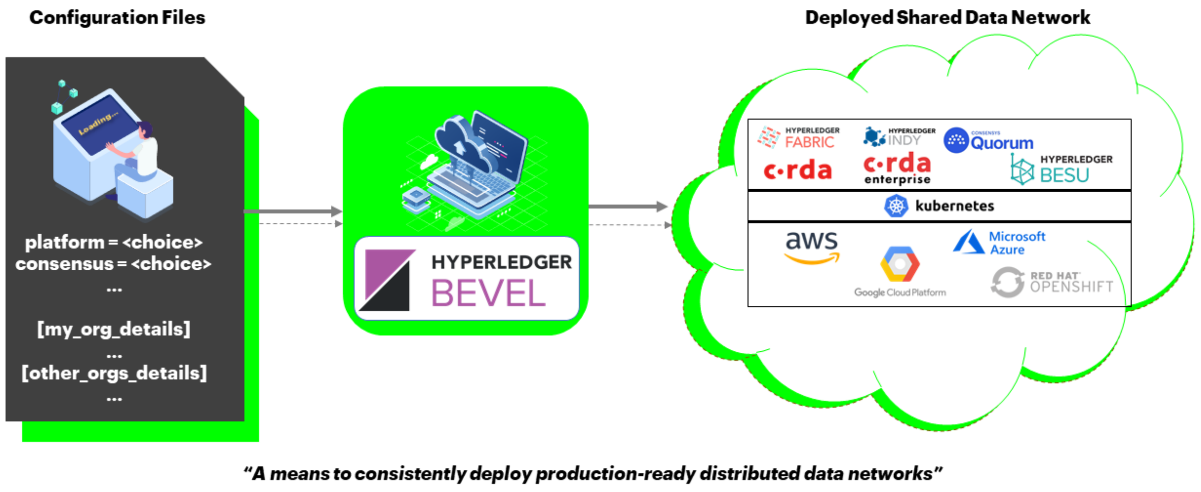
Setting up a new DLT/Blockchain network or maintaining an existing DLT/Blockchain network in a production-scale environment is not straightforward. For the existing DLT/Blockchain platforms, each has its own architecture, which means the same way of setting up one DLT/Blockchain network cannot be applied to others.

Therefore, when blockchain developers are asked to use an unfamiliar DLT/Blockchain platform, it requires significant effort for even experienced technicians to properly setup the DLT/Blockchain network. This is especially true in large-scale production projects across heterogeneous corporate environments which require other key aspects such as security and service availability.

Being aware of the potential difficulty and complexity of getting a production-scale DLT/Blockchain network ready, cloud vendors such as AWS and Azure have provisioned their own managed Blockchain services (aka Blockchain as a Service or BaaS) to help alleviate various pain-points during the process. However, limitations can still be identified in their BaaS solutions, e.g. limited network size, locked to all nodes on a single cloud provider, or limited choice of DLT/Blockchain platform, etc.

1.1 Hyperledger Bevel Platform

The objective of Bevel is to provide a consistent means by which developers can deploy production-ready distributed networks across public and private cloud providers. This enables developers to focus on building business applications quickly, knowing that the framework upon which they are building can be adopted by an enterprise IT production operations organization. Bevel is not intended solely to quickly provision development environments which can be done more efficiently with other projects/scripts. Likewise, Hyperledger Bevel is not intended to replace BaaS offerings in the market, but instead, Bevel is an alternative when existing BaaS offerings do not support a consortium's current set of requirements.



1.2 How is it different from other BaaS?

- Hyperledger Bevel deployment scripts can be reused across cloud providers like AWS, Azure, GCP, DigitalOcean and OpenShift
- Can deploy networks and smart contracts across different DLT/Blockchain platforms
- Supports heterogeneous deployments in a multi-cloud, multi-owner model where each node is completely owned and managed by separate organizations
- Bring Your Own Infrastructure (BYOI) - You provide GIT, Kubernetes cluster(s), and Hashicorp Vault services provisioned to meet your specific requirements and enterprise standards
- No network size limit
- Specifies only the number of organizations and the number of nodes per organization in a *network.yaml file* uniquely designed in Hyperledger Bevel for a new DLT/Blockchain network set-up and its future maintenance
- Provides a sample supply chain application which runs on multiple DLT/Blockchain platforms that can be used as a reference pattern for how to safely abstract application logic from the underlying DLT/Blockchain platform

1.2.1 What next?

We have been actively searching for partners who need and understand the value of Hyperledger Bevel, who share the vision of building and owning well architected solutions. We wish to work together so as to identify the market needs for those partners, to further reduce the barriers in adoption.

CHAPTER 2

Release notes

Release notes have been moved to GitHub here.

CHAPTER 3

Key Concepts

This section introduces the key concepts along with their features used within Hyperledger Bevel. This section works as step one that will pave the way for new users to understand the key conceptual building blocks used in Hyperledger Bevel's architecture design.

3.1 Ansible

Ansible is an automation command line tool that helps IT technicians easily achieve system configuration, software deployment and other complex tasks in orchestration.

Ansible provisions several types of command line tools such as ansible, ansible-playbook and ansible-galaxy, etc. Each serves different scenarios so that a user can choose the most appropriate one or more to be adopted in the chosen scenario(s).

Below gives a simple description of the three mentioned above, and a user can use the link to find more information for each of them.

- ansible: it is the simplistic command line tool that enables a user to quickly achieve simple IT tasks, e.g. list one or more local/remote machines' information.
- ansible-playbook: it is an advanced command line that will run one or more Ansible playbooks (i.e. YAML files that have all the steps configured to achieve one or more complex tasks). Ansible roles are defined to group relavant configurations together that can be resuable in multi playbooks.
- ansible-galaxy: it is an advanced command line that can run existing Ansible roles predefined by other users in the Ansible community.

Hyperledger Bevel extensively uses Ansible playbooks along with roles to spin up a DLT/Blockchain network. For instance, to issue certificates for each node in the DLT/Blockchain network, and then put the certificates to HashiCorp Vaults. In Hyperledger Bevel, there are different Ansible playbooks being designed, and the key player that makes the whole DLT/Blockchain network set-up to happen automatically is the roles defined in the playbooks following a specific order.

3.2 Kubernetes Services

3.2.1 Container

A Docker Container is an ephermeral running process that has all the necessary package dependencies within it. It differentiates from a Docker Image that is a multi-layered file. A container is much more light-weighted, standalone and resuable compared to a Virtual Machine (VM).

3.2.2 Cluster

A cluster of containers is grouped by one or more running containers serving different purposes with their duplicates that can ensure high availability of services. One example of a cluster is Docker Swarm.

3.2.3 Kubernetes

Kubernetes (K8s) is an open-source system for automating deployment, scaling and maintaining containerized applications. Kubernetes provisions more advanced configurations and features to set up a cluster compared to Docker Swarm, which make it a very strong candidate in any production-scale environment.

3.2.4 Managed Kubernetes Services

The open-source K8s services requires technicians to set up an underlying infrastructure and all initial K8s clusters, but the setting-up process is normally time-consuming and error-prone. This is why K8s is well known for its deep learning curves. To alleviate this complex process for users, many Cloud service providers such as AWS, Azure, GCP and DO, have provisioned their own Managed K8s Services.

Hyperledger Bevel leverages Kubernetes' various features for deploying a DLT/Blockchain network along with other required services in one or more K8s clusters. All the current functions have been tested on Amazon K8s Services (AKS) as a managed K8s service, but in theory they should work on a non-managed K8s service as well.

3.2.5 Ambassador

Ambassador is an open-source microservices API gateway designed for K8s.

Hyperledger Bevel uses Ambassador to route traffic amongst multiple K8s clusters. For each K8s cluster, an Ambassador Loadbalancer Service will be created to sit inside it. A user has to manually use a DNS server (e.g. AWS Route53) to map the public IP of the Ambassador Service to a DNS name for each cluster. Optionally, you can configure External-DNS on the cluster and map the routes automatically. Automatic updation of routes via External DNS is supported from Bevel 0.3.0.0 onwards.

A simplistic view of how Ambassador works is as follows:

If a pod in Cluster1 wants to reach a target pod in Cluster2, it will just use the Domain address or IP in Cluster2 and then Cluster2 Ambassador will route the traffic to the target pod in Cluster2.

NOTE: If only one cluster is used in a DLT/Blockchain network, Ambassador may not be needed, but it will still be installed (if chosen).

3.2.6 HAProxy Ingress

HAProxy Ingress is another way of routing traffic from outside your cluster to services within the cluster. This is implemented in Bevel Fabric from Release 0.3.0.0 onwards as we were unable to configure Ambassador to do ssl-passthrough for GRPC.

In Bevel, HAProxy Ingress does the same thing as Ambassador does i.e. it routes traffic amongst multiple K8s clusters. For each K8s cluster, an HAProxy Ingress Loadbalancer Service will be created to sit inside it. A user has to manually use a DNS server (e.g. AWS Route53) to map the public IP of the HAProxy Service to a DNS name for each cluster. Optionally, you can configure External-DNS on the cluster and map the routes automatically. Automatic updation of routes via External DNS is supported from Bevel 0.3.0.0 onwards.

NOTE: If only one cluster is used in a DLT/Blockchain network, HAProxy may not be needed, but it will still be installed (if chosen).

3.3 Helm

Essentially, Helm is a package manager for K8s. Helm Charts are configuration files designed for K8s to help define, install and upgrade complex K8s applications.

Helm brings below features:

1. Predictable deployments.
2. Maintains "Bill of Materials" of all the pods that work together to deliver the application.
3. Keeps (forces) a team to stay synchronised.
4. Strong version control.
5. Easier testing and QA.
6. Rollbacks on an application level, not just a one-off pod level.

Hyperledger Bevel uses Helm Charts for designing and configuring the architecture of each DLT/Blockchain platform for its own network set-up.

3.4 HashiCorp Vault

HashiCorp Vault provisions a secure approach to store and gain secret information such as tokens, passwords and certificates.

Hyperledger Bevel relies on Vaults for managing certificates used in each node of a DLT/Blockchain network during the lifecycle of a deployment, and it is a prerequisite that the Vault is installed and unsealed prior to deployment of a DLT/Blockchain network.

3.4.1 Installation

There are two approaches to installing Vault:

- Using a precompiled binary
- Installing from source

Downloading a precompiled binary is easiest and provides downloads over TLS along with SHA256 sums to verify the binary. Hashicorp also distributes a PGP signature with the SHA256 sums that should be verified.

3.4.2 Securing RPC Communication with TLS Encryption

Securing your cluster with TLS encryption is an important step for production deployments. The recomended tool for vault certificate management is Consul. Hashicorp Consul is a networking tool that provides a fully featured service-mesh control plane, service discovery, configuration, and segmentation.

Consul supports using TLS to verify the authenticity of servers and clients. To enable TLS, Consul requires that all servers have certificates that are signed by a single Certificate Authority (CA). Clients should also have certificates that are authenticated with the same CA.

After generating the necessary client and server certificates, the values.yaml file `tls` field can be populated with the `ca.cert` certificates. Populating this field will enable or disable TLS for vault communication if a value present.

The latest documentation on generating tls material with consul can be found at: [(https://learn.hashicorp.com/consul/security-networking/certificates])

3.5 GitOps

GitOps introduces an approach that can make K8s cluster management easier and also guarantee the latest application delivery is on time.

Hyperledger Bevel uses Weavework's Flux for the implementation of GitOps and executes an Ansible role called *setup/flux* defined in its GitHub repo that will:

- Scan for existing SSH Hosts
- Authorize client machine as per kube.yaml
- Add weavework flux repository in helm local repository
- Install flux

3.6 Hyperledger Bevel's Features

3.6.1 Multi-Cloud service providers support

Hyperledger Bevel's scripts do not stick to any one of the Cloud service provider. On the contrary, they can be used on any Cloud platform as long as all the *prerequisites* are met.

3.6.2 Multi-DLT/Blockchain platforms support

Hyperledger Bevel supports an environment of multi-clusters for the spin-up of a DLT/Blockchain network (e.g. Hyperledger Fabric or R3 Corda). Regardless of unique components (e.g. channels and orderers in Fabric, and Doorman, Notary in Corda) designed in each platform which make the DLT/Blockchain ecosystems become heterogeneous, Hyperledger Bevel does remove this complexity and challenge by leveraging a uniquely-designed *network.yaml* file, which enables the set-up of a DLT/Blockchain network on either platform to be consistent.

3.6.3 No dependency on managed K8s services

Setting up a DLT network does not depend on a managed K8s services, which means non-managed K8s clusters can be used to make a DLT network set-up happen.

3.6.4 One touch/command deployment

A single Ansible playbook called **site.yaml** can spin up an entire DLT network and a substantial amount of time can be reduced which is involved in configuring and managing the network components of a Corda or Fabric DLT network.

3.6.5 Security through Vault

HashiCorp Vault is used to provide identity-based security. When it comes to managing secrets with machines in a multi-cloud environment, the dynamic nature of HashiCorp Vault becomes very useful. Vault enables Hyperledger Bevel to securely store and tightly control access to tokens, passwords, certificates, and encryption keys for protecting machines, applications, and sensitive data.

3.6.6 Sharing a Network.yaml file without disclosing any confidentiality

Hyperledger Bevel allows an organization to use a configured network.yaml file to set up an initial DLT/Blockchain network and a first node in the network, and allows this file to be shared by new organizations that will have to join this DLT/Blockchain network to reuse this network.yaml file, but without revealing any confidential data of the first organization.

CHAPTER 4

Getting Started

4.1 Install and Configure Prerequisites

Follow instructions to *install* and *configure* common prerequisites first. Once you have the prerequisites installed and configured, you are ready to fork the GitHub repository and start using Hyperledger Bevel.

There are two ways in which you can start using Hyperledger Bevel for your DLT deployment.

1. Using the **bevel-build** Docker container as Ansible controller.
2. Using your own machine as Ansible controller.

4.2 Using Docker container

Follow *these instructions* for how to use docker container as Ansible controller.

4.3 Using Own machine

NOTE All the instructions are for an **Ubuntu** machine, but configurations can be changed for other machines. Although it is best to use the Docker container if you do not have an Ubuntu machine.

4.3.1 Install additional Prerequisites

Install *additional prerequisites*.

4.4 Update Configuration File

Once all the prerequisites have been configured, it is time to update Hyperledger Bevel configuration file. Depending on your platform of choice, there can be some differences in the configuration file. Please follow platform specific links below to learn more on updating the configuration file.

- *R3 Corda Configuration File*
- *Hyperledger Fabric Configuration File*
- *Hyperledger Indy Configuration File*
- *Quorum Configuration File*
- *Hyperledger Besu Configuration File*

4.5 Deploy the Network

After the configuration file is updated and saved on the **Ansible Controller**, run the provisioning script to deploy the network using the following command.

```
# go to bevel
cd bevel
# Run the provisioning scripts
ansible-playbook  platforms/shared/configuration/site.yaml -e "@/path/to/network.yaml"
```

For more detailed instructions to set up a network, read *Setting up a DLT/Blockchain network*. For instructions on how to verify or troubleshoot network, read *How to debug a Bevel deployment*

CHAPTER 5

Operations Guide

This section defines the pre-requisites installation and steps for setup of a DLT network. If this is your first time, do refer to Key-Concepts, Getting-Started and Architecture-References before moving ahead.

5.1 Pre-requisites

5.1.1 Install Common Pre-requisites

Following are the common pre-requiste software/client/platforms etc. needed before you can start deploying/operating blockchain networks using Hyperledger Bevel.

Git Repository

GitOps is a *key concept* for Hyperledger Bevel, so a Git repository is needed for Bevel (this can be a GitHub repository as well). Fork or import the Bevel GitHub repo to this Git repository.

The Operator should have a user created on this repo with read-write access to the Git Repository.

NOTE: Install Git Client Version > **2.31.0**

Kubernetes

Hyperledger Bevel deploys the DLT/Blockchain network on Kubernetes clusters; hence, at least one Kubernetes cluster should be available. Bevel recommends one Kubernetes cluster per organization for production-ready projects. Also, a user needs to make sure that the Kubernetes clusters can support the number of pods and persistent volumes that will be created by Bevel.

NOTE: For the current release Bevel has been tested on Amazon EKS with Kubernetes version **1.19**.

Bevel has been tested on Kubernetes >= 1.14 and <= 1.21

Also, install kubectl Client version **v1.19.8**

Please follow Amazon instructions to set-up your required Kubernetes cluster(s). To connect to Kubernetes cluster(s), you will also need kubectl Command Line Interface (CLI). Refer here for installation instructions, although Hyperledger Bevel configuration code (Ansible scripts) installs this automatically.

HashiCorp Vault

In this current release, Hashicorp Vault is mandatory for Hyperledger Bevel as the certificate and key storage solution; hence, at least one Vault server should be available. Bevel recommends one Vault per organization for production-ready projects.

Follow official instructions to deploy Vault in your environment.

NOTE: Recommended approach is to create one Vault deployment on one VM and configure the backend as a cloud storage.

Vault version should be **1.7.1**

Internet Domain

Hyperledger Bevel uses Ambassador or HAProxy Ingress Controller for inter-cluster communication. So, for the Kubernetes services to be available outside the specific cluster, at least one DNS Domain is required. This domain name can then be sub-divided across multiple clusters and the domain-resolution configured for each. Although for production implementations, each organization (and thereby each cluster), must have one domain name.

NOTE: If single cluster is being used for all organizations in a dev/POC environment, then domain name is not needed.

Docker

Hyperledger Bevel provides pre-built docker images which are available on GitHub Repo. If specific changes are needed in the Docker images, then you can build them locally using the Dockerfiles provided. A user needs to install Docker CLI to make sure the environment has the capability of building these Dockerfiles to generate various docker images. Platform specific docker image details are mentioned *here*.

NOTE: Hyperledger Bevel uses minimum Docker version **18.03.0**

You can check the version of Docker you have installed with the following command from a terminal prompt:

```
docker --version
```

For storing private docker images, a private docker registry can be used. Information such as registry url, username, password, etc. can be configured in the configuration file like *Fabric configuration file*.

5.1.2 Additional Prerequisites for own Ansible Controller

NOTE: These are not needed when using **bevel-build** as these comes pre-packaged.

Ansible

Hyperledger Bevel configuration is essentially Ansible scripts, so install Ansible on the machine from which you will deploy the DLT/Blockchain network. This can be a local machine as long as Ansible commands can run on it.

Please note that this machine (also called **Ansible Controller**) should have connectivity to the Kubernetes cluster(s) and the Hashicorp Vault service(s). And it is essential to install the git client on the Ansible Controller.

NOTE: Minimum **Ansible** version should be **2.12.6** with **Python3**

Also, Ansible's k8s module requires the **openshift python package (>= 0.12.0)** and some collections and jq.

```
pip3 install openshift==0.13.1
ansible-galaxy install -r platforms/shared/configuration/requirements.yaml
apt-get install -y jq       #Run equivalent for Mac or Linux
```

NOTE (MacOS): Ansible requires GNU tar. Install it on MacOS through Homebrew `brew install gnu-tar`

Configuring Ansible Inventory file

In Hyperledger Bevel, we connect to Kubernetes cluster through the **Ansible Controller** and do not modify or connect to any other machine directly. Hyperledger Bevel's sample inventory file is located here.

Add the contents of this file in your Ansible host configuration file (typically in file /etc/ansible/hosts).

Read more about Ansible inventory here.

NPM

Hyperledger Bevel provides the feature of automated validation of the configuration file (network.yaml), this is done using ajv (JSON schema validator) cli. The deployment scripts install ajv using npm module which requires npm as prerequisite.

You can install the latest NPM version from offical site.

5.1.3 Configure Common Pre-requisites

- *GitOps Authentication*
- *Vault Initialization and unseal*
- *Docker Images*
- *DNS Update*
- *External DNS*

GitOps Authentication

For synchronizing the Git repo with the cluster, Hyperledger Bevel configures Flux for each cluster. The authentication is via SSH or HTTPS which can be specified in the configuration file `gitops.protocol` section.

For **HTTPS**, just generate a git token and give that read-write access. Keep the token safe and use in the `gitops.password` section of the configuration file.

For **SSH**, run the following command to generate a private-public key pair named **gitops**.

```
ssh-keygen -q -N "" -f ./gitops
```

The above command generates an SSH key-pair: **gitops** (private key) and **gitops.pub** (public key).

Use the path to the private key (**gitops**) in the `gitops.private_key` section of the configuration file.

NOTE: Ensure that the Ansible host has read-access to the private key file (gitops).

And add the public key contents (starts with **ssh-rsa**) as an Access Key (with read-write permissions) in your Github repository by following this guide.

Unseal Hashicorp Vault

The Hashicorp Vault service should be accessible by the ansible controller as well as the kubernetes cluster (proper inbound/outbound rules should be configured). If not initialised and unsealed already, complete the following steps to unseal and access the Vault.

- Install Vault client. Follow the instructions on Install Vault.
- Set the environment Variable **VAULT_ADDR** as the Vault service.

```
export VAULT_ADDR=http://my-vault-server:9000
```

NOTE The port should be accessible from the host where you are running this command from, as well as the Ansible controller and the Kubernetes nodes.

- Now execute the following:

```
vault operator init -key-shares=1 -key-threshold=1
```

It will give following output:

```
Unseal Key 1: << unseal key>>

Initial Root Token: << root token>>
```

Save the root token and unseal key in a secure location. This root token is to be updated in Hyperledger Bevel's network.yaml file before running the Ansible playbook(s) to deploy the DLT/Blockchain network.

- Unseal with the following command:

```
vault operator unseal << unseal-key-from-above >>
```

- Run this command to check if Vault is unsealed:

```
vault status
```

NOTE: It is recommended to use Vault auto-unseal using Cloud KMS for Production Systems. And also, rotate the root token regularly.

Docker Images

Hyperledger Bevel provides pre-built docker images which are available on GitHub Repo. Ensure that the versions/tags you need are available. If not, raise it on our Discord Channel.

For Corda Enterprise, the docker images should be built and put in a private docker registry. Please follow these instructions to build docker images for Corda Enterprise.

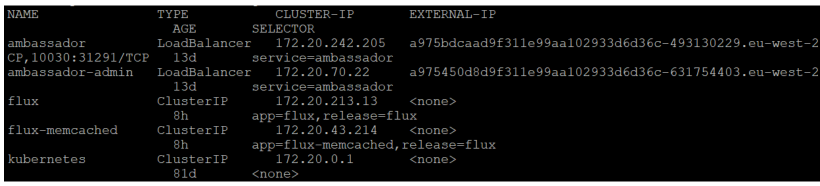
NOTE: Hyperledger Bevel recommends use of private docker registry for production use. The username/password for the docker registry can be provided in a **network.yaml** file so that the Kubernetes cluster can access the registry.

DNS Update

Hyperledger Bevel uses Ambassador or HAProxy Ingress Controller (for Fabric) for inter-cluster communication. Bevel automation deploys both as per the configuration provided in `network.env.proxy` section of the Bevel configuration file, but if you are not using *External DNS*, you will have to manually add DNS entries.

- After Ambassador/HAProxy is deployed on the cluster (manually or using `platforms/shared/configuration/kubernetes-env-setup.yaml` playbook), get the external IP address of the Ambassador/HAProxy service.

  ```
  kubectl get services -o wide
  ```

  The output of the above command will look like this: 

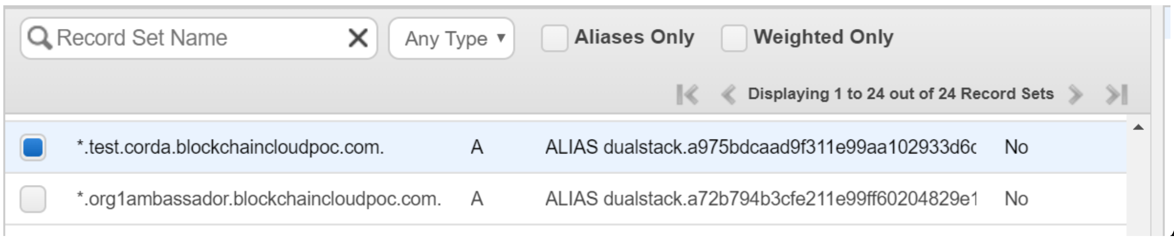
```
NAME                TYPE          CLUSTER-IP       EXTERNAL-IP
                      AGE       SELECTOR
ambassador          LoadBalancer   172.20.242.205   a975bdcaad9f311e99aa102933d6d36c-493130229.eu-west-2
CP,10030:31291/TCP    13d       service=ambassador
ambassador-admin    LoadBalancer   172.20.70.22     a975450d8d9f311e99aa102933d6d36c-631754403.eu-west-2
                      13d       service=ambassador
flux                ClusterIP      172.20.213.13    <none>
                      8h        app=flux,release=flux
flux-memcached      ClusterIP      172.20.43.214    <none>
                      8h        app=flux-memcached,release=flux
kubernetes          ClusterIP      172.20.0.1       <none>
                      81d       <none>
```

  Service Output

- Copy the **EXTERNAL-IP** for **ambassador** service from the output.

NOTE: If Ambassador is configured by the playbook, then this configuration has to be done while the playbook is being executed, otherwise the deployment will fail.

- Configure your subdomain configuration to redirect the external DNS name to this external IP. For example, if you want to configure the external domain suffix as **test.corda.blockchaincloudpoc.com**, then update the DNS mapping to redirect all requests to ***.test.corda.blockchaincloudpoc.com** towards **EXTERNAL-IP** from above as an ALIAS. In AWS Route53, the settings look like below (in Hosted Zones).



☑	*.test.corda.blockchaincloudpoc.com.	A	ALIAS dualstack.a975bdcaad9f311e99aa102933d6c	No
☐	*.org1ambassador.blockchaincloudpoc.com.	A	ALIAS dualstack.a72b794b3cfe211e99ff60204829e1	No

Ambassador DNS Configuration

NOTE: Ambassador for AWS and AWS-baremetal expose Hyperledger Indy nodes via a TCP Network Load Balancer with a fixed IP address. The fixed IP address is used as EIP allocation ID for all steward public IPs found in the network.yaml. The same public IP is specified for all stewards within one organization. All ports used by Indy nodes in the particular organization have to be exposed.

External DNS

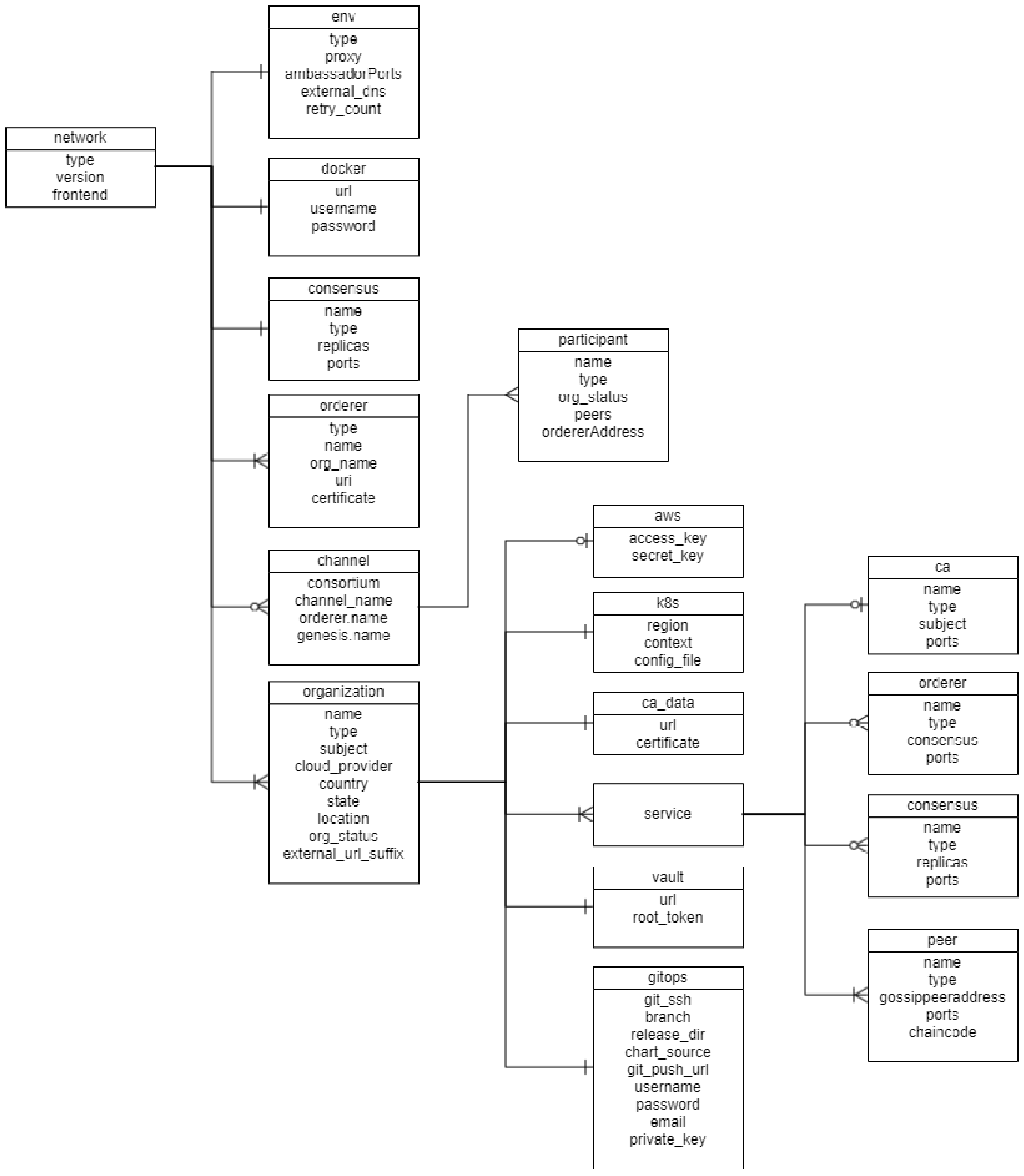
In case you do not want to manually update the route configurations every time you change DNS name, you can use External DNS for automatic updation of DNS routes. Follow the steps as per your cloud provider, and then use `external_dns: enabled` in the `env` section of the Bevel configuration file (network.yaml).

NOTE: Detailed configuration for External DNS setup is not provided here, please refer the link above.

5.2 Fabric operations

5.2.1 Configuration file specification: Hyperledger-Fabric

A network.yaml file is the base configuration file designed in Hyperledger Bevel for setting up a Fabric DLT network. This file contains all the information related to the infrastructure and network specifications. Below shows its structure.



Before setting up a Fabric DLT/Blockchain network, this file needs to be updated with the required specifications.

A sample configuration file is provided in the repo path:`platforms/hyperledger-fabric/configuration/samples/network-fabricv2.yaml`

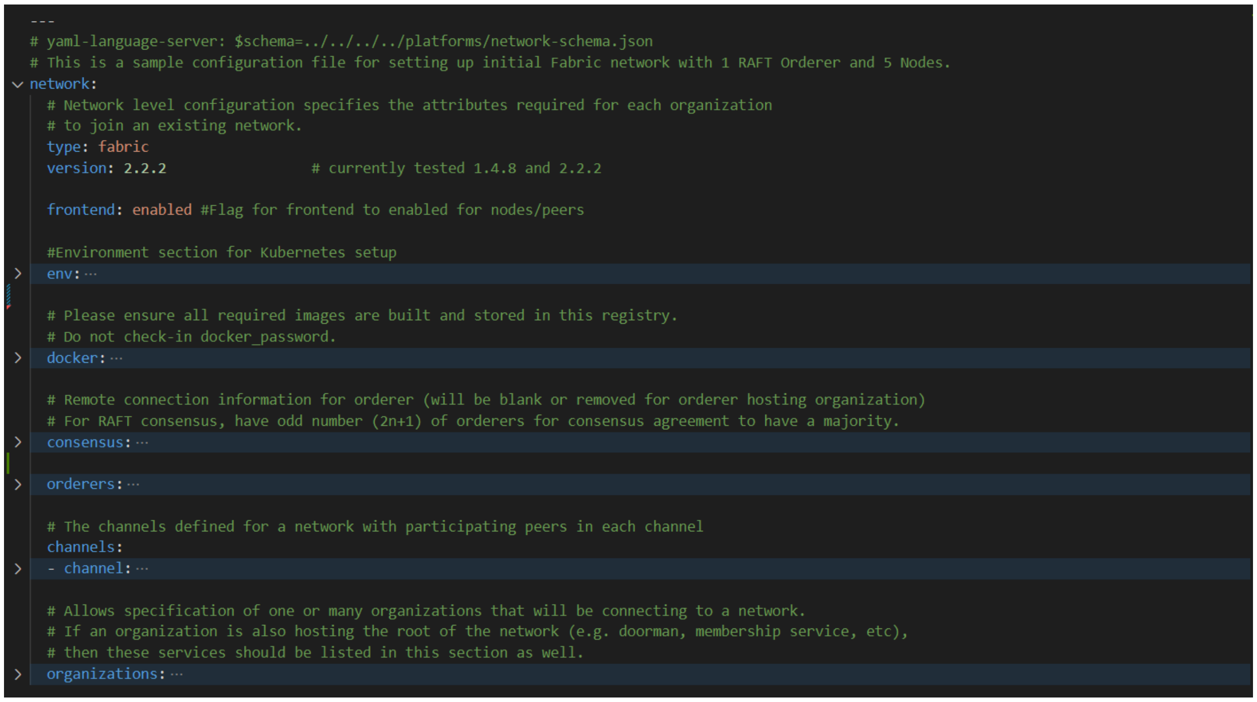
A json-schema definition is provided in `platforms/network-schema.json` to assist with semantic validations and lints. You can use your favorite yaml lint plugin compatible with json-schema specification, like `redhat.vscode-yaml` for VSCode. You need to adjust the directive in template located in the first line based on your actual build directory:

```
# yaml-language-server: $schema=../platforms/network-schema.json
```

The configurations are grouped in the following sections for better understanding.

- type
- version
- docker
- frontend
- env
- consensus
- orderers
- channels
- organizations

Here is the snapshot from the sample configuration file



```
---
# yaml-language-server: $schema=../../../../platforms/network-schema.json
# This is a sample configuration file for setting up initial Fabric network with 1 RAFT Orderer and 5 Nodes.
network:
  # Network level configuration specifies the attributes required for each organization
  # to join an existing network.
  type: fabric
  version: 2.2.2                # currently tested 1.4.8 and 2.2.2

  frontend: enabled #Flag for frontend to enabled for nodes/peers

  #Environment section for Kubernetes setup
  env:…

  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:…

  # Remote connection information for orderer (will be blank or removed for orderer hosting organization)
  # For RAFT consensus, have odd number (2n+1) of orderers for consensus agreement to have a majority.
  consensus:…

  orderers:…

  # The channels defined for a network with participating peers in each channel
  channels:
  - channel:…

  # Allows specification of one or many organizations that will be connecting to a network.
  # If an organization is also hosting the root of the network (e.g. doorman, membership service, etc),
  # then these services should be listed in this section as well.
  organizations:…
```

The sections in the sample configuration file are:

`type` defines the platform choice like corda/fabric, here in the example its Fabric

`version` defines the version of platform being used. The current Fabric version support is 1.4.8, 2.2.0 & 2.2.2

`frontend` is a flag which defines if frontend is enabled for nodes or not. Its value can only be enabled/disabled. This is only applicable if the sample Supplychain App is being installed.

`env` section contains the environment type and additional (other than 8443) Ambassador port configuration. Vaule for proxy field under this section can be 'ambassador' or 'haproxy'

The snapshot of the `env` section with example value is below

```
env:
  type: "env_type"              # tag for the environment. Important to run␣
↪multiple flux on single cluster
```

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```
    proxy: haproxy                  # values can be 'haproxy' or 'none' (for minikube)
    ambassadorPorts:                # Any additional Ambassador ports can be given␣
↪here, this is valid only if proxy='ambassador'
      portRange:              # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021      # For specific ports
    loadBalancerSourceRanges: # (Optional) Default value is '0.0.0.0/0', this value␣
↪can be changed to any other IP adres or list (comma-separated without spaces) of IP␣
↪adresses, this is valid only if proxy='ambassador'
    retry_count: 100                # Retry count for the checks
    external_dns: enabled           # Should be enabled if using external-dns for␣
↪automatic route configuration
```

The fields under `env` section are

`docker` section contains the credentials of the repository where all the required images are built and stored.

The snapshot of the `docker` section with example values is below

```
  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "docker_url"
    username: "docker_username"
    password: "docker_password"
```

The fields under `docker` section are

NOTE: Please follow these instructions to build and store the docker images before running the Ansible playbooks.

`consensus` section contains the consensus service that uses the orderers provided in the following `orderers` section.

```
  consensus:
    name: raft
    type: broker          #This field is not consumed for raft consensus
    replicas: 4           #This field is not consumed for raft consensus
    grpc:
      port: 9092          #This field is not consumed for raft consensus
```

The fields under the each `consensus` are

`orderers` section contains a list of orderers with variables which will expose it for the network.

The snapshot of the `orderers` section with example values is below

```
  # Remote connection information for orderer (will be blank or removed for orderer␣
↪hosting organization)
  orderers:
    - orderer:
      type: orderer
      name: orderer1
```

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```
      org_name: supplychain              #org_name should match one organization␣
↪definition below in organizations: key
      uri: orderer1.org1ambassador.blockchaincloudpoc.com:8443   # Can be external or␣
↪internal URI for orderer which should be reachable by all peers
      certificate: /home/bevel/build/orderer1.crt           # Ensure that the␣
↪directory exists
    - orderer:
      type: orderer
      name: orderer2
      org_name: supplychain              #org_name should match one organization␣
↪definition below in organizations: key
      uri: orderer2.org1ambassador.blockchaincloudpoc.com:8443   # Can be external or␣
↪internal URI for orderer which should be reachable by all peers
      certificate: /home/bevel/build/orderer2.crt           # Ensure that the␣
↪directory exists
    - orderer:
      type: orderer
      name: orderer3
      org_name: supplychain              #org_name should match one organization␣
↪definition below in organizations: key
      uri: orderer3.org1ambassador.blockchaincloudpoc.com:8443   # Can be external or␣
↪internal URI for orderer which should be reachable by all peers
      certificate: /home/bevel/build/orderer3.crt           # Ensure that the␣
↪directory exists
```

The fields under the each `orderer` are

The `channels` sections contains the list of channels mentioning the participating peers of the organizations.

The snapshot of channels section with its fields and sample values is below

```
    # The channels defined for a network with participating peers in each channel
  channels:
  - channel:
    consortium: SupplyChainConsortium
    channel_name: AllChannel
    chaincodes:
      - "chaincode_name"
    orderers:
      - supplychain
    participants:
    - organization:
      name: carrier
      type: creator       # creator organization will create the channel and␣
↪instantiate chaincode, in addition to joining the channel and install chaincode
      org_status: new
      peers:
      - peer:
        name: peer0
        gossipAddress: peer0.carrier-net.org3ambassador.blockchaincloudpoc.com:8443
↪# External or internal URI of the gossip peer
        peerAddress: peer0.carrier-net.org3ambassador.blockchaincloudpoc.com:8443 #␣
↪External URI of the peer
      ordererAddress: orderer1.org1ambassador.blockchaincloudpoc.com:8443
↪# External or internal URI of the orderer
    - organization:
      name: store
```

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```
      type: joiner        # joiner organization will only join the channel and␣
↪install chaincode
      org_status: new
      peers:
      - peer:
        name: peer0
        gossipAddress: peer0.store-net.org4ambassador.blockchaincloudpoc.com:8443
        peerAddress: peer0.store-net.org4ambassador.blockchaincloudpoc.com:8443 #␣
↪External URI of the peer
      ordererAddress: orderer1.org1ambassador.blockchaincloudpoc.com:8443
    - organization:
      name: warehouse
      type: joiner
      org_status: new
      peers:
      - peer:
        name: peer0
        gossipAddress: peer0.warehouse-net.org5ambassador.blockchaincloudpoc.com:8443
        peerAddress: peer0.warehouse-net.org5ambassador.blockchaincloudpoc.com:8443 #␣
↪External URI of the peer
      ordererAddress: orderer1.org1ambassador.blockchaincloudpoc.com:8443
    - organization:
      name: manufacturer
      type: joiner
      org_status: new
      peers:
      - peer:
        name: peer0
        gossipAddress: peer0.manufacturer-net.org2ambassador.blockchaincloudpoc.
↪com:8443
        peerAddress: peer0.manufacturer-net.org2ambassador.blockchaincloudpoc.
↪com:8443 # External URI of the peer
      ordererAddress: orderer1.org1ambassador.blockchaincloudpoc.com:8443
    endorsers:
      # Only one peer per org required for endorsement
    - organization:
      name: carrier
      peers:
      - peer:
        name: peer0
        corepeerAddress: peer0.carrier-net.org3ambassador.blockchaincloudpoc.com:8443
        certificate: "/path/ca.crt" # certificate path for peer
    - organization:
      name: warehouse
      peers:
      - peer:
        name: peer0
        corepeerAddress: peer0.warehouse-net.org5ambassador.blockchaincloudpoc.
↪com:8443
        certificate: "/path/ca.crt" # certificate path for peer
    - organization:
      name: manufacturer
      peers:
      - peer:
        name: peer0
        corepeerAddress: peer0.manufacturer-net.org2ambassador.blockchaincloudpoc.
↪com:8443
```

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```
        certificate: "/path/ca.crt" # certificate path for peer
    - organization:
      name: store
      peers:
      - peer:
        name: peer0
        corepeerAddress: peer0.store-net.org4ambassador.blockchaincloudpoc.com:8443
        certificate: "/path/ca.crt" # certificate path for peer
    genesis:
      name: OrdererGenesis
```

The fields under the `channel` are

Each `organization` field under `participants` field of the channel contains the following fields

Each `organization` field under `endorsers` field of the channel contains the following fields

The `organizations` section contains the specifications of each organization.

In the sample configuration example, we have five organization under the `organizations` section

The snapshot of an organization field with sample values is below

```
  organizations:
    # Specification for the 1st organization. Each organization maps to a VPC and a␣
↪separate k8s cluster
    - organization:
      name: supplychain
      country: UK
      state: London
      location: London
      subject: "O=Orderer,L=51.50/-0.13/London,C=GB"
      type: orderer
      external_url_suffix: org1ambassador.blockchaincloudpoc.com
      org_status: new
      ca_data:
        url: ca.supplychain-net:7054
        certificate: file/server.crt        # This has not been implemented
      cloud_provider: aws    # Options: aws, azure, gcp, digitalocean, minikube
```

Each `organization` under the `organizations` section has the following fields.

For the aws and k8s field the snapshot with sample values is below

```
      aws:
        access_key: "<aws_access_key>"    # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "<aws_secret>"        # AWS Secret key, only used when cloud_
↪provider=aws

      # Kubernetes cluster deployment variables.
      k8s:
        region: "<k8s_region>"
        context: "<cluster_context>"
        config_file: "<path_to_k8s_config_file>"
```

The `aws` field under each organization contains: (This will be ignored if cloud_provider is not 'aws')

The `k8s` field under each organization contains

For gitops fields the snapshot from the sample configuration file with the example values is below

```
      # Git Repo details which will be used by GitOps/Flux.
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "https://github.com/<username>/bevel.git" # Gitops htpps or ssh url␣
↪for flux value files
        branch: "<branch_name>"                                                    #␣
↪Git branch where release is being made
        release_dir: "platforms/hyperledger-fabric/releases/dev" # Relative Path in␣
↪the Git repo for flux sync per environment.
        chart_source: "platforms/hyperledger-fabric/charts"      # Relative Path␣
↪where the Helm charts are stored in Git repo
        git_repo: "github.com/<username>/bevel.git" # without https://
        username: "<username>"          # Git Service user who has rights to check-in␣
↪in all branches
        password: "<password>"          # Git Server user password/personal token␣
↪(Optional for ssh; Required for https)
        email: "<git_email>"              # Email to use in git config
        private_key: "<path to gitops private key>" # Path to private key (Optional␣
↪for https; Required for ssh)
```

The gitops field under each organization contains

The services field for each organization under `organizations` section of Fabric contains list of `services` which could be ca/orderers/consensus/peers based on if the type of organization.

Each organization will have a CA service under the service field. The snapshot of CA service with example values is below

```
      # Services maps to the pods that will be deployed on the k8s cluster
      # This sample is an orderer service and includes a zk-kafka consensus
      services:
        ca:
          name: ca
          subject: "/C=GB/ST=London/L=London/O=Orderer/CN=ca.supplychain-net"
          type: ca
          grpc:
            port: 7054
```

The fields under `ca` service are

Each organization with type as peer will have a peers service. The snapshot of peers service with example values is below

```
        peers:
        - peer:
          name: peer0
          type: anchor    # This can be anchor/nonanchor. Atleast one peer should be␣
↪anchor peer.
          gossippeeraddress: peer0.manufacturer-net:7051 # Internal Address of the␣
↪other peer in same Org for gossip, same peer if there is only one peer
          peerAddress: peer0.carrier-net.org3ambassador.blockchaincloudpoc.com:8443 #␣
↪External URI of the peer
          cli: disabled      # Creates a peer cli pod depending upon the (enabled/
↪disabled) tag.
          grpc:
            port: 7051
          events:
```

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```
          port: 7053
        couchdb:
          port: 5984
        restserver:           # This is for the rest-api server
          targetPort: 20001
          port: 20001
        expressapi:           # This is for the express api server
          targetPort: 3000
          port: 3000
        chaincodes:
          - name: "chaincode_name" #This has to be replaced with the name of the␣
↪chaincode
            version: "chaincode_version" #This has to be replaced with the version␣
↪of the chaincode
            maindirectory: "chaincode_main"  #The main directory where chaincode is␣
↪needed to be placed
            repository:
              username: "git_username"          # Git Service user who has rights␣
↪to check-in in all branches
              password: "git_password"
              url: "github.com/hyperledger/bevel.git"
              branch: develop
              path: "chaincode_src"   #The path to the chaincode
            arguments: 'chaincode_args' #Arguments to be passed along with the␣
↪chaincode parameters
            endorsements: "" #Endorsements (if any) provided along with the␣
↪chaincode
```

The fields under `peer` service are

The chaincodes section contains the list of chaincode for the peer, the fields under each chaincode are below

The organization with orderer type will have concensus service. The snapshot of consensus service with example values is below

```
      consensus:
        name: raft
        type: broker        #This field is not consumed for raft consensus
        replicas: 4         #This field is not consumed for raft consensus
        grpc:
          port: 9092        #This field is not consumed for raft consensus
```

The fields under `consensus` service are

The organization with orderer type will have orderers service. The snapshot of orderers service with example values is below

```
      orderers:
      # This sample has multiple orderers as an example.
      # You can use a single orderer for most production implementations.
      - orderer:
        name: orderer1
        type: orderer
        consensus: raft
        grpc:
          port: 7050
      - orderer:
```

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```
          name: orderer2
          type: orderer
          consensus: raft
          grpc:
            port: 7050
        - orderer:
          name: orderer3
          type: orderer
          consensus: raft
          grpc:
            port: 7050
```

The fields under `orderer` service are

\ ** feature is in future scope

5.2.2 Upgrading Hyperledger Fabric version

- *Pre-requisites*
- *Modifying image versions*

Pre-requisites

Hyperledger Fabric image versions, which are compatible with the target fabric version need to be known.

For example, for Fabric v1.4.8, these are the image tags of the supporting docker images

---

NOTE: This change only upgrades the docker images, any other configuration changes is not covered by this guide. Please refer to Fabric documentation for any specific configuration changes.

Modifying image versions

The network.yaml here should be updated with the required version tag under `network.version` for upgrading the base images of CA, orderer and peer. For example:

```
network:
  version: 1.4.8
```

2 files need to be edited in order to support version change for kafka, zookeeper and couchDB

Executing Ansible playbook

The playbook site.yaml (ReadMe) can be run after the configuration file (for example: network.yaml for Fabric) has been updated.

```
ansible-playbook platforms/shared/configuration/site.yaml --extra-vars "@path-to-
↪network.yaml"
```

Verify network deployment

For instructions on how to verify or troubleshoot network, read *How to debug a Bevel deployment*

5.2.3 Adding a new organization in Hyperledger Fabric

- *Prerequisites*
- *Modifying configuration file*
- *Running playbook to deploy Hyperledger Fabric network*

Prerequisites

To add a new organization a fully configured Fabric network must be present already, i.e. a Fabric network which has Orderers, Peers, Channels (with all Peers already in the channels). The corresponding crypto materials should also be present in their respective Hashicorp Vault.

NOTE: Addition of a new organization has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

Modifying Configuration File

Refer this guide for details on editing the configuration file.

While modifying the configuration file(`network.yaml`) for adding new organization, all the existing organizations should have `org_status` tag as `existing` and the new organization should have `org_status` tag as `new` under `network.channels` e.g.

```
network:
  channels:
  - channel:
    ..
    ..
    participants:
    - organization:
      ..
      ..
      org_status: new  # new for new organization(s)
    - organization:
      ..
      ..
      org_status: existing  # existing for old organization(s)
```

and under `network.organizations` as

```
network:
  organizations:
    - organization:
      ..
      ..
```

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```
      org_status: new  # new for new organization(s)
    - organization:
      ..
      ..
      org_status: existing  # existing for old organization(s)
```

The `network.yaml` file should contain the specific `network.organization` details along with the orderer information.

For reference, see `network-fabric-add-organization.yaml` file here.

Run playbook

The add-new-organization.yaml playbook is used to add a new organization to the existing network. This can be done using the following command

```
ansible-playbook platforms/shared/configuration/add-new-organization.yaml --extra-
↪vars "@path-to-network.yaml"
```

NOTE: Make sure that the `org_status` label was set as `new` when the network is deployed for the first time. If you have additional applications, please deploy them as well.

5.2.4 Adding a new Orderer organization in Hyperledger Fabric

- *Prerequisites*
- *Modifying configuration file*
- *Running playbook to deploy Hyperledger Fabric network*

Prerequisites

To add a new Orderer organization, a fully configured Fabric network must be present already setup, i.e. a Fabric network which has Orderers, Peers, Channels (with all Peers already in the channels). The corresponding crypto materials should also be present in their respective Hashicorp Vault.

NOTE: Addition of a new Orderer organization has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team. Addition of new Orderer organization only works with Fabric 2.2.2 and RAFT Service.

Modifying Configuration File

Refer this guide for details on editing the configuration file.

While modifying the configuration file(`network.yaml`) for adding new orderer organization, all the existing organizations should have `org_status` tag as `existing` and the new organization should have `org_status` tag as `new` under `network.channels` e.g.

```
network:
  channels:
  - channel:
    ..
    ..
    participants:
    - organization:
      ..
      ..
      org_status: new  # new for new organization(s)
    - organization:
      ..
      ..
      org_status: existing  # existing for old organization(s)
```

and under `network.organizations` as

```
network:
  organizations:
    - organization:
      ..
      ..
      org_status: new  # new for new organization(s)
    - organization:
      ..
      ..
      org_status: existing  # existing for old organization(s)
```

The `network.yaml` file should contain the specific `network.organization` details along with the orderer information.

For reference, see `network-fabric-add-ordererorg.yaml` file here.

Run playbook

The add-orderer-organization.yaml playbook is used to add a new Orderer organization to the existing network. This can be done using the following command

```
ansible-playbook platforms/hyperledger-fabric/configuration/add-orderer-organization.
↪yaml --extra-vars "@path-to-network.yaml"
```

NOTE: Make sure that the `org_status` label was set as `new` when the network is deployed for the first time. If you have additional applications, please deploy them as well.

5.2.5 Adding a new channel in Hyperledger Fabric

- *Prerequisites*
- *Modifying configuration file*
- *Running playbook to deploy Hyperledger Fabric network*

Prerequisites

To add a new channel a fully configured Fabric network must be present already, i.e. a Fabric network which has Orderers, Peers, Channels (with all Peers already in the channels). The corresponding crypto materials should also be present in their respective Hashicorp Vault.

NOTE: Do not try to add a new organization as a part of this operation. Use only existing organization for new channel addition.

Modifying Configuration File

Refer this guide for details on editing the configuration file.

While modifying the configuration file(`network.yaml`) for adding new channel, all the existing channel should have `channel_status` tag as `existing` and the new channel should have `channel_status` tag as `new` under `network.channels` e.g.

```
network:
  channels:
  - channel:
    channel_status: existing
    ..
    ..
    participants:
    - organization:
      ..
      ..
    - organization:
      ..
      ..
  - channel:
    channel_status: new
    ..
    ..
    participants:
    - organization:
      ..
      ..
    - organization:
      ..
      ..
```

The `network.yaml` file should contain the specific `network.organization` details along with the orderer information.

For reference, see `network-fabric-add-channel.yaml` file here.

Run playbook

The add-new-channel.yaml playbook is used to add a new channel to the existing network. This can be done using the following command

```
ansible-playbook platforms/hyperledger-fabric/configuration/add-new-channel.yaml --
↪extra-vars "@path-to-network.yaml"
```

NOTE: Make sure that the `channel_status` label was set as `new` when the network is deployed for the first time. If you have additional applications, please deploy them as well.

5.2.6 Removing an organization in Hyperledger Fabric

- *Prerequisites*
- *Modifying Configuration File*
- *Run playbook*

Prerequisites

To remove an organization a fully configured Fabric network must be present already, i.e. a Fabric network which has Orderers, Peers, Channels (with all Peers already in the channels). The corresponding crypto materials should also be present in their respective Hashicorp Vault.

NOTE: Removing an organization has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

Modifying Configuration File

Refer this guide for details on editing the configuration file.

While modifying the configuration file(`network.yaml`) for removing an organization, all the existing organizations should have `org_status` tag as `existing` and to be deleted organization should have `org_status` tag as `delete` under `network.channels` e.g.

```
network:
  channels:
  - channel:
    ..
    ..
    participants:
    - organization:
      ..
      ..
      org_status: delete   # delete for to be deleted organization(s)
    - organization:
      ..
      ..
      org_status: existing   # existing for old organization(s)
```

and under `network.organizations` as

```
network:
  organizations:
    - organization:
      ..
      ..
      org_status: delete  # delete for to be deleted organization(s)
    - organization:
      ..
      ..
      org_status: existing  # existing for old organization(s)
```

The `network.yaml` file should contain the specific `network.organization` details along with the orderer information.

For reference, see `network-fabric-remove-organization.yaml` file here.

Run playbook

The remove-organization.yaml playbook is used to remove organization(s) from the existing network. This can be done using the following command

```
ansible-playbook platforms/hyperledger-fabric/configuration/remove-organization.yaml -
↪-extra-vars "@path-to-network.yaml"
```

NOTE: Make sure that the `org_status` label was set as `new` when the network is deployed for the first time. If you have additional applications, please deploy them as well.

5.2.7 Adding a new peer to existing organization in Hyperledger Fabric

- *Prerequisites*
- *Modifying Configuration File*
- *Run playbook*
- *Chaincode Installation*

Prerequisites

To add a new peer a fully configured Fabric network must be present already, i.e. a Fabric network which has Orderers, Peers, Channels (with all Peers already in the channels) and the organization to which the peer is being added. The corresponding crypto materials should also be present in their respective Hashicorp Vault.

NOTE: Addition of a new peer has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

Modifying Configuration File

A Sample configuration file for adding new peer is available here. Please go through this file and all the comments there and edit accordingly.

For generic instructions on the Fabric configuration file, refer this guide.

While modifying the configuration file(`network.yaml`) for adding new peer, all the existing peers should have `peerstatus` tag as `existing` and the new peers should have `peerstatus` tag as `new` under `network.channels` e.g.

```
network:
  channels:
  - channel:
    ..
    ..
    participants:
    - organization:
      peers:
      - peer:
        ..
        ..
        peerstatus: new  # new for new peers(s)
        gossipAddress: peer0.xxxx.com # gossip Address must be one existing peer
      - peer:
        ..
        ..
        peerstatus: existing  # existing for existing peers(s)
```

and under `network.organizations` as

```
network:
  organizations:
    - organization:
      org_status: existing  # org_status must be existing when adding peer
      ..
      ..
      services:
        peers:
        - peer:
          ..
          ..
          peerstatus: new   # new for new peers(s)
          gossipAddress: peer0.xxxx.com # gossip Address must be one existing peer
        - peer:
          ..
          ..
          peerstatus: existing   # existing for existing peers(s)
```

The `network.yaml` file should contain the specific `network.organization` details. Orderer information is needed if you are going to install/upgrade the existing chaincodes, otherwise it is not needed. And the `org_status` must be `existing` when adding peer.

Ensure the following is considered when adding the new peer on a different cluster:

- The CA server is accessible publicly or at least from the new cluster.
- The CA server public certificate is stored in a local path and that path provided in network.yaml.
- There is a single Hashicorp Vault and both clusters (as well as ansible controller) can access it.

- Admin User certs have been already generated and store in Vault (this is taken care of by deploy-network.yaml playbook if you are using Bevel to setup the network).
- The `network.env.type` is different for different clusters.
- The GitOps release directory `gitops.release_dir` is different for different clusters.

Run playbook

The add-peer.yaml playbook is used to add a new peer to an existing organization in the existing network. This can be done using the following command

```
ansible-playbook platforms/hyperledger-fabric/configuration/add-peer.yaml --extra-
↪vars "@path-to-network.yaml"
```

NOTE: The `peerstatus` is not required when the network is deployed for the first time but is mandatory for addition of new peer. If you have additional applications, please deploy them as well.

Chaincode Installation

Use the same network.yaml if you need to install chaincode on the new peers.

NOTE: With Fabric 2.2 chaincode lifecyle, re-installing chaincode on new peer is not needed as when the blocks are synced, the new peer will have access to already committed chaincode. If still needed, you can upgrade the version of the chaincode and install on all peers.

Refer this guide for details on installing chaincode.

5.2.8 Adding a new RAFT orderer to existing Orderer organization in Hyperledger Fabric

- *Prerequisites*
- *Modifying Configuration File*
- *Run playbook*
- *Chaincode Installation*

Prerequisites

To add a new Orderer node, a fully configured Fabric network must be present already, i.e. a Fabric network which has Orderers, Peers, Channels (with all Peers already in the channels) and the organization to which the peer is being added. The corresponding crypto materials should also be present in their respective Hashicorp Vault.

NOTE: Addition of a new Orderer node has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team. This works only for RAFT Orderer.

Modifying Configuration File

A Sample configuration file for adding new orderer is available here. Please go through this file and all the comments there and edit accordingly.

For generic instructions on the Fabric configuration file, refer this guide.

While modifying the configuration file(`network.yaml`) for adding new peer, all the existing orderers should have `status` tag as `existing` and the new orderers should have `status` tag as `new` under `network.organizations` as

```
network:
  organizations:
    - organization:
      org_status: existing  # org_status must be existing when adding peer
      ..
      ..
      services:
        orderers:
        - orderer:
          ..
          ..
          status: new   # new for new peers(s)
        - orderer:
          ..
          ..
          status: existing   # existing for existing peers(s)
```

The `network.yaml` file should contain the specific `network.organization` details.

Ensure the following is considered when adding the new orderer on a different cluster:

- The CA server is accessible publicly or at least from the new cluster.
- The CA server public certificate is stored in a local path and that path provided in network.yaml.
- There is a single Hashicorp Vault and both clusters (as well as ansible controller) can access it.
- Admin User certs have been already generated and store in Vault (this is taken care of by deploy-network.yaml playbook if you are using Bevel to setup the network).
- The `network.env.type` is different for different clusters.
- The GitOps release directory `gitops.release_dir` is different for different clusters.

Run playbook

The add-orderer.yaml playbook is used to add a new peer to an existing organization in the existing network. This can be done using the following command

```
ansible-playbook platforms/hyperledger-fabric/configuration/add-orderer.yaml --extra-
↪vars "@path-to-network.yaml"
```

NOTE: The `orderer.status` is not required when the network is deployed for the first time but is mandatory for addition of new orderer.

5.2.9 Installing and instantiating chaincode in Bevel deployed Hyperledger Fabric Network

Pre-requisites

Hyperledger Fabric network deployed and network.yaml configuration file already set.

Modifying configuration file

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organizations.services.peers.chaincodes` section, which is consumed when the chaincode-ops playbook is run

For reference, following snippet shows that section of `network.yaml`

```
---
network:
  ..
  ..
  organizations:
    - organization:
      name: manufacturer
      ..
      ..
      services:
        peers:
        - peer:
          name: peer0
          ..
          chaincodes:
            - name: "chaincode_name" #This has to be replaced with the name of the␣
↪chaincode
              version: "chaincode_version" # This has to be different than the␣
↪current version
              maindirectory: "chaincode_main"  #The main directory where chaincode is␣
↪needed to be placed
              repository:
                username: "git_username"          # Git Service user who has rights␣
↪to check-in in all branches
                password: "git_password"
                url: "github.com/hyperledger/bevel.git"
                branch: develop
                path: "chaincode_src"   #The path to the chaincode
              arguments: 'chaincode_args' #Arguments to be passed along with the␣
↪chaincode parameters
              endorsements: "" #Endorsements (if any) provided along with the␣
↪chaincode
```

Chaincode Operations in Bevel for the deployed Hyperledger Fabric network

The playbook chaincode-ops.yaml is used to install and instantiate chaincode for the existing fabric network. For Fabric v2.2 multiple operations such as approve, commit and invoke the chaincode are available in the same playbook. This can be done by using the following command

```
  ansible-playbook platforms/hyperledger-fabric/configuration/chaincode-ops.yaml --
↪extra-vars "@path-to-network.yaml"
```

NOTE: The same process is executed for installing and instantiating multiple chaincodes

5.2.10 Upgrading chaincode in Hyperledger Fabric

Pre-requisites

Hyperledger Fabric network deployed, network.yaml configuration file already set and chaincode is installed and instantiated or packaged, approved and commited in case of Fabric version 2.2.

Modifying configuration file

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organizations.services.peers.chaincodes[*].arguments`, `network.organizations.services.peers.chaincodes[*].version` and `network.organizations.services.peers.chaincodes[*].name` variables which are used as arguments while upgrading the chaincode.

For reference, following snippet shows that section of `network.yaml`

```
---
network:
  ..
  ..
  organizations:
    - organization:
      name: manufacturer
      ..
      ..
      services:
        peers:
        - peer:
          name: peer0
          ..
          chaincodes:
```

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```
          - name: "chaincode_name" #This has to be replaced with the name of the␣
↪chaincode
            version: "chaincode_version" # This has to be greater than the current␣
↪version, should be an integer.
            maindirectory: "chaincode_main"  #The main directory where chaincode is␣
↪needed to be placed
            lang: "java" # The chaincode language, optional field with default␣
↪vaule of 'go'.
            repository:
              username: "git_username"          # Git Service user who has rights␣
↪to check-in in all branches
              password: "git_password"
              url: "github.com/hyperledger/bevel.git"
              branch: develop
              path: "chaincode_src"   #The path to the chaincode
            arguments: 'chaincode_args' #Arguments to be passed along with the␣
↪chaincode parameters
            endorsements: "" #Endorsements (if any) provided along with the␣
↪chaincode
```

Run playbook for Fabric version 1.4.x

The playbook chaincode-upgrade.yaml is used to upgrade chaincode to a new version in the existing fabric network with version 1.4.x. This can be done by using the following command

```
   ansible-playbook platforms/hyperledger-fabric/configuration/chaincode-upgrade.
↪yaml --extra-vars "@path-to-network.yaml"
```

Run playbook for Fabric version 2.2.x

The playbook chaincode-ops.yaml is used to upgrade chaincode to a new version in the existing fabric network with version 2.2.x. This can be done by using the following command

```
   ansible-playbook platforms/hyperledger-fabric/configuration/chaincode-ops.yaml --
↪extra-vars "@path-to-network.yaml" -e "add_new_org='false'"
```

NOTE: The Chaincode should be upgraded for all participants of the channel.

5.2.11 Deploying Fabric Operations Console

- *Prerequisites*
- *Modifying Configuration File*
- *Run playbook*

Prerequisites

The Fabric Operations Console can be deployed along with the Fabric Network. You can then manually add peers, orderers, CA to the console by importing appropriate JSON files.

The Helm Chart for Fabric Operations Console is available here.

If you want to create the JSON files automatically by using our ansible playbook, the CA server endpoint should be accessible publicly and that endpoint details added in `organization.ca_data.url`.

NOTE: The Fabric Operations Console has only been tested with `operations.tls.enabled = false` for Fabric Peers, Orderers and CAs.

Modifying Configuration File

A Sample configuration file for deploying Operations Console is available here. Main change being addition of a new key `organization.fabric_console` which when `enabled` will deploy the operations console for the organization.

For generic instructions on the Fabric configuration file, refer this guide.

Run playbook

The deploy-fabric-console.yaml playbook should be used to automatically generate the JSON files and deploy the console. This can be done using the following command

```
ansible-playbook platforms/hyperledger-fabric/configuration/deploy-fabric-console.
↪yaml --extra-vars "@/path/to/network.yaml"
```

This will deploy the console which will be available over your proxy at **https://<org_name>console.<org_namespace>.<org_external_url_suffix>**

The JSON files will be available in `<project_dir>/build/assets` folder. You can import individual files on respective organization console as well as use bulk import for uploading the zip file `<project_dir>/build/console_assets.zip`

Refer this guide for details on operating the Console.

5.2.12 Refresh certificates in Hyperledger Fabric

- *Prerequisites*
- *Run playbook*

Prerequisites

To refresh certificates a fully configured Fabric network must be present already, i.e. a Fabric network which has Orderers, Peers, Channels (with all Peers already in the channels). The corresponding crypto materials should also be present in their respective Hashicorp Vault.

NOTE:The process of refreshing certificates has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team. The process must be carried out before the expiration of the certificates

---

Run playbook

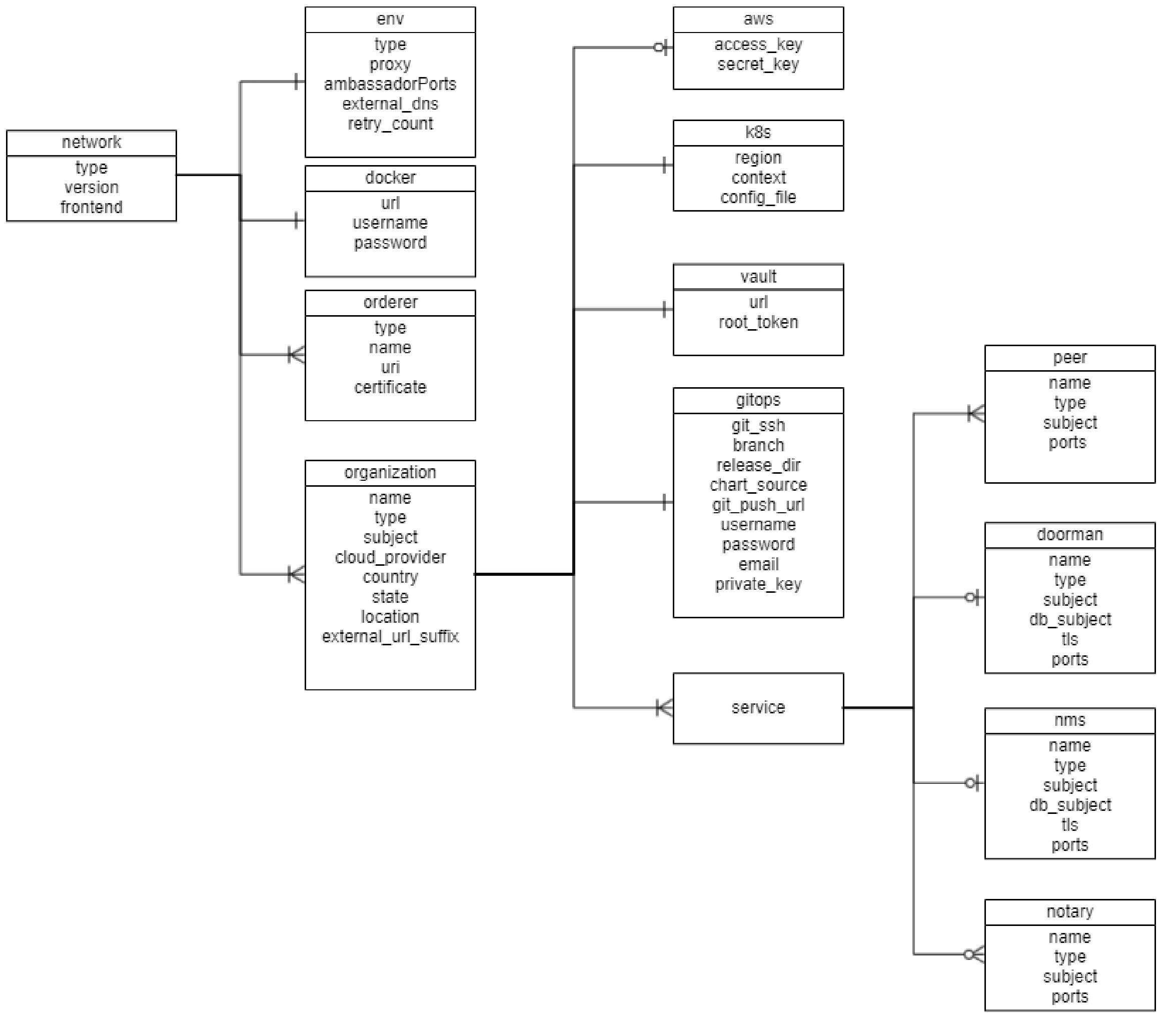
The same configuration files can be used to refresh the certificates. This can be done using the following command

```
ansible-playbook platforms/hyperledger-fabric/configuration/refresh_certificates.yaml␣
↪--extra-vars "@path-to-network.yaml"
```

5.3 Corda operations

5.3.1 Configuration file specification: R3 Corda

A network.yaml file is the base configuration file for setting up a Corda DLT network. This file contains all the information related to the infrastructure and network specifications. Here is the structure of it.



Before setting up a Corda DLT/Blockchain network, this file needs to be updated with the required specifications. A sample configuration file is provide in the repo path:`platforms/r3-corda/configuration/samples/network-cordav2.yaml`

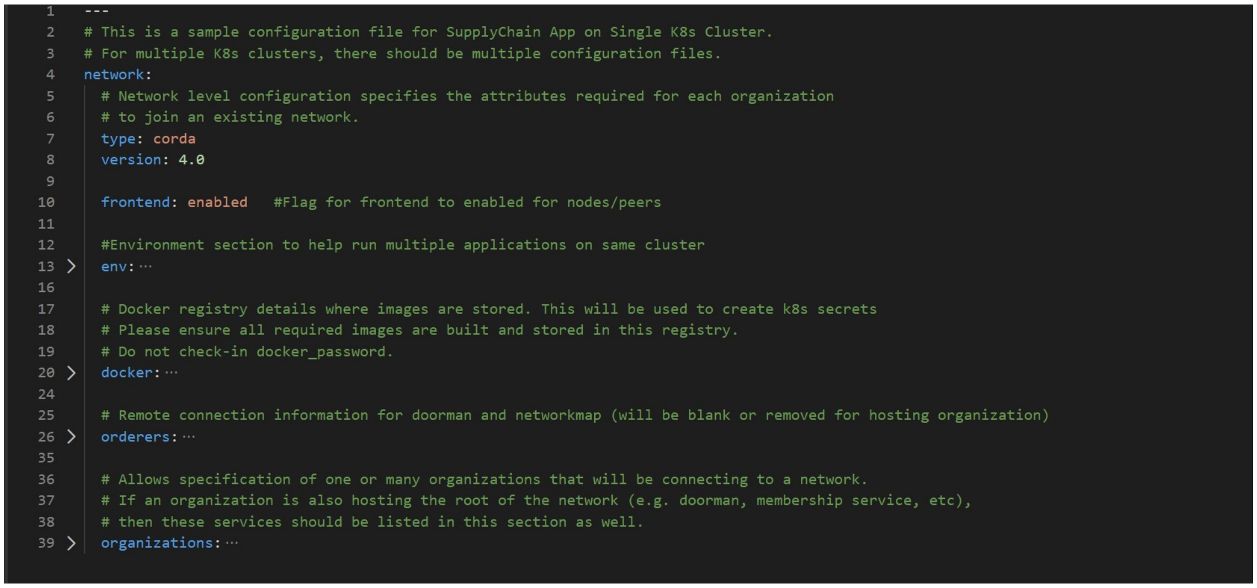
A json-schema definition is provided in `platforms/network-schema.json` to assist with semantic validations and lints. You can use your favorite yaml lint plugin compatible with json-schema specification, like `redhat.vscode-yaml` for VSCode. You need to adjust the directive in template located in the first line based on your actual build directory:

`# yaml-language-server: $schema=../platforms/network-schema.json`

The configurations are grouped in the following sections for better understanding.

- type
- version
- frontend
- env
- docker
- network_services
- organizations

Here is the snapshot from the sample configuration file



```
---
# This is a sample configuration file for SupplyChain App on Single K8s Cluster.
# For multiple K8s clusters, there should be multiple configuration files.
network:
  # Network level configuration specifies the attributes required for each organization
  # to join an existing network.
  type: corda
  version: 4.0

  frontend: enabled   #Flag for frontend to enabled for nodes/peers

  #Environment section to help run multiple applications on same cluster
  env:...

  # Docker registry details where images are stored. This will be used to create k8s secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:...

  # Remote connection information for doorman and networkmap (will be blank or removed for hosting organization)
  orderers:...

  # Allows specification of one or many organizations that will be connecting to a network.
  # If an organization is also hosting the root of the network (e.g. doorman, membership service, etc),
  # then these services should be listed in this section as well.
  organizations:...
```

The sections in the sample configuration file are

`type` defines the platform choice like corda/fabric/quorum. Use `corda` for **Corda Opensource** and `corda-enterprise` for **Corda Enterprise**.

`version` defines the version of platform being used, here in example the Corda version is 4.0, the corda version 4.7 is supported by latest release. Please note only 4.4 above is supported for **Corda Enterprise**.

`frontend` is a flag which defines if frontend is enabled for nodes or not. Its value can only be enabled/disabled. This is only applicable if the sample Supplychain App is being installed.

`env` section contains the environment type and additional (other than 8443) Ambassador port configuration. Value for proxy field under this section has to be 'ambassador' as 'haproxy' has not been implemented for Corda.

The snapshot of the `env` section with example values is below

```
  env:
    type: "env-type"                # tag for the environment. Important to run␣
↪multiple flux on single cluster
```

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```
    proxy: ambassador                # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for Corda
    ambassadorPorts:                 # Any additional Ambassador ports can be given␣
↪here, this is valid only if proxy='ambassador'
      portRange:               # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021       # For specific ports
    loadBalancerSourceRanges: # (Optional) Default value is '0.0.0.0/0', this value␣
↪can be changed to any other IP adres or list (comma-separated without spaces) of IP␣
↪adresses, this is valid only if proxy='ambassador'
    retry_count: 20                  # Retry count for the checks
    external_dns: enabled            # Should be enabled if using external-dns for␣
↪automatic route configuration
```

The fields under `env` section are

`docker` section contains the credentials of the repository where all the required images are built and stored.

For Opensource Corda, the required instructions are found here.

For **Corda Enterprise**, all Docker images has to be built and stored in a private Docker registry before running the Ansible playbooks. The required instructions are found here.

The snapshot of the `docker` section with example values is below

```
  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  docker:
    url: "<url>"
    username: "<username>"
    password: "<password>"
```

The fields under `docker` section are

NOTE: Please follow these instructions to build and store the docker images before running the Ansible playbooks.

The snapshot of the `network_services` section with example values is below

```
  # Remote connection information for doorman/idman and networkmap (will be blank or␣
↪removed for hosting organization)
  network_services:
    - service:
      name: doorman
      type: doorman
      uri: https://doorman.test.corda.blockchaincloudpoc.com:8443
      certificate: home_dir/platforms/r3-corda/configuration/build/corda/doorman/tls/
↪ambassador.crt
      crlissuer_subject: "CN=Corda TLS CRL Authority,OU=Corda UAT,O=R3 HoldCo LLC,
↪L=New York,C=US"
    - service:
      name: networkmap
      type: networkmap
      uri: https://networkmap.test.corda.blockchaincloudpoc.com:8443
```

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```
      certificate: home_dir/platforms/r3-corda/configuration/build/corda/networkmap/
↪tls/ambassador.crt
      truststore: home_dir/platforms/r3-corda-ent/configuration/build/
↪networkroottruststore.jks #Certificate should be encoded in base64 format
      truststore_pass: rootpassword
```

The `network_services` section contains a list of doorman/networkmap which is exposed to the network. Each `service` has the following fields:

The `organizations` section allows specification of one or many organizations that will be connecting to a network. If an organization is also hosting the root of the network (e.g. doorman, membership service, etc), then these services should be listed in this section as well. In the sample example the 1st Organisation is hosting the root of the network, so the services doorman, nms and notary are listed under the 1st organization's service.

The snapshot of an organization field with sample values is below

```
    - organization:
      name: manufacturer
      country: CH
      state: Zurich
      location: Zurich
      subject: "O=Manufacturer,OU=Manufacturer,L=Zurich,C=CH"
      type: node
      external_url_suffix: test.corda.blockchaincloudpoc.com
      cloud_provider: aws # Options: aws, azure, gcp
```

Each organization under the `organizations` section has the following fields.

For the aws and k8s field the snapshot with sample values is below

```
      aws:
        access_key: "<aws_access_key>"    # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "<aws_secret>"        # AWS Secret key, only used when cloud_
↪provider=aws

      # Kubernetes cluster deployment variables.
      k8s:
        region: "<k8s_region>"
        context: "<cluster_context>"
        config_file: "<path_to_k8s_config_file>"
```

The `aws` field under each organisation contains: (This will be ignored if cloud_provider is not 'aws')

The `k8s` field under each organisation contains

For gitops fields the snapshot from the sample configuration file with the example values is below

```
      # Git Repo details which will be used by GitOps/Flux.
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "https://github.com/<username>/bevel.git" # Gitops htpps or ssh url␣
↪for flux value files
        branch: "<branch_name>"                                           #␣
↪Git branch where release is being made
        release_dir: "platforms/r3-corda/releases/dev" # Relative Path in the Git␣
↪repo for flux sync per environment.
        chart_source: "platforms/r3-corda/charts"      # Relative Path where the Helm␣
↪charts are stored in Git repo
```

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```
        git_repo: "github.com/<username>/bevel.git"
        username: "<username>"          # Git Service user who has rights to check-in␣
↪in all branches
        password: "<password>"          # Git Server user password/personal token␣
↪(Optional for ssh; Required for https)
        email: "<git_email>"              # Email to use in git config
        private_key: "<path to gitops private key>" # Path to private key (Optional␣
↪for https; Required for ssh)
```

The gitops field under each organization contains

The credentials field under each organization contains

For organization as type cenm the credential block looks like

```
      credentials:
        keystore:
          keystore: cordacadevpass #notary keystore password
          idman: password #idman keystore password
          networkmap: password #networkmap keystore password
          subordinateca: password #subordinateCA keystore password
          rootca: password # rootCA keystore password
          tlscrlsigner: password #tls-crl-signer keystore password
        truststore:
          truststore: trustpass #notary truststore password
          rootca: password #network root truststore password
          ssl: password #corda ssl truststore password
        ssl:
          networkmap: password #ssl networkmap keystore password
          idman: password #ssl idman keystore password
          signer: password #ssl signer keystore password
          root: password #ssl root keystore password
          auth: password #ssl auth keystore password
```

For organization as type node the credential section is under peers section and looks like

```
          credentials:
            truststore: trustpass #node truststore password
            keystore: cordacadevpass #node keystore password
```

For cordapps fields the snapshot from the sample configuration file with the example values is below: This has not been implented for **Corda Enterprise**.

```
      # Cordapps Repository details (optional use if cordapps jar are store in a␣
↪repository)
      cordapps:
        jars:
        - jar:
            # e.g https://alm.accenture.com/nexus/repository/
↪AccentureBlockchainFulcrum_Release/com/supplychain/bcc/cordapp-supply-chain/0.1/
↪cordapp-supply-chain-0.1.jar
            url:
        - jar:
            # e.g https://alm.accenture.com/nexus/repository/
↪AccentureBlockchainFulcrum_Release/com/supplychain/bcc/cordapp-contracts-states/0.1/
↪cordapp-contracts-states-0.1.jar
            url:
```

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```
        username: "cordapps_repository_username"
        password: "cordapps_repository_password"
```

The `cordapps` optional field under each organization contains

For **Corda Enterprise**, following additional fields have been added under each `organisation`.

```
      firewall:
        enabled: true       # true if firewall components are to be deployed
        subject: "CN=Test Firewall CA Certificate, OU=HQ, O=HoldCo LLC, L=New York,␣
↪C=US"
        credentials:
            firewallca: firewallcapassword
            float: floatpassword
            bridge: bridgepassword
```

The `Firewall` field under each node type organization contains; valid only for enterprise corda

The services field for each organization under `organizations` section of Corda contains list of `services` which could be doorman/idman/nms/notary/peers for opensource, and additionally idman/networkmap/signer/bridge/float for **Corda Enterprise**.

The snapshot of doorman service with example values is below

```
      services:
        doorman:
          name: doormanskar
          subject: "CN=Corda Doorman CA,OU=DLT,O=DLT,L=Berlin,C=DE"
          db_subject: "/C=US/ST=California/L=San Francisco/O=My Company Ltd/OU=DBA/
↪CN=mongoDB"
          type: doorman
          ports:
            servicePort: 8080
            targetPort: 8080
          tls: "on"
```

The fields under `doorman` service are

The snapshot of nms service example values is below

```
        nms:
          name: networkmapskar
          subject: "CN=Network Map,OU=FRA,O=FRA,L=Berlin,C=DE"
          db_subject: "/C=US/ST=California/L=San Francisco/O=My Company Ltd/OU=DBA/
↪CN=mongoDB"
          type: networkmap
          ports:
            servicePort: 8080
            targetPort: 8080
          tls: "on"
```

The fields under `nms` service are

For **Corda Enterprise**, following services must be added to CENM Support.

The snapshot of zone service with example values is below

```
      services:
        zone:
          name: zone
          type: cenm-zone
          ports:
            enm: 25000
            admin: 12345
```

The fields under `zone` service are

The snapshot of auth service with example values is below

```
        auth:
          name: auth
          subject: "CN=Test TLS Auth Service Certificate, OU=HQ, O=HoldCo LLC, L=New␣
↪York, C=US"
          type: cenm-auth
          port: 8081
          username: admin
          userpwd: p4ssWord
```

The fields under `auth` service are

The snapshot of gateway service with example values is below

```
        gateway:
          name: gateway
          subject: "CN=Test TLS Gateway Certificate, OU=HQ, O=HoldCo LLC, L=New York,␣
↪C=US"
          type: cenm-gateway
          ports:
            servicePort: 8080
            ambassadorPort: 15008
```

The fields under `gateway` service are

The snapshot of idman service with example values is below

```
      services:
        idman:
          name: idman
          subject: "CN=Test Identity Manager Service Certificate, OU=HQ, O=HoldCo LLC,
↪ L=New York, C=US"
          crlissuer_subject: "CN=Corda TLS CRL Authority,OU=Corda UAT,O=R3 HoldCo LLC,
↪L=New York,C=US"
          type: cenm-idman
          port: 10000
```

The fields under `idman` service are

The snapshot of networkmap service with example values is below

```
      services:
        networkmap:
          name: networkmap
          subject: "CN=Test Network Map Service Certificate, OU=HQ, O=HoldCo LLC,␣
↪L=New York, C=US"
          type: cenm-networkmap
          ports:
```

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```
            servicePort: 10000
            targetPort: 10000
```

The fields under `networkmap` service are

The snapshot of signer service with example values is below

```
      services:
        signer:
          name: signer
          subject: "CN=Test Subordinate CA Certificate, OU=HQ, O=HoldCo LLC, L=New␣
↪York, C=US"
          type: cenm-signer
          ports:
            servicePort: 8080
            targetPort: 8080
```

The fields under `signer` service are

The snapshot of notary service with example values is below

```
        # Currently only supporting a single notary cluster, but may want to expand␣
↪in the future
        notary:
          name: notary1
          subject: "O=Notary,OU=Notary,L=London,C=GB"
          serviceName: "O=Notary Service,OU=Notary,L=London,C=GB" # available for␣
↪Corda 4.7 onwards to support HA Notary
          type: notary
          p2p:
            port: 10002
            targetPort: 10002
            ambassador: 15010       #Port for ambassador service (must be from env.
↪ambassadorPorts above)
          rpc:
            port: 10003
            targetPort: 10003
          rpcadmin:
            port: 10005
            targetPort: 10005
          dbtcp:
            port: 9101
            targetPort: 1521
          dbweb:
            port: 8080
            targetPort: 81
```

The fields under `notary` service are

The snapshot of float service with example values is below

```
      float:
        name: float
        subject: "CN=Test Float Certificate, OU=HQ, O=HoldCo LLC, L=New York, C=US"
        external_url_suffix: test.cordafloat.blockchaincloudpoc.com
        cloud_provider: aws   # Options: aws, azure, gcp
        aws:
          access_key: "aws_access_key"        # AWS Access key, only used when cloud_
↪provider=aws
```

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```
          secret_key: "aws_secret_key"        # AWS Secret key, only used when cloud_
↪provider=aws
        k8s:
          context: "float_cluster_context"
          config_file: "float_cluster_config"
        vault:
          url: "float_vault_addr"
          root_token: "float_vault_root_token"
        gitops:
          git_url: "https://github.com/<username>/bevel.git"         # Gitops https␣
↪or ssh url for flux value files
          branch: "develop"           # Git branch where release is being made
          release_dir: "platforms/r3-corda-ent/releases/float" # Relative Path in the␣
↪Git repo for flux sync per environment.
          chart_source: "platforms/r3-corda-ent/charts"     # Relative Path where the␣
↪Helm charts are stored in Git repo
          git_repo: "github.com/<username>/bevel.git"   # Gitops git repository URL␣
↪for git push
          username: "git_username"          # Git Service user who has rights to␣
↪check-in in all branches
          password: "git_access_token"          # Git Server user password/access␣
↪token (Optional for ssh; Required for https)
          email: "git_email"                # Email to use in git config
          private_key: "path_to_private_key"          # Path to private key file␣
↪which has write-access to the git repo (Optional for https; Required for ssh)
        ports:
          p2p_port: 40000
          tunnelport: 39999
          ambassador_tunnel_port: 15021
          ambassador_p2p_port: 15020
```

The fields under `float` service are below. Valid for corda enterprise only.

The fields under `bridge` service are below. Valid for corda enterprise only.

The snapshot of peer service with example values is below

```
      # The participating nodes are named as peers
      services:
        peers:
        - peer:
          name: manufacturerskar
          subject: "O=Manufacturer,OU=Manufacturer,L=47.38/8.54/Zurich,C=CH"
          type: node
          p2p:
            port: 10002
            targetPort: 10002
            ambassador: 15010       #Port for ambassador service (must be from env.
↪ambassadorPorts above)
          rpc:
            port: 10003
            targetPort: 10003
          rpcadmin:
            port: 10005
            targetPort: 10005
          dbtcp:
            port: 9101
```

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```
          targetPort: 1521
        dbweb:
          port: 8080
          targetPort: 81
        springboot:              # This is for the springboot server
          targetPort: 20001
          port: 20001
        expressapi:              # This is for the express api server
          targetPort: 3000
          port: 3000
```

The fields under each `peer` service are

5.3.2 Adding cordapps to R3 Corda network

1. Adding directly from build directory

Pre-requisites:

R3 Corda network deployed and network.yaml configuration file already set.

Build CorDapp jars

Build the CorDapp jars. If you have multiple jars, place them in a single location e.g. at `path/to/cordapp-jars`.

Run playbook

The playbook deploy-cordapps.yaml is used to deploy cordapps over the existing R3 Corda network. This can be done manually using the following command

```
ansible-playbook platforms/r3-corda/configuration/deploy-cordapps.yaml -e "@path-to-
↪network.yaml" -e "source_dir='path/to/cordapp-jars'"
```

2. Adding from a nexus repository

Pre-requisites:

Build the CorDapp jars. If you have multiple jars, place them in a single location e.g. at `path/to/cordapp-jars`. Publishing the CorDapp jars to the nexus repository.

In order to publish the jars add the following information in `example\supplychain-app\corda\gradle.properties` file

```
# Repository URL e.g : https://alm.accenture.com/nexus/repository/
↪AccentureBlockchainFulcrum_Release/
repoURI=nexus_repository_url
# Repository credentials
repoUser=repository_user_name
repoPassword=repository_user_password
```

Add the appropriate jar information as artifacts in `example\supplychain-app\corda\build.gradle` file, change this file only if you need to add or remove jars other that the ones mentioned below

```
publishing{
    publications {
    maven1(MavenPublication) {
        artifactId = 'cordapp-supply-chain'
        artifact('build/cordapp-supply-chain-0.1.jar')
            }
    maven2(MavenPublication) {
        artifactId = 'cordapp-contracts-states'
        artifact('build/cordapp-contracts-states-0.1.jar')
            }
        }
        repositories {
        maven {
            url project.repoURI
            credentials {
                username project.repoUser
                password project.repoPassword
                }
            }
        }
}
```

Publishing the artifacts/jars, use the below command to publish the jars into the nexus repository

```
gradle publish
```

Change the corda configuration file to add jar information under the cordapps field of required organisation.

Example given in the sample configuration file`platforms/r3-corda/configuration/samples/network-cordav2.yaml`

The snapshot from the sample configuration file with the example values is below

```
      # Cordapps Repository details (optional use if cordapps jar are store in a␣
↪repository)
      cordapps:
        jars:
        - jar:
            # e.g https://alm.accenture.com/nexus/repository/
↪AccentureBlockchainFulcrum_Release/com/supplychain/bcc/cordapp-supply-chain/0.1/
↪cordapp-supply-chain-0.1.jar
            url:
        - jar:
            # e.g https://alm.accenture.com/nexus/repository/
↪AccentureBlockchainFulcrum_Release/com/supplychain/bcc/cordapp-contracts-states/0.1/
↪cordapp-contracts-states-0.1.jar
            url:
        username: "cordapps_repository_username"
        password: "cordapps_repository_password"
```

Adding the jars by deploying the network

After the configuration file is updated and saved, run the following command from the **bevel** folder to deploy your network.

```
ansible-playbook platforms/shared/configuration/site.yaml --extra-vars "@path-to-
↪network.yaml"
```

This will deploy the network and add the cordapps.

5.3.3 Adding a new organization in R3 Corda

- *Prerequisites*
- *Create configuration file*
- *Run playbook*

Prerequisites

To add a new organization, Corda Doorman/Idman and Networkmap services should already be running. The public certificates from Doorman/Idman and Networkmap should be available and specified in the configuration file.

NOTE: Addition of a new organization has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

Create Configuration File

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organization` details along with the network service information about the networkmap and doorman service.

NOTE: Make sure the doorman and networkmap service certificates are in plain text and not encoded in base64 or any other encoding scheme, along with correct paths to them mentioned in network.yaml.

For reference, sample `network.yaml` file looks like below (but always check the latest at `platforms/r3-corda/configuration/samples`):

```
network:
  # Network level configuration specifies the attributes required for each␣
↪organization
  # to join an existing network.
  type: corda
  version: 4.0
  #enabled flag is frontend is enabled for nodes
  frontend: enabled

  #Environment section for Kubernetes setup
  env:
    type: "env_type"                # tag for the environment. Important to run␣
↪multiple flux on single cluster
    proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for Corda
```

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```
    ambassadorPorts:                # Any additional Ambassador ports can be given␣
↪here, this is valid only if proxy='ambassador'
      portRange:              # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021      # For specific ports
    retry_count: 20                 # Retry count for the checks
    external_dns: enabled           # Should be enabled if using external-dns for␣
↪automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "docker_url"
    username: "docker_username"
    password: "docker_password"

  # Remote connection information for doorman and networkmap (will be blank or␣
↪removed for hosting organization)
  network_service:
    - service:
      type: doorman
      uri: https://doorman.test.corda.blockchaincloudpoc.com:8443
      certificate: home_dir/platforms/r3-corda/configuration/build/corda/doorman/tls/
↪ambassador.crt
    - service:
      type: networkmap
      uri: https://networkmap.test.corda.blockchaincloudpoc.com:8443
      certificate: home_dir/platforms/r3-corda/configuration/build/corda/networkmap/
↪tls/ambassador.crt

  # Allows specification of one or many organizations that will be connecting to a␣
↪network.
  # If an organization is also hosting the root of the network (e.g. doorman,␣
↪membership service, etc),
  # then these services should be listed in this section as well.
  organizations:
    # Specification for the new organization. Each organization maps to a VPC and a␣
↪separate k8s cluster
    - organization:
      name: neworg
      country: US
      state: New York
      location: New York
      subject: "O=Neworg,OU=Neworg,L=New York,C=US"
      type: node
      external_url_suffix: test.corda.blockchaincloudpoc.com

      cloud_provider: aws   # Options: aws, azure, gcp
      aws:
        access_key: "aws_access_key"        # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "aws_secret_key"        # AWS Secret key, only used when cloud_
↪provider=aws
```

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```
      # Kubernetes cluster deployment variables. The config file path and name has to␣
↪be provided in case
      # the cluster has already been created.
      k8s:
        region: "cluster_region"
        context: "cluster_context"
        config_file: "cluster_config"

      # Hashicorp Vault server address and root-token. Vault should be unsealed.
      # Do not check-in root_token
      vault:
        url: "vault_addr"
        root_token: "vault_root_token"

      # Git Repo details which will be used by GitOps/Flux.
      # Do not check-in git_password
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "gitops_ssh_url"         # Gitops https or ssh url for flux value␣
↪files like "https://github.com/hyperledger/bevel.git"
        branch: "gitops_branch"           # Git branch where release is being made
        release_dir: "gitops_release_dir" # Relative Path in the Git repo for flux␣
↪sync per environment.
        chart_source: "gitops_charts"     # Relative Path where the Helm charts are␣
↪stored in Git repo
        git_repo: "gitops_repo_url"   # Gitops git repository URL for git push like
↪"github.com/hyperledger/bevel.git"
        username: "git_username"          # Git Service user who has rights to check-
↪in in all branches
        password: "git_password"          # Git Server user access token (Optional␣
↪for ssh; Required for https)
        email: "git_email"                # Email to use in git config
        private_key: "path_to_private_key"          # Path to private key file which␣
↪has write-access to the git repo (Optional for https; Required for ssh)

      services:
        peers:
        - peer:
          name: neworg
          subject: "O=Neworg,OU=Neworg,L=New York,C=US"
          type: node
          p2p:
            port: 10002
            targetPort: 10002
            ambassador: 10070       #Port for ambassador service (use one port per␣
↪org if using single cluster)
          rpc:
            port: 10003
            targetPort: 10003
          rpcadmin:
            port: 10005
            targetPort: 10005
          dbtcp:
            port: 9101
            targetPort: 1521
          dbweb:
            port: 8080
```

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```
            targetPort: 81
          springboot:
            targetPort: 20001
            port: 20001
          expressapi:
            targetPort: 3000
            port: 3000
```

Run playbook

The add-new-organization.yaml playbook is used to add a new organization to the existing network. This can be done using the following command

```
ansible-playbook platforms/shared/configuration/add-new-organization.yaml --extra-
↪vars "@path-to-network.yaml"
```

NOTE: If you have CorDapps and applications, please deploy them as well.

5.3.4 Adding a new Notary organization in R3 Corda Enterprise

Corda Enterprise Network Map (CENM) 1.2 does not allow dynamic addition of new Notaries to an existing network via API Call. This process is manual and involves few steps as described in the Corda Official Documentation here. To overcome this, we have created an Ansible playbook. The playbook will update the Networkmap service so that a networkparameter update is submitted. But the `run flagDay` command has to be manual, as it is not possible to login to each Network Participant and accept the new parameters. Also, whenever the parameter update happens, it will trigger a node shutdown. Hence, the `run flagDay` command must be executed when no transactions are happening in the network.

`run flagDay` command must be run after the network parameters update deadline is over (+10 minutes by default). And this command must be run during downtime as it will trigger Corda node restart.

- *Prerequisites*
- *Deploy new Notary Service*
- *Run playbook*
- *Run parameter update*

Prerequisites

To add a new Notary organization, Corda Idman and Networkmap services should already be running. The public certificates and NetworkTrustStore from Idman and Networkmap should be available and specified in the configuration file.

NOTE: Addition of a new Notary organization has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

Deploy new Notary Service

Deploy the additional notary/notaries as separate organizations by following the guidance on how to add new organizations here. A sample network.yaml for adding new notary orgs can be found here.

Run Playbook

After the new notary is running, execute the playbook `platforms/r3-corda-ent/configuration/add-notaries.yaml` with the same configuration file as used in previous step.

```
ansible-playbook platforms/r3-corda-ent/configuration/add-notaries.yaml --extra-vars
↪"@path-to-new-network.yaml"
```

Run Parameter Update

The default networkparameters update timeout is 10 minutes, so wait for 10 minutes and then login to the networkmap ssh shell from the networkmap pod by running the commands below

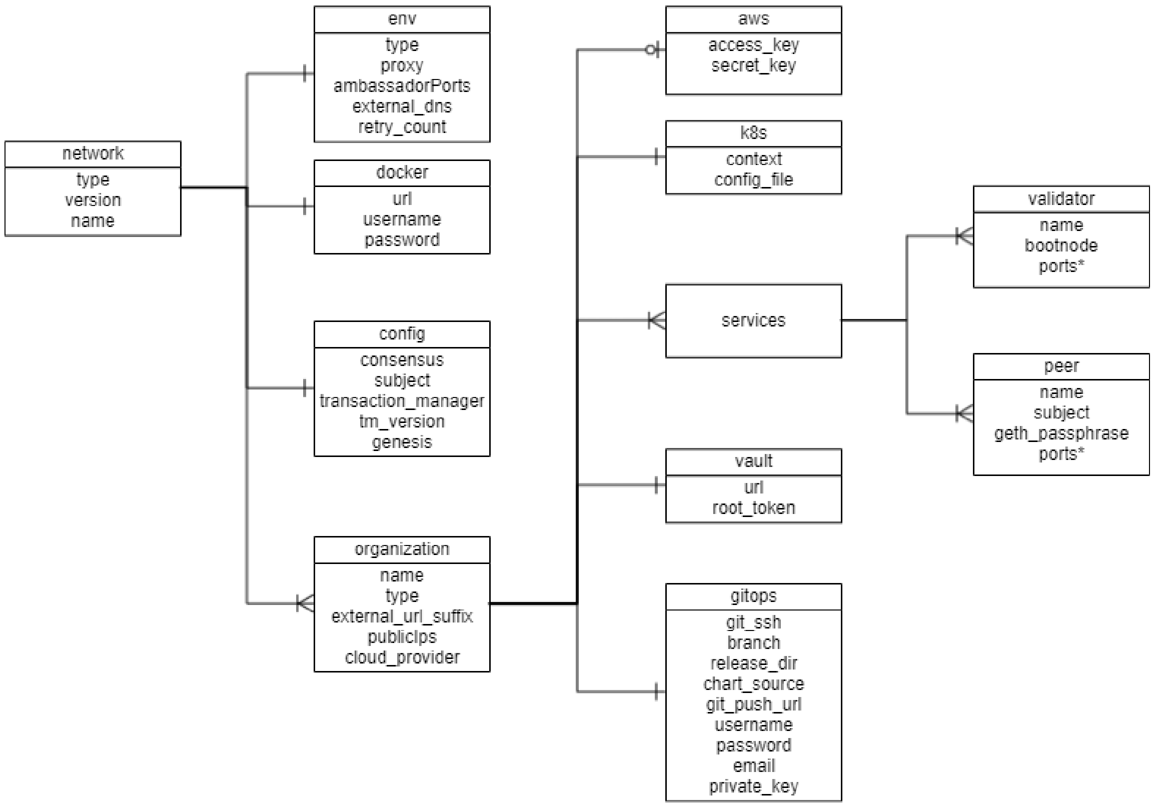
```
#Login to networkmap pod
kubectl exec -it networkmap-0 -n <cenm-namespace> -c main -- bash
root@networkmap-0:/opt/corda# ssh nmap@localhost -p 2222   # say yes for hostkey␣
↪message
Password authentication
Password:                                        # Enter password at prompt
            _   __     __  __  ___
           / | / /__  / /_/  |/  /___ ______
          /  |/ / _ \/ __/ /|_/ / __ `/ __ \
         / /|  /  __/ /_/ /  / / /_/ / /_/ /
        /_/ |_/\___/\__/_/  /_/\__,_/ .___/
                                   /_/
        Welcome to the Network Map interactive shell.
        Type 'help' to see what commands are available.

        Thu Dec 03 17:40:37 GMT 2020>>> view notaries
↪# to view current notaries

# Run the following commands to execute flagday so that latest network parameters␣
↪update is accepted

  Thu Dec 03 17:43:04 GMT 2020>>> view networkParametersUpdate   # to check the␣
↪current update (will be empty if no updates are in progress)

        Thu Dec 03 17:43:57 GMT 2020>>> run flagDay                    # to initiate␣
↪flagDay which will apply the networkParameters update only if the deadline has␣
↪passed

        # If you want to cancel the update, run following
Thu Dec 03 17:45:17 GMT 2020>>> run cancelUpdate
```

Ensure that the Corda Node users know that the network parameters have changed which will trigger node restart automatically.

5.4 Besu operations

5.4.1 Configuration file specification: Hyperledger Besu

A network.yaml file is the base configuration file designed in Hyperledger Bevel for setting up a Hyperledger Besu DLT/Blockchain network. This file contains all the configurations related to the network that has to be deployed. Below shows its structure.



Before setting up a Hyperledger Besu DLT/Blockchain network, this file needs to be updated with the required specifications.A sample configuration file is provided in the repo path:`platforms/hyperledger-besu/configuration/samples/network-besu.yaml`

A json-schema definition is provided in `platforms/network-schema.json` to assist with semantic validations and lints. You can use your favorite yaml lint plugin compatible with json-schema specification, like `redhat.vscode-yaml` for VSCode. You need to adjust the directive in template located in the first line based on your actual build directory:

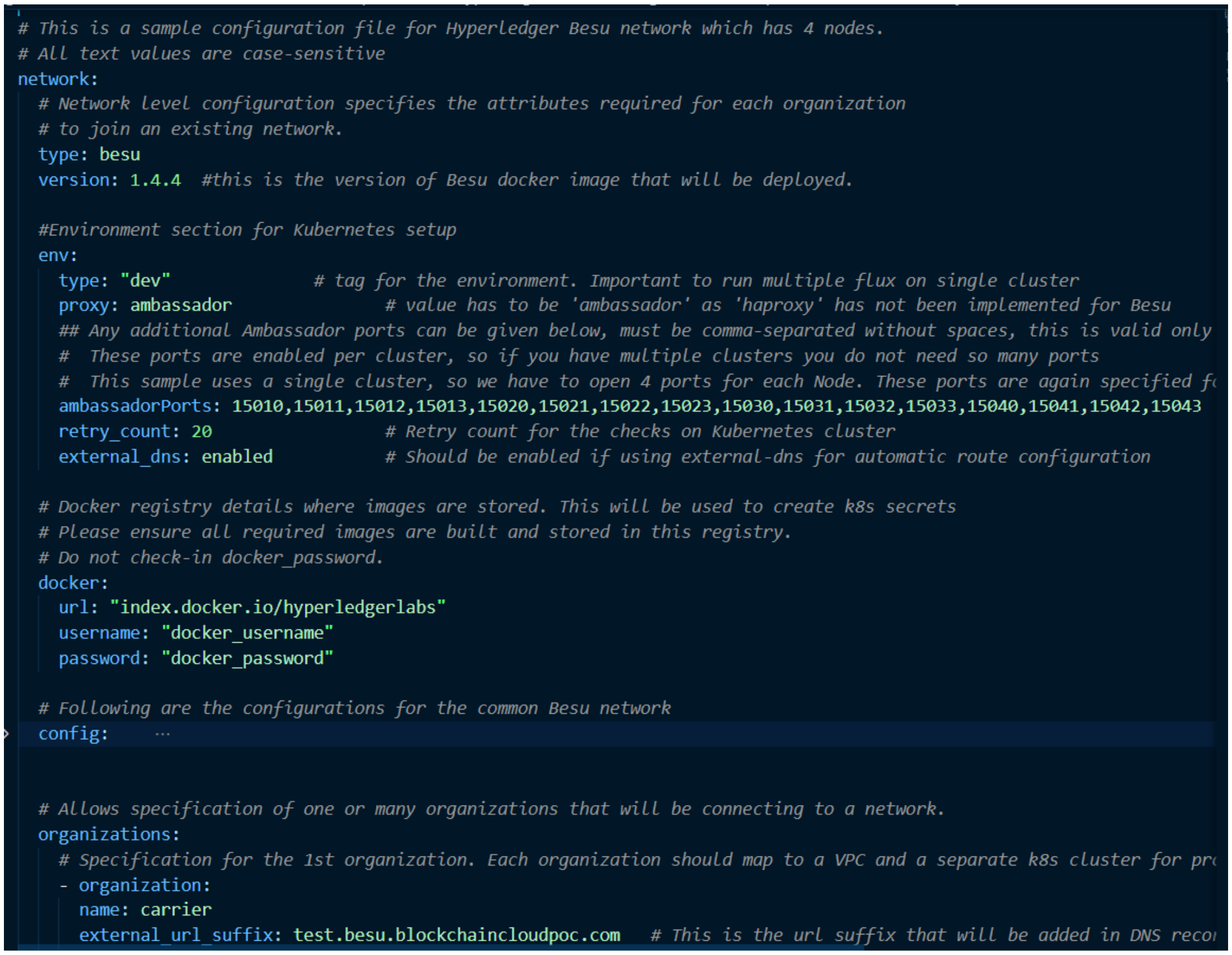
```
# yaml-language-server: $schema=../platforms/network-schema.json
```

The configurations are grouped in the following sections for better understanding.

- type
- version
- env
- docker
- config

- organizations

Here is the snapshot from the sample configuration file



```
# This is a sample configuration file for Hyperledger Besu network which has 4 nodes.
# All text values are case-sensitive
network:
  # Network level configuration specifies the attributes required for each organization
  # to join an existing network.
  type: besu
  version: 1.4.4  #this is the version of Besu docker image that will be deployed.

  #Environment section for Kubernetes setup
  env:
    type: "dev"              # tag for the environment. Important to run multiple flux on single cluster
    proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has not been implemented for Besu
    ## Any additional Ambassador ports can be given below, must be comma-separated without spaces, this is valid only
    #  These ports are enabled per cluster, so if you have multiple clusters you do not need so many ports
    #  This sample uses a single cluster, so we have to open 4 ports for each Node. These ports are again specified f
    ambassadorPorts: 15010,15011,15012,15013,15020,15021,15022,15023,15030,15031,15032,15033,15040,15041,15042,15043
    retry_count: 20                 # Retry count for the checks on Kubernetes cluster
    external_dns: enabled           # Should be enabled if using external-dns for automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "index.docker.io/hyperledgerlabs"
    username: "docker_username"
    password: "docker_password"

  # Following are the configurations for the common Besu network
  config:   ···


  # Allows specification of one or many organizations that will be connecting to a network.
  organizations:
    # Specification for the 1st organization. Each organization should map to a VPC and a separate k8s cluster for pr
    - organization:
      name: carrier
      external_url_suffix: test.besu.blockchaincloudpoc.com   # This is the url suffix that will be added in DNS reco
```

The sections in the sample configuration file are

`type` defines the platform choice like corda/fabric/indy/quorum/besu, here in the example its **besu**.

`version` defines the version of platform being used. The current Hyperledger Besu version support is only for **21.10.6**.

`env` section contains the environment type and additional (other than 8443) Ambassador port configuration. Vaule for proxy field under this section can be 'ambassador' as 'haproxy' has not been implemented for Besu.

The snapshot of the `env` section with example value is below

```
  env:
    type: "env-type"                # tag for the environment. Important to run␣
↪multiple flux on single cluster
    proxy: ambassador                 # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for Hyperledger Besu
    #  These ports are enabled per cluster, so if you have multiple clusters you do␣
↪not need so many ports
    #  This sample uses a single cluster, so we have to open 4 ports for each Node.␣
↪These ports are again specified for each organization below
    ambassadorPorts:                  # Any additional Ambassador ports can be given␣
↪here, this is valid only if proxy='ambassador'
```

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```
      portRange:              # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021      # For specific ports
    loadBalancerSourceRanges: # (Optional) Default value is '0.0.0.0/0', this value␣
↪can be changed to any other IP adres or list (comma-separated without spaces) of IP␣
↪adresses, this is valid only if proxy='ambassador'
    retry_count: 50                # Retry count for the checks
    external_dns: enabled           # Should be enabled if using external-dns for␣
↪automatic route configuration
```

The fields under env section are

docker section contains the credentials of the repository where all the required images are built and stored.

The snapshot of the docker section with example values is below

```
  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "docker_url"
    username: "docker_username"
    password: "docker_password"
```

The fields under docker section are

config section contains the common configurations for the Hyperledger Besu network.

The snapshot of the config section with example values is below

```
  config:
    consensus: "ibft"                 # Options are "ibft", "ethash", "clique"
    ## Certificate subject for the root CA of the network.
    #  This is for development usage only where we create self-signed certificates␣
↪and the truststores are generated automatically.
    #  Production systems should generate proper certificates and configure␣
↪truststores accordingly.
    subject: "CN=DLT Root CA,OU=DLT,O=DLT,L=London,C=GB"
    transaction_manager: "tessera"     # Transaction manager can be "tessera" or "orion
↪"; 21.x.x features are same for both
    # This is the version of transaction_manager docker image that will be deployed
    # Supported versions #
    # orion: 1.6.0 (for besu 1.5.5)
    # orion/tessra: 21.7.3(for besu 21.10.6)
    tm_version: "21.7.3"
    # TLS can be True or False for the transaction manager
    tm_tls: True
    # Tls trust value
    tm_trust: "tofu"                  # Options are: "ca-or-tofu", "ca", "tofu"
    ## File location for saving the genesis file should be provided.
    genesis: "/home/user/bevel/build/besu_genesis"    # Location where genesis file␣
↪will be saved
    ## At least one Transaction Manager nodes public addresses should be provided.
    #  - "https://node.test.besu.blockchaincloudpoc-develop.com:15022" for orion
    #  - "https://node.test.besu.blockchaincloudpoc-develop.com" for tessera
    # The above domain name is formed by the (http or https)://(peer.name).(org.
↪external_url_suffix):(ambassador tm_nodeport)
```

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```
    tm_nodes:
      - "https://carrier.test.besu.blockchaincloudpoc-develop.com"
```

The fields under `config` are

The `organizations` section contains the specifications of each organization.

In the sample configuration example, we have four organization under the `organizations` section.

The snapshot of an organization field with sample values is below

```
  organizations:
    # Specification for the 1st organization. Each organization maps to a VPC and a␣
↪separate k8s cluster
    - organization:
      name: carrier
      type: member
      # Provide the url suffix that will be added in DNS recordset. Must be different␣
↪for different clusters
      external_url_suffix: test.besu.blockchaincloudpoc.com
      cloud_provider: aws   # Options: aws, azure, gcp, minikube
```

Each `organization` under the `organizations` section has the following fields.

For the `aws` and `k8s` field the snapshot with sample values is below

```
      aws:
        access_key: "<aws_access_key>"    # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "<aws_secret>"        # AWS Secret key, only used when cloud_
↪provider=aws
        region: "<aws_region>"                # AWS Region where cluster and EIPs are␣
↪created
      # Kubernetes cluster deployment variables.
      k8s:
        context: "<cluster_context>"
        config_file: "<path_to_k8s_config_file>"
```

The `aws` field under each organization contains: (This will be ignored if cloud_provider is not `aws`)

The `k8s` field under each organization contains

For gitops fields the snapshot from the sample configuration file with the example values is below

```
      # Git Repo details which will be used by GitOps/Flux.
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "https://github.com/<username>/bevel.git" # Gitops htpps or ssh url␣
↪for flux value files
        branch: "<branch_name>"                                              #␣
↪Git branch where release is being made
        release_dir: "platforms/hyperledger-besu/releases/dev" # Relative Path in the␣
↪Git repo for flux sync per environment.
        chart_source: "platforms/hyperledger-besu/charts"      # Relative Path where␣
↪the Helm charts are stored in Git repo
        git_repo: "github.com/<username>/bevel.git" # without https://
        username: "<username>"          # Git Service user who has rights to check-in␣
↪in all branches
        password: "<password>"          # Git Server user password/personal token␣
↪(Optional for ssh; Required for https)
```

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```
        email: "<git_email>"                # Email to use in git config
        private_key: "<path to gitops private key>" # Path to private key (Optional␣
↪for https; Required for ssh)
```

The gitops field under each organization contains

The services field for each organization under `organizations` section of Hyperledger Besu contains list of `services` which could be peers or validators.

Each organization with type as `member` will have a peers service. The snapshot of peers service with example values is below

```
        peers:
        - peer:
          name: carrier
          subject: "O=Carrier,OU=Carrier,L=51.50/-0.13/London,C=GB" # This is the␣
↪node subject. L=lat/long is mandatory for supplychain sample app
          geth_passphrase: "12345"  # Passphrase to be used to generate geth account
          lock: true        # (for future use) Sets Besu node to lock or unlock mode.␣
↪Can be true or false
          p2p:
            port: 30303
            ambassador: 15010       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15011       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
          db:
            port: 3306        # Only applicable for tessra where mysql db is used
          tm_nodeport:
            port: 8888
            ambassador: 15013   # Port exposed on ambassador service (Transaction␣
↪manager node port)
          tm_clientport:
            port: 8080
```

The fields under `peer` service are

The peer in an organization with type as `member` can be used to deploy the smarcontracts with additional field `peer.smart_contract`. The snapshot of peers service with example values is below

```
        peers:
        - peer:
          name: carrier
          subject: "O=Carrier,OU=Carrier,L=51.50/-0.13/London,C=GB" # This is the␣
↪node subject. L=lat/long is mandatory for supplychain sample app
          geth_passphrase: "12345"  # Passphrase to be used to generate geth account
          p2p:
            port: 30303
            ambassador: 15010       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15011       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
```

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```
          ws:
            port: 8546
          tm_nodeport:
            port: 8888
            ambassador: 15013   # Port exposed on ambassador service (Transaction␣
↪manager node port)
          tm_clientport:
            port: 8080
          geth_url: "http://manufacturerl.test.besu.blockchaincloudpoc.com:15011"  #␣
↪geth url of the node
          # smartcontract to be deployed only from one node (should not be repeated␣
↪in other nodes)
          smart_contract:
            name: "General"           # Name of the smart contract or Name of the␣
↪main Smart contract Class
            deployjs_path: "examples/supplychain-app/besu/smartContracts" # location␣
↪of folder containing deployment script from Bevel directory
            contract_path: "../../besu/smartContracts/contracts"       # Path of the␣
↪smart contract folder relative to deployjs_path
            iterations: 200           # Number of Iteration of execution to which the␣
↪gas and the code is optimised
            entrypoint: "General.sol" # Main entrypoint solidity file of the contract
            private_for: "hPFajDXpdKzhgGdurWIrDxOimWFbcJOajaD3mJJVrxQ=,
↪7aOvXjjkajr6gJm5mdHPhAuUANPXZhJmpYM5rDdS5nk=" # Orion Public keys for the␣
↪privateFor
```

The additional fields under `peer` service are

Each organization with type as `validator` will have a validator service. The snapshot of validator service with example values is below

```
      validators:
        - validator:
          name: validator1
          bootnode: true          # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15010       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15011       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
```

The fields under `validator` service are

*** feature is in future scope

5.4.2 Adding a new member organization in Besu

- *Prerequisites*
- *Create Configuration File*

- *Run playbook*

Prerequisites

To add a new organization in Besu, an existing besu network should be running, enode information of all existing nodes present in the network should be available, genesis file should be available in base64 encoding and the information of orion nodes should be available. The new node account should be unlocked prior adding the new node to the existing besu network.

NOTE: Addition of a new organization has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

NOTE: The guide is only for the addition of member organization in existing besu network.

Create Configuration File

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organization` details along with the enode information, genesis file in base64 encoding and orion transaction manager details

---

NOTE: Make sure that the genesis flie is provided in base64 encoding. Also, if you are adding node to the same cluster as of another node, make sure that you add the ambassador ports of the existing node present in the cluster to the network.yaml

---

For reference, sample `network.yaml` file looks like below for IBFT consensus (but always check the latest network-besu-new-memberorg.yaml at `platforms/hyperledger-besu/configuration/samples`):

```
---
# This is a sample configuration file for Hyperledger Besu network which has 4 nodes.
# All text values are case-sensitive
network:
  # Network level configuration specifies the attributes required for each␣
↪organization
  # to join an existing network.
  type: besu
  version: 1.5.5  #this is the version of Besu docker image that will be deployed.

  #Environment section for Kubernetes setup
  env:
    type: "dev"              # tag for the environment. Important to run multiple␣
↪flux on single cluster
    proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for besu
    ## Any additional Ambassador ports can be given below, this is valid only if␣
↪proxy='ambassador'
    #  These ports are enabled per cluster, so if you have multiple clusters you do␣
↪not need so many ports
```

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```
    #  This sample uses a single cluster, so we have to open 4 ports for each Node.␣
↪These ports are again specified for each organization below
    ambassadorPorts:
      portRange:              # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021      # For specific ports
    retry_count: 20                 # Retry count for the checks on Kubernetes cluster
    external_dns: enabled           # Should be enabled if using external-dns for␣
↪automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "ghcr.io/hyperledger"
    username: "docker_username"
    password: "docker_password"

  # Following are the configurations for the common Besu network
  config:
    consensus: "ibft"                 # Options are "ibft", "ethash" and "clique".
    ## Certificate subject for the root CA of the network.
    #  This is for development usage only where we create self-signed certificates␣
↪and the truststores are generated automatically.
    #  Production systems should generate proper certificates and configure␣
↪truststores accordingly.
    subject: "CN=DLT Root CA,OU=DLT,O=DLT,L=London,C=GB"
    transaction_manager: "orion"    # Transaction manager is "orion"
    # This is the version of "orion" docker image that will be deployed
    tm_version: "1.6.0"
    # TLS can be True or False for the orion tm
    tm_tls: True
    # Tls trust value
    tm_trust: "ca-or-tofu"                  # Options are: "ca-or-tofu", "ca", "tofu"
    ## File location where the base64 encoded genesis file is located.
    genesis: "/home/user/bevel/build/besu_genesis"   # Location where genesis file␣
↪will be fetched
    ## Transaction Manager nodes public addresses should be provided.
    #  - "https://node.test.besu.blockchain-develop.com:15013"
    # The above domain name is formed by the (http or https)://(peer.name).(org.
↪external_url_suffix):(ambassador orion node port)
    tm_nodes:
      - "https://carrier.test.besu.blockchaincloudpoc-develop.com:15013"
      - "https://manufacturer.test.besu.blockchaincloudpoc-develop.com:15023"
      - "https://store.test.besu.blockchaincloudpoc-develop.com:15033"
      - "https://warehouse.test.besu.blockchaincloudpoc-develop.com:15043"
    # Besu rpc public address list for existing validator and member nodes
    #  - "http://node.test.besu.blockchaincloudpoc-develop.com:15011"
    # The above domain name is formed by the (http)://(peer.name).(org.external_url_
↪suffix):(ambassador node rpc port)
    besu_nodes:
      - "http://validator.test.besu.blockchaincloudpoc-develop.com:15051"
      - "http://carrier.test.besu.blockchaincloudpoc-develop.com:15011"
      - "http://manufacturer.test.besu.blockchaincloudpoc-develop.com:15021"
      - "http://store.test.besu.blockchaincloudpoc-develop.com:15031"
```

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```
  # Allows specification of one or many organizations that will be connecting to a␣
↪network.
  organizations:
    # Specification for the 1st organization. Each organization should map to a VPC␣
↪and a separate k8s cluster for production deployments
    - organization:
      name: neworg
      type: member
      # Provide the url suffix that will be added in DNS recordset. Must be different␣
↪for different clusters
      # This is not used for Besu as Besu does not support DNS hostnames currently.␣
↪Here for future use
      external_url_suffix: test.besu.blockchaincloudpoc-develop.com
      cloud_provider: aws   # Options: aws, azure, gcp
      aws:
        access_key: "aws_access_key"        # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "aws_secret_key"        # AWS Secret key, only used when cloud_
↪provider=aws
        region: "aws_region"                # AWS Region where cluster and EIPs are␣
↪created
      # Kubernetes cluster deployment variables. The config file path and name has to␣
↪be provided in case
      # the cluster has already been created.
      k8s:
        context: "cluster_context"
        config_file: "cluster_config"
      # Hashicorp Vault server address and root-token. Vault should be unsealed.
      # Do not check-in root_token
      vault:
        url: "vault_addr"
        root_token: "vault_root_token"
        secret_path: "secretsv2"
      # Git Repo details which will be used by GitOps/Flux.
      # Do not check-in git_access_token
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "https://github.com/<username>/bevel.git"         # Gitops https or␣
↪ssh url for flux value files
        branch: "develop"           # Git branch where release is being made
        release_dir: "platforms/hyperledger-besu/releases/dev" # Relative Path in the␣
↪Git repo for flux sync per environment.
        chart_source: "platforms/hyperledger-besu/charts"     # Relative Path where␣
↪the Helm charts are stored in Git repo
        git_repo: "github.com/<username>/bevel.git"   # Gitops git repository URL for␣
↪git push
        username: "git_username"          # Git Service user who has rights to check-
↪in in all branches
        password: "git_access_token"      # Git Server user access token (Optional␣
↪for ssh; Required for https)
        email: "git_email"                # Email to use in git config
        private_key: "path_to_private_key"          # Path to private key file which␣
↪has write-access to the git repo (Optional for https; Required for ssh)
      # The participating nodes are named as peers
      services:
        peers:
```

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```
        - peer:
          name: newOrg
          subject: "O=Neworg,OU=Neworg,L=51.50/-0.13/London,C=GB" # This is the node␣
↪subject. L=lat/long is mandatory for supplychain sample app
          geth_passphrase: 12345  # Passphrase to be used to generate geth account
          lock: false        # Sets Besu node to lock or unlock mode. Can be true or␣
↪false
          p2p:
            port: 30303
            ambassador: 15020       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15021       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
          tm_nodeport:
            port: 15022             # Port exposed on ambassador service must be same
            ambassador: 15022
          tm_clientport:
            port: 8888
```

Three new sections are added to the network.yaml

Run playbook

The site.yaml playbook is used to add a new organization to the existing network. This can be done using the following command

```
ansible-playbook platforms/shared/configuration/site.yaml --extra-vars "@path-to-
↪network.yaml" --extra-vars "add_new_org=True"
```

Verify network deployment

For instructions on how to verify or troubleshoot network, read *How to debug a Bevel deployment*

5.4.3 Adding a new validator node in Besu

- *Prerequisites*
- *Create Configuration File*
- *Run playbook*

Prerequisites

To add a new node in Besu, an existing besu network should be running, enode information of all existing nodes present in the network should be available, genesis file should be available in base64 encoding and the information of orion nodes and existing validator nodes should be available. The new node account should be unlocked prior adding the new node to the existing besu network.

NOTE: Addition of a new validator node has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

Create Configuration File

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organization` details along with the orion transaction manager node details and existing validator and member node details.

NOTE: Make sure that the genesis flie is provided in base64 encoding. Also, if you are adding node to the same cluster as of another node, make sure that you add the ambassador ports of the existing node present in the cluster to the network.yaml

---

For reference, sample `network.yaml` file looks like below for IBFT consensus (but always check the latest network-besu-new-validatornode.yaml at `platforms/hyperledger-besu/configuration/samples`):

```
---
# This is a sample configuration file to add a new validator node to existing network.
# This DOES NOT support proxy=none
# All text values are case-sensitive
network:
# Network level configuration specifies the attributes required for each organization␣
↪to join an existing network.
  type: besu
  version: 21.10.6  #this is the version of Besu docker image that will be deployed.

#Environment section for Kubernetes setup
  env:
    type: "dev"                     # tag for the environment. Important to run␣
↪multiple flux on single cluster
    proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for besu
    ## Any additional Ambassador ports can be given below, this is valid only if␣
↪proxy='ambassador'
    #  These ports are enabled per cluster, so if you have multiple clusters you do␣
↪not need so many ports
    # This sample uses a single cluster, so we have to open 4 ports for each Node.
    # These ports are again specified for each organization below
    ambassadorPorts:
      portRange:                    # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021            # For specific ports
    retry_count: 20                 # Retry count for the checks on Kubernetes cluster
    external_dns: enabled           # Should be enabled if using external-dns for␣
↪automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
```

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```
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "ghcr.io/hyperledger"
    username: "docker_username"
    password: "docker_password"

  # Following are the configurations for the common Besu network
  config:
    consensus: "ibft"                    # Options are "ibft", "ethash" and "clique".
    ## Certificate subject for the root CA of the network.
    # This is for development usage only where we create self-signed certificates
    # and the truststores are generated automatically.
    # Production systems should generate proper certificates and configure␣
↪truststores accordingly.
    subject: "CN=DLT Root CA,OU=DLT,O=DLT,L=London,C=GB"
    transaction_manager: "orion"    # Transaction manager is "orion"
    # This is the version of "orion" docker image that will be deployed
    tm_version: "21.7.3"
    # TLS can be True or False for the orion tm
    tm_tls: True
    # Tls trust value
    tm_trust: "ca-or-tofu"               # Options are: "ca-or-tofu", "ca", "tofu"
    ## File location where the base64 encoded genesis file is located.
    genesis: "/home/user/bevel/build/besu_genesis"
    ## Transaction Manager nodes public addresses should be provided.
    #  - "https://node.test.besu.blockchain-develop.com:15013"
    # The above domain name is formed by the (http or https)://(peer.name).(org.
↪external_url_suffix):(ambassador orion node port)
    tm_nodes:
      - "https://carrier.test.besu.blockchaincloudpoc-develop.com:15013"
      - "https://manufacturer.test.besu.blockchaincloudpoc-develop.com:15023"
      - "https://store.test.besu.blockchaincloudpoc-develop.com:15033"
      - "https://warehouse.test.besu.blockchaincloudpoc-develop.com:15043"
    # Besu rpc public address list for existing validator and member nodes
    #  - "http://node.test.besu.blockchaincloudpoc-develop.com:15011"
    # The above domain name is formed by the (http)://(peer.name).(org.external_url_
↪suffix):(ambassador node rpc port)
    besu_nodes:
      - "http://validator1.test.besu.blockchaincloudpoc-develop.com:15011"
      - "http://validator2.test.besu.blockchaincloudpoc-develop.com:15013"
      - "http://validator3.test.besu.blockchaincloudpoc-develop.com:15015"
      - "http://validator4.test.besu.blockchaincloudpoc-develop.com:15017"
      - "https://carrier.test.besu.blockchaincloudpoc-develop.com:15050"
      - "https://manufacturer.test.besu.blockchaincloudpoc-develop.com:15053"
      - "https://store.test.besu.blockchaincloudpoc-develop.com:15056"
      - "https://warehouse.test.besu.blockchaincloudpoc-develop.com:15059"

  # Allows specification of one or many organizations that will be connecting to a␣
↪network.
  organizations:
  # Specification for the 1st organization. Each organization should map to a VPC and␣
↪a separate k8s cluster for production deployments
    - organization:
      name: supplychain
      type: validator
      # Provide the url suffix that will be added in DNS recordset. Must be different␣
↪for different clusters
```

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```
      # This is not used for Besu as Besu does not support DNS hostnames currently.␣
↪Here for future use
      external_url_suffix: test.besu.blockchaincloudpoc-develop.com
      cloud_provider: aws   # Options: aws, azure, gcp
      aws:
        access_key: "aws_access_key"        # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "aws_secret_key"        # AWS Secret key, only used when cloud_
↪provider=aws
        region: "aws_region"                # AWS Region where cluster and EIPs are␣
↪created
      # Kubernetes cluster deployment variables. The config file path and name has to␣
↪be provided in case
      # the cluster has already been created.
      k8s:
        context: "cluster_context"
        config_file: "cluster_config"
      # Hashicorp Vault server address and root-token. Vault should be unsealed.
      # Do not check-in root_token
      vault:
        url: "vault_addr"
        root_token: "vault_root_token"
        secret_path: "secretsv2"
      # Git Repo details which will be used by GitOps/Flux.
      # Do not check-in git_access_token
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "https://github.com/<username>/bevel.git"  # Gitops https or ssh url␣
↪for flux value files
        branch: "develop"
↪# Git branch where release is being made
        release_dir: "platforms/hyperledger-besu/releases/dev"
↪# Relative Path in the Git repo for flux sync per environment.
        chart_source: "platforms/hyperledger-besu/charts"
↪# Relative Path where the Helm charts are stored in Git repo
        git_repo: "github.com/<username>/bevel.git"         # Gitops git repository␣
↪URL for git push
        username: "git_username"                              # Git Service user who␣
↪has rights to check-in in all branches
        password: "git_access_token"                          # Git Server user␣
↪access token (Optional for ssh; Required for https)
        email: "git_email"                                    # Email to use in git␣
↪config
        private_key: "path_to_private_key"                    # Path to private key␣
↪file which has write-access to the git repo (Optional for https; Required for ssh)
      # As this is a validator org, it is hosting a few validators as services
      services:
        validators:
        - validator:
          name: validator1
          status: existing        # needed to know which  validator node exists
          bootnode: true          # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15020     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
```

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```
          rpc:
            port: 8545
            ambassador: 15021     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
        - validator:
          name: validator2
          status: existing        # needed to know which  validator node exists
          bootnode: true          # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15012     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15013     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
        - validator:
          name: validator3
          status: existing        # needed to know which  validator node exists     ␣
↪
          bootnode: false         # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15014     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15015     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
        - validator:
          name: validator4
          status: existing        # needed to know which  validator node exists     ␣
↪
          bootnode: false         # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15016     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15017     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
        - validator:
          name: validator5
          status: new             # needed to know which  validator node exists     ␣
↪
```

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```
          bootnode: false         # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15018     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15019     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
```

Three new sections are added to the network.yaml

Run playbook

The add-validator.yaml playbook is used to add a new validator node to an existing organization in a running network. This can be done using the following command

```
ansible-playbook platforms/hyperledger-besu/configuration/add-validator.yaml --extra-
↪vars "@path-to-network.yaml"
```

5.4.4 Adding a new validator organization in Besu

- *Prerequisites*
- *Create Configuration File*
- *Run playbook*

Prerequisites

To add a new organization in Besu, an existing besu network should be running, enode information of all existing nodes present in the network should be available, genesis file should be available in base64 encoding and the information of orion nodes and existing validator nodes should be available. The new node account should be unlocked prior adding the new node to the existing besu network.

NOTE: Addition of a new organization has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

Create Configuration File

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organization` details along with the orion transaction manager node details and existing validator and member node details.

NOTE: Make sure that the genesis flie is provided in base64 encoding. Also, if you are adding node to the same cluster as of another node, make sure that you add the ambassador ports of the existing node present in the cluster to the network.yaml

---

For reference, sample `network.yaml` file looks like below for IBFT consensus (but always check the latest network-besu-new-validatororg.yaml at `platforms/hyperledger-besu/configuration/samples`):

```
---
# This is a sample configuration file to add a new validator organization to existing␣
↪network.
# This DOES NOT support proxy=none
# All text values are case-sensitive
network:
# Network level configuration specifies the attributes required for each organization␣
↪to join an existing network.
  type: besu
  version: 21.10.6  #this is the version of Besu docker image that will be deployed.

#Environment section for Kubernetes setup
  env:
    type: "dev"                   # tag for the environment. Important to run␣
↪multiple flux on single cluster
    proxy: ambassador             # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for besu
    ## Any additional Ambassador ports can be given below, this is valid only if␣
↪proxy='ambassador'
    # These ports are enabled per cluster, so if you have multiple clusters you do␣
↪not need so many ports
    # This sample uses a single cluster, so we have to open 4 ports for each Node.
    # These ports are again specified for each organization below
    ambassadorPorts:
      portRange:                  # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021          # For specific ports
    retry_count: 20               # Retry count for the checks on Kubernetes cluster
    external_dns: enabled         # Should be enabled if using external-dns for␣
↪automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "ghcr.io/hyperledger"
    username: "docker_username"
    password: "docker_password"

  # Following are the configurations for the common Besu network
  config:
    consensus: "ibft"                   # Options are "ibft", "ethash" and "clique".
    ## Certificate subject for the root CA of the network.
    #  This is for development usage only where we create self-signed certificates␣
↪and the truststores are generated automatically.
    #  Production systems should generate proper certificates and configure␣
↪truststores accordingly.
    subject: "CN=DLT Root CA,OU=DLT,O=DLT,L=London,C=GB"
```

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```
    transaction_manager: "orion"    # Transaction manager is "orion"
    # This is the version of "orion" docker image that will be deployed
    tm_version: "21.7.3"
    # TLS can be True or False for the orion tm
    tm_tls: True
    # Tls trust value
    tm_trust: "ca-or-tofu"                # Options are: "ca-or-tofu", "ca", "tofu"
    ## File location where the base64 encoded genesis file is located.
    genesis: "/home/user/bevel/build/besu_genesis"
    ## Transaction Manager nodes public addresses should be provided.
    #  - "https://node.test.besu.blockchain-develop.com:15013"
    # The above domain name is formed by the (http or https)://(peer.name).(org.
↪external_url_suffix):(ambassador orion node port)
    tm_nodes:
      - "https://carrier.test.besu.blockchaincloudpoc-develop.com:15013"
      - "https://manufacturer.test.besu.blockchaincloudpoc-develop.com:15023"
      - "https://store.test.besu.blockchaincloudpoc-develop.com:15033"
      - "https://warehouse.test.besu.blockchaincloudpoc-develop.com:15043"
    # Besu rpc public address list for existing validator and member nodes
    #  - "http://node.test.besu.blockchaincloudpoc-develop.com:15011"
    # The above domain name is formed by the (http)://(peer.name).(org.external_url_
↪suffix):(ambassador node rpc port)
    besu_nodes:
      - "http://validator1.test.besu.blockchaincloudpoc-develop.com:15011"
      - "http://validator2.test.besu.blockchaincloudpoc-develop.com:15013"
      - "http://validator3.test.besu.blockchaincloudpoc-develop.com:15015"
      - "http://validator4.test.besu.blockchaincloudpoc-develop.com:15017"
      - "https://carrier.test.besu.blockchaincloudpoc-develop.com:15050"
      - "https://manufacturer.test.besu.blockchaincloudpoc-develop.com:15053"
      - "https://store.test.besu.blockchaincloudpoc-develop.com:15056"
      - "https://warehouse.test.besu.blockchaincloudpoc-develop.com:15059"

  # Allows specification of one or many organizations that will be connecting to a␣
↪network.
  organizations:
  # Specification for the 1st organization. Each organization should map to a VPC and␣
↪a separate k8s cluster for production deployments
    - organization:
      name: supplychain
      type: validator
      # Provide the url suffix that will be added in DNS recordset. Must be different␣
↪for different clusters
      # This is not used for Besu as Besu does not support DNS hostnames currently.␣
↪Here for future use
      external_url_suffix: test.besu.blockchaincloudpoc-develop.com
      cloud_provider: aws   # Options: aws, azure, gcp
      aws:
        access_key: "aws_access_key"        # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "aws_secret_key"        # AWS Secret key, only used when cloud_
↪provider=aws
        region: "aws_region"                # AWS Region where cluster and EIPs are␣
↪created
      # Kubernetes cluster deployment variables. The config file path and name has to␣
↪be provided in case
      # the cluster has already been created.
      k8s:
```

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```
        context: "cluster_context"
        config_file: "cluster_config"
      # Hashicorp Vault server address and root-token. Vault should be unsealed.
      # Do not check-in root_token
      vault:
        url: "vault_addr"
        root_token: "vault_root_token"
        secret_path: "secretsv2"
      # Git Repo details which will be used by GitOps/Flux.
      # Do not check-in git_access_token
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "https://github.com/<username>/bevel.git"  # Gitops https or ssh url␣
↪for flux value files
        branch: "develop"
↪# Git branch where release is being made
        release_dir: "platforms/hyperledger-besu/releases/dev"
↪# Relative Path in the Git repo for flux sync per environment.
        chart_source: "platforms/hyperledger-besu/charts"
↪# Relative Path where the Helm charts are stored in Git repo
        git_repo: "github.com/<username>/bevel.git"         # Gitops git repository␣
↪URL for git push
        username: "git_username"                              # Git Service user who␣
↪has rights to check-in in all branches
        password: "git_access_token"                          # Git Server user␣
↪access token (Optional for ssh; Required for https)
        email: "git_email"                                    # Email to use in git␣
↪config
        private_key: "path_to_private_key"                    # Path to private key␣
↪file which has write-access to the git repo (Optional for https; Required for ssh)
      # As this is a validator org, it is hosting a few validators as services
      services:
        validators:
        - validator:
          name: validator1
          status: existing        # needed to know which  validator node exists
          bootnode: true          # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15020     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15021     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
        - validator:
          name: validator2
          status: existing        # needed to know which  validator node exists
          bootnode: true          # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15012     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
```

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```
          rpc:
            port: 8545
            ambassador: 15013     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
        - validator:
          name: validator3
          status: existing        # needed to know which  validator node exists      ␣
↪
          bootnode: false         # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15014     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15015     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546
        - validator:
          name: validator4
          status: existing        # needed to know which  validator node exists      ␣
↪
          bootnode: false         # true if the validator node is used also a␣
↪bootnode for the network
          p2p:
            port: 30303
            ambassador: 15016     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8545
            ambassador: 15017     #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          ws:
            port: 8546

  - organization:
    name: supplychain2
    type: validator
    # Provide the url suffix that will be added in DNS recordset. Must be different␣
↪for different clusters
    external_url_suffix: test.besu.blockchaincloudpoc-develop.com

    cloud_provider: aws   # Options: aws, azure, gcp
    aws:
      access_key: "aws_access_key"          # AWS Access key, only used when cloud_
↪provider=aws
      secret_key: "aws_secret_key"          # AWS Secret key, only used when cloud_
↪provider=aws
      region: "aws_region"                  # AWS Region where cluster and EIPs are␣
↪created
    # Kubernetes cluster deployment variables. The config file path and name has to␣
↪be provided in case
    # the cluster has already been created.
```

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```
    k8s:
      context: "cluster_context"
      config_file: "cluster_config"
    # Hashicorp Vault server address and root-token. Vault should be unsealed.
    # Do not check-in root_token
    vault:
      url: "vault_addr"
      root_token: "vault_root_token"
      secret_path: "secretsv2"
    # Git Repo details which will be used by GitOps/Flux.
    # Do not check-in git_access_token
    gitops:
      git_protocol: "https" # Option for git over https or ssh
      git_url: "https://github.com/<username>/bevel.git"    # Gitops https or ssh url␣
↪for flux value files
      branch: "develop"
↪# Git branch where release is being made
      release_dir: "platforms/hyperledger-besu/releases/dev"
↪# Relative Path in the Git repo for flux sync per environment.
      chart_source: "platforms/hyperledger-besu/charts"
↪# Relative Path where the Helm charts are stored in Git repo
      git_repo: "github.com/<username>/bevel.git"           # Gitops git repository␣
↪URL for git push
      username: "git_username"                                # Git Service user who␣
↪has rights to check-in in all branches
      password: "git_access_token"                            # Git Server user␣
↪password/token (Optional for ssh; Required for https)
      email: "git@email.com"                                  # Email to use in git␣
↪config
      private_key: "path_to_private_key"                      # Path to private key␣
↪file which has write-access to the git repo (Optional for https; Required for ssh)
    # As this is a validator org, it is hosting a few validators as services
    services:
      validators:
      - validator:
        name: validator5
        status: new               # needed to know which  validator node exists
        bootnode: true            # true if the validator node is used also a␣
↪bootnode for the network
        p2p:
          port: 30303
          ambassador: 15026       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
        rpc:
          port: 8545
          ambassador: 15027       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
        ws:
          port: 8546
      - validator:
        name: validator6
        status: new               # needed to know which  validator node exists
        bootnode: true            # true if the validator node is used also a␣
↪bootnode for the network
        p2p:
          port: 30303
          ambassador: 15028       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
```

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```
        rpc:
          port: 8545
          ambassador: 15029       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
        ws:
          port: 8546
```

Three new sections are added to the network.yaml

Run playbook

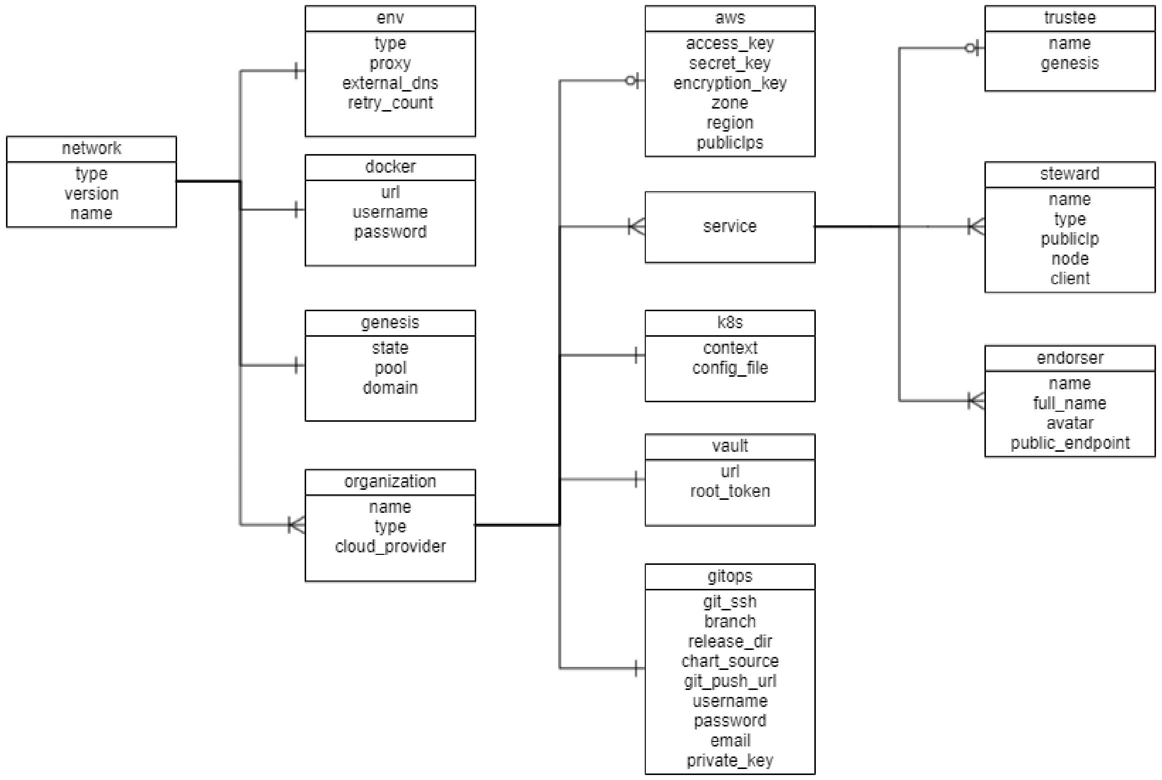
The add-validator.yaml playbook is used to add a new validator organization to the existing network. This can be done using the following command

```
ansible-playbook platforms/hyperledger-besu/configuration/add-validator.yaml --extra-
↪vars "@path-to-network.yaml" --extra-vars "add_new_org='true'"
```

5.5 Indy operations

5.5.1 Configuration file specification: Indy

A network.yaml file is the base configuration file for setting up a Indy network. This file contains all the information related to the infrastructure and network specifications. Here is the structure of it.



Before setting up a Indy network, this file needs to be updated with the required specifications. A sample configuration file is provide in the repo path:`platforms/hyperledger-indy/configuration/samples/network-indyv3.yaml`

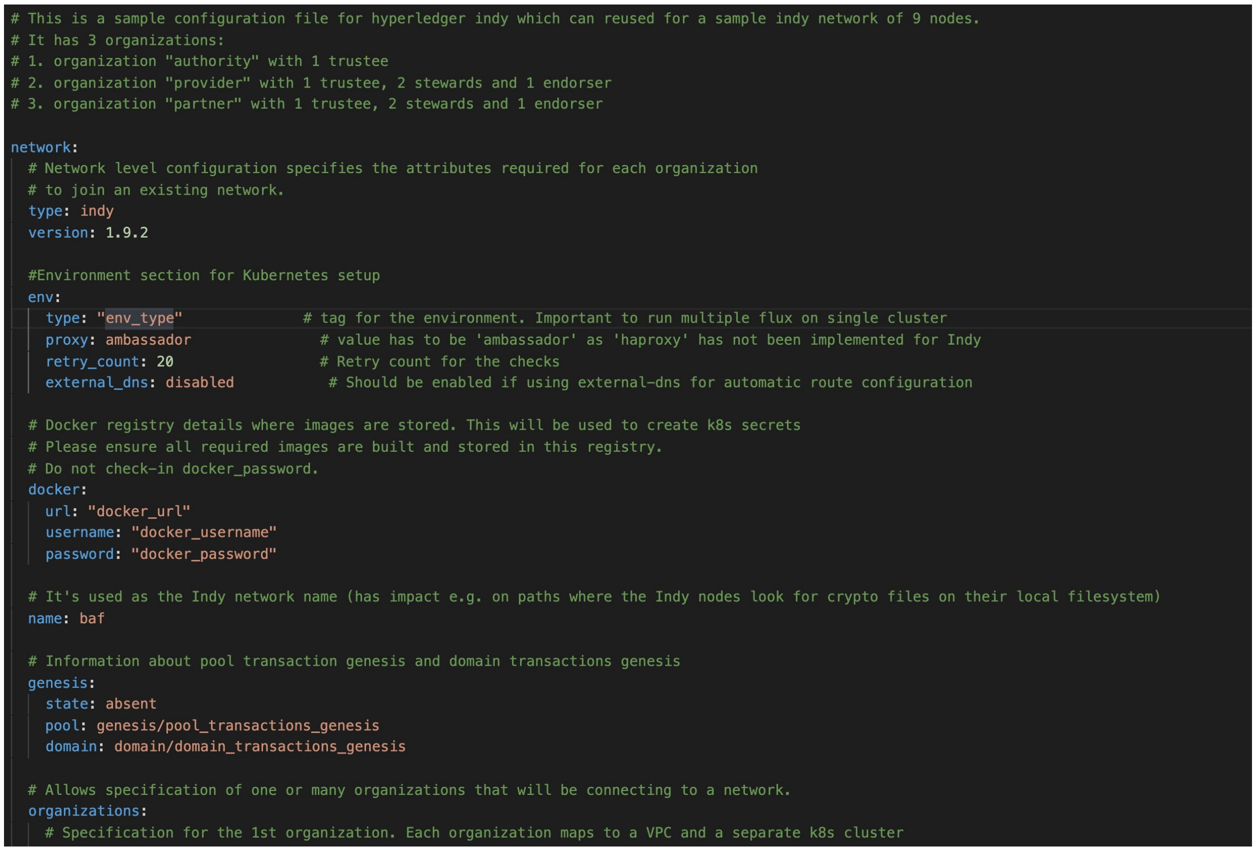
A json-schema definition is provided in `platforms/network-schema.json` to assist with semantic validations and lints. You can use your favorite yaml lint plugin compatible with json-schema specification, like `redhat.vscode-yaml` for VSCode. You need to adjust the directive in template located in the first line based on your actual build directory:

`# yaml-language-server: $schema=../platforms/network-schema.json`

The configurations are grouped in the following sections for better understanding.

- type
- version
- env
- docker
- name
- genesis
- organizations

Here is the snapshot from the sample configuration file



```
# This is a sample configuration file for hyperledger indy which can reused for a sample indy network of 9 nodes.
# It has 3 organizations:
# 1. organization "authority" with 1 trustee
# 2. organization "provider" with 1 trustee, 2 stewards and 1 endorser
# 3. organization "partner" with 1 trustee, 2 stewards and 1 endorser

network:
  # Network level configuration specifies the attributes required for each organization
  # to join an existing network.
  type: indy
  version: 1.9.2

  #Environment section for Kubernetes setup
  env:
    type: "env_type"              # tag for the environment. Important to run multiple flux on single cluster
    proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has not been implemented for Indy
    retry_count: 20                 # Retry count for the checks
    external_dns: disabled           # Should be enabled if using external-dns for automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "docker_url"
    username: "docker_username"
    password: "docker_password"

  # It's used as the Indy network name (has impact e.g. on paths where the Indy nodes look for crypto files on their local filesystem)
  name: baf

  # Information about pool transaction genesis and domain transactions genesis
  genesis:
    state: absent
    pool: genesis/pool_transactions_genesis
    domain: domain/domain_transactions_genesis

  # Allows specification of one or many organizations that will be connecting to a network.
  organizations:
    # Specification for the 1st organization. Each organization maps to a VPC and a separate k8s cluster
```

The sections in the sample configuration file are

`type` defines the platform choice like corda/fabric/indy, here in example its Indy

`version` defines the version of platform being used, here in example the Indy version is 1.9.2.

`env` section contains the environment type and additional configuration. Value for proxy field under this section has to be 'ambassador' as 'haproxy' has not been implemented for Indy.

The snapshot of the `env` section with example values is below

```
env:
  type: "env_type"              # tag for the environment. Important to run␣
↪multiple flux on single cluster
  proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for Indy
  # Must be different from all steward ambassador ports specified in the rest of␣
↪this network yaml
  ambassadorPorts:                # Any additional Ambassador ports can be given␣
↪here, this is valid only if proxy='ambassador'
    # portRange:              # For a range of ports
    #   from: 15010
    #   to: 15043
    ports: 15010,15023,15024,15033,15034,15043,15044  # Indy does not use a port␣
↪range as it creates an NLB, and only necessary ports should be opened
  loadBalancerSourceRanges: # (Optional) Default value is '0.0.0.0/0', this value␣
↪can be changed to any other IP adres or list (comma-separated without spaces) of IP␣
↪adresses, this is valid only if proxy='ambassador'
  retry_count: 20                 # Retry count for the checks
  external_dns: disabled           # Should be enabled if using external-dns for␣
↪automatic route configuration
```

The fields under `env` section are

`docker` section contains the credentials of the repository where all the required images are built and stored.

The snapshot of the `docker` section with example values is below

```
# Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
# Please ensure all required images are built and stored in this registry.
# Do not check-in docker_password.
docker:
  url: "docker_url"
  username: "docker_username"
  password: "docker_password"
```

The fields under `docker` section are

NOTE: Please follow these instructions to build and store the docker images before running the Ansible playbooks.

`name` is used as the Indy network name (has impact e.g. on paths where the Indy nodes look for crypto files on their local filesystem)

The snapshot of the `genesis` section with example values is below

```
# Information about pool transaction genesis and domain transactions genesis
genesis:
  state: absent
  pool: genesis/pool_transactions_genesis
  domain: domain/domain_transactions_genesis
```

The genesis section contains Information about pool transaction genesis and domain transactions genesis. genesis contains the following fields:

The organizations section allows specification of one or many organizations that will be connecting to a network. If an organization is also hosting the root of the network (e.g. membership service, etc), then these services should be listed in this section as well.

The snapshot of an organization field with sample values is below

```
    - organization:
      name: authority
      type: peer
      external_url_suffix: indy.blockchaincloudpoc.com  # Provide the external dns␣
↪suffix. Only used when Indy webserver/Clients are deployed.
      cloud_provider: aws             # Values can be 'aws-baremetal', 'aws' or
↪'minikube'
```

Each organization under the organizations section has the following fields.

For the aws and k8s field the snapshot with sample values is below

```
      aws:
        access_key: "aws_access_key"            # AWS Access key
        secret_key: "aws_secret_key"            # AWS Secret key
        encryption_key: "encryption_key_id"     # AWS encryption key. If present, it
↪'s used as the KMS key id for K8S storage class encryption.
        zone: "availability_zone"               # AWS availability zone
        region: "region"                        # AWS region

      publicIps: ["1.1.1.1","2.2.2.2"]                          # List of all public␣
↪IP addresses of each availability zone

      # Kubernetes cluster deployment variables. The config file path has to be␣
↪provided in case
      # the cluster has already been created.
      k8s:
        config_file: "cluster_config"
        context: "kubernetes-admin@kubernetes"
```

The aws field under each organisation contains: (This will be ignored if cloud_provider is not 'aws')

The publicIps field under each organisation contains:

NOTE: Network.yaml file consists of more organizations, where each organization can be under different availability zone. It means, that each organization has different IP. The field publicIps holds list of all IPs of all organizations in the same cluster. This should be in JSON Array format like ["1.1.1.1","2.2.2.2"] and must contain different IP for each availability zone on the K8s cluster i.e. If the K8s cluster is in two AZ, then two IP addresses should be provided here.

The k8s field under each organisation contains

For the vault field the snapshot with sample values is below

```
      # Hashicorp Vault server address and root-token. Vault should be unsealed.
      # Do not check-in root_token
      vault:
        url: "vault_addr"
        root_token: "vault_root_token"
```

The vault field under each organisation contains:

For gitops fields the snapshot from the sample configuration file with the example values is below

```
      # Git Repo details which will be used by GitOps/Flux.
      # Do not check-in git_password
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "gitops_ssh_url"                    # Gitops https or ssh url for␣
↪flux value files like "https://github.com/hyperledger/bevel.git"
        branch: "gitops_branch"                      # Git branch where release is␣
↪being made
        release_dir: "gitops_release_dir"            # Relative Path in the Git repo␣
↪for flux sync per environment.
        chart_source: "gitops_charts"                # Relative Path where the Helm␣
↪charts are stored in Git repo
        git_repo: "gitops_repo_url"              # Gitops git repository URL for git␣
↪push like "github.com/hyperledger/bevel.git"
        username: "git_username"                     # Git Service user who has rights␣
↪to check-in in all branches
        password: "git_password"                     # Git Server user password/ user␣
↪token (Optional for ssh; Required for https)
        email: "git_email"                           # Email to use in git config
        private_key: "path_to_private_key"           # Path to private key file which␣
↪has write-access to the git repo (Optional for https; Required for ssh)
```

The `gitops` field under each organization contains

The services field for each organization under `organizations` section of Indy contains list of `services` which could be trustee/steward/endorser

The snapshot of trustee service with example values is below

```
      services:
        trustees:
        - trustee:
          name: provider-trustee
          genesis: true
          server:
            port: 8000
            ambassador: 15010
```

The fields under `trustee` service are (find more about differences between trustee/steward/endorser here)

The snapshot of steward service example values is below

```
      services:
        stewards:
        - steward:
          name: provider-steward-1
          type: VALIDATOR
          genesis: true
          publicIp: 3.221.78.194
          node:
            port: 9711
            targetPort: 9711
            ambassador: 9711        # Port for ambassador service
          client:
            port: 9712
            targetPort: 9712
            ambassador: 9712        # Port for ambassador service
```

The fields under `steward` service are

The snapshot of endorser service with example values is below

```
      services:
        endorsers:
        - endorser:
          name: provider-endorser
          full_name: Some Decentralized Identity Mobile Services Provider
          avatar: https://provider.com/avatar.png
          # public endpoint will be {{ endorser.name}}.{{ external_url_suffix}}:{
↪{endorser.server.httpPort}}
          # E.g. In this sample https://provider-endorser.indy.blockchaincloudpoc.
↪com:15020/
          # For minikube: http://<minikubeip>>:15020
          server:
            httpPort: 15020
            apiPort: 15030
```

The fields under `endorser` service are

5.5.2 Adding a new validator organization in Indy

- *Prerequisites*
- *Add a new validator organization to a Bevel managed network*
  - *Create Configuration File*
  - *Run playbook*
- *Add a new validator organization to network managed outside of Bevel*
  - *Create Configuration File*
  - *Run playbook up-to genesis config map creation*
  - *Provide public STEWARD identity crypto to network manager*
  - *Run rest of playbook*

Prerequisites

To add a new organization in Indy, an existing Indy network should be running, pool and domain genesis files should be available.

NOTE: The guide is only for the addition of VALIDATOR Node in existing Indy network.

Add a new validator organization to a Bevel managed network

Create Configuration File

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organization` details.

NOTE: If you are adding node to the same cluster as of another node, make sure that you add the ambassador ports of the existing node present in the cluster to the network.yaml

For reference, sample `network.yaml` file looks like below (but always check the latest network-indy-newnode-to-bevel-network.yaml at `platforms/hyperledger-indy/configuration/samples`):

```
---
# This is a sample configuration file for hyperledger indy which can be reused for␣
↪adding of new org with 1 validator node to a fully Bevel managed network.
# It has 2 organizations:
# 1. existing organization "university" with 1 trustee, 4 stewards and 1 endorser
# 2. new organization "bank" with 1 trustee, 1 steward and 1 endorser

network:
  # Network level configuration specifies the attributes required for each␣
↪organization
  # to join an existing network.
  type: indy
  version: 1.11.0                         # Supported versions 1.11.0 and 1.12.1

  #Environment section for Kubernetes setup
  env:
    type: indy              # tag for the environment. Important to run multiple flux␣
↪on single cluster
    proxy: ambassador                 # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for Indy
    ambassadorPorts:
      portRange:              # For a range of ports
        from: 9711
        to: 9720
    loadBalancerSourceRanges: # (Optional) Default value is '0.0.0.0/0', this value␣
↪can be changed to any other IP adres or list (comma-separated without spaces) of IP␣
↪adresses, this is valid only if proxy='ambassador'
    retry_count: 40                   # Retry count for the checks
    external_dns: enabled             # Should be enabled if using external-dns for␣
↪automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "ghcr.io/hyperledger"
    username: "docker_username"
    password: "docker_password"

  # It's used as the Indy network name (has impact e.g. on paths where the Indy nodes␣
↪look for crypto files on their local filesystem)
  name: bevel

  # Information about pool transaction genesis and domain transactions genesis
  # All the fields below in the genesis section are MANDATORY
  genesis:
    state: present              # must be present when add_new_org is true
```

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```
    pool: /path/to/pool_transactions_genesis         # path where pool_transactions_
↪genesis from existing network has been stored locally
    domain: /path/to/domain_transactions_genesis     # path where domain_transactions_
↪genesis from existing has been stored locally

  # Allows specification of one or many organizations that will be connecting to a␣
↪network.
  organizations:
  - organization:
    name: university
    type: peer
    org_status: existing # Status of the organization for the existing network, can␣
↪be new / existing
    cloud_provider: aws
    external_url_suffix: indy.blockchaincloudpoc.com  # Provide the external dns␣
↪suffix. Only used when Indy webserver/Clients are deployed.

    aws:
      access_key: "aws_access_key"            # AWS Access key
      secret_key: "aws_secret_key"            # AWS Secret key
      encryption_key: "encryption_key_id"     # AWS encryption key. If present, it's␣
↪used as the KMS key id for K8S storage class encryption.
      zone: "availability_zone"               # AWS availability zone
      region: "region"                        # AWS region

    publicIps: ["3.221.78.194"]             # List of all public IP addresses of each␣
↪availability zone from all organizations in the same k8s cluster

    # Kubernetes cluster deployment variables. The config file path has to be␣
↪provided in case
    # the cluster has already been created.
    k8s:
      config_file: "/path/to/cluster_config"
      context: "kubernetes-admin@kubernetes"

    # Hashicorp Vault server address and root-token. Vault should be unsealed.
    # Do not check-in root_token
    vault:
      url: "vault_addr"
      root_token: "vault_root_token"

    # Git Repo details which will be used by GitOps/Flux.
    # Do not check-in git_access_token
    gitops:
      git_protocol: "https" # Option for git over https or ssh
      git_url: "https://github.com/<username>/bevel.git"                 # Gitops␣
↪https or ssh url for flux value files
      branch: "develop"                   # Git branch where release is being made
      release_dir: "platforms/hyperledger-indy/releases/dev"         # Relative Path␣
↪in the Git repo for flux sync per environment.
      chart_source: "platforms/hyperledger-indy/charts"             # Relative Path␣
↪where the Helm charts are stored in Git repo
      git_repo: "github.com/<username>/bevel.git"           # Gitops git repository␣
↪URL for git push
      username: "git_username"                    # Git Service user who has rights to␣
↪check-in in all branches
      password: "git_access_token"                    # Git Server user password
```

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```
      email: "git@email.com"                          # Email to use in git config
      private_key: "path_to_private_key"        # Path to private key file which has␣
↪write-access to the git repo (Optional for https; Required for ssh)

    # Services maps to the pods that will be deployed on the k8s cluster
    # This sample has trustee, 2 stewards and endoorser
    services:
      trustees:
      - trustee:
        name: university-trustee
        genesis: true
      stewards:
      - steward:
        name: university-steward-1
        type: VALIDATOR
        genesis: true
        publicIp: 3.221.78.194        # IP address of current organization in current␣
↪availability zone
        node:
          port: 9713
          targetPort: 9713
          ambassador: 9713            # Port for ambassador service
        client:
          port: 9714
          targetPort: 9714
          ambassador: 9714            # Port for ambassador service
      - steward:
        name: university-steward-2
        type: VALIDATOR
        genesis: true
        publicIp: 3.221.78.194        # IP address of current organization in current␣
↪availability zone
        node:
          port: 9715
          targetPort: 9715
          ambassador: 9715            # Port for ambassador service
        client:
          port: 9716
          targetPort: 9716
          ambassador: 9716            # Port for ambassador service
      - steward:
        name: university-steward-3
        type: VALIDATOR
        genesis: true
        publicIp: 3.221.78.194        # IP address of current organization in current␣
↪availability zone
        node:
          port: 9717
          targetPort: 9717
          ambassador: 9717            # Port for ambassador service
        client:
          port: 9718
          targetPort: 9718
          ambassador: 9718            # Port for ambassador service
      - steward:
        name: university-steward-4
        type: VALIDATOR
```

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```
        genesis: true
        publicIp: 3.221.78.194        # IP address of current organization in current␣
↪availability zone
        node:
          port: 9719
          targetPort: 9719
          ambassador: 9719            # Port for ambassador service
        client:
          port: 9720
          targetPort: 9720
          ambassador: 9720            # Port for ambassador service
      endorsers:
      - endorser:
        name: university-endorser
        full_name: Some Decentralized Identity Mobile Services Partner
        avatar: http://university.com/avatar.png
        # public endpoint will be {{ endorser.name}}.{{ external_url_suffix}}:{
↪{endorser.server.httpPort}}
        # Eg. In this sample http://university-endorser.indy.blockchaincloudpoc.
↪com:15033/
        # For minikube: http://<minikubeip>>:15033
        server:
          httpPort: 15033
          apiPort: 15034
          webhookPort: 15035
  - organization:
    name: bank
    type: peer
    org_status: new # Status of the organization for the existing network, can be new␣
↪/ existing
    cloud_provider: aws
    external_url_suffix: indy.blockchaincloudpoc.com  # Provide the external dns␣
↪suffix. Only used when Indy webserver/Clients are deployed.

    aws:
      access_key: "aws_access_key"            # AWS Access key
      secret_key: "aws_secret_key"            # AWS Secret key
      encryption_key: "encryption_key_id"     # AWS encryption key. If present, it's␣
↪used as the KMS key id for K8S storage class encryption.
      zone: "availability_zone"               # AWS availability zone
      region: "region"                        # AWS region

    publicIps: ["3.221.78.194"]               # List of all public IP addresses of␣
↪each availability zone from all organizations in the same k8s cluster              ␣
↪         # List of all public IP addresses of each availability zone

    # Kubernetes cluster deployment variables. The config file path has to be␣
↪provided in case
    # the cluster has already been created.
    k8s:
      config_file: "/path/to/cluster_config"
      context: "kubernetes-admin@kubernetes"

    # Hashicorp Vault server address and root-token. Vault should be unsealed.
    # Do not check-in root_token
    vault:
      url: "vault_addr"
```

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```
      root_token: "vault_root_token"

    # Git Repo details which will be used by GitOps/Flux.
    # Do not check-in git_access_token
    gitops:
      git_protocol: "https" # Option for git over https or ssh
      git_url: "https://github.com/<username>/bevel.git"                   # Gitops␣
↪https or ssh url for flux value files
      branch: "develop"                      # Git branch where release is being made
      release_dir: "platforms/hyperledger-indy/releases/dev"           # Relative␣
↪Path in the Git repo for flux sync per environment.
      chart_source: "platforms/hyperledger-indy/charts"               # Relative Path␣
↪where the Helm charts are stored in Git repo
      git_repo: "github.com/<username>/bevel.git"             # Gitops git repository␣
↪URL for git push
      username: "git_username"                    # Git Service user who has rights␣
↪to check-in in all branches
      password: "git_access_token"                    # Git Server user password
      email: "git@email.com"                          # Email to use in git config
      private_key: "path_to_private_key"          # Path to private key file which␣
↪has write-access to the git repo (Optional for https; Required for ssh)

    # Services maps to the pods that will be deployed on the k8s cluster
    # This sample has trustee, 2 stewards and endoorser
    services:
      trustees:
      - trustee:
        name: bank-trustee
        genesis: true
      stewards:
      - steward:
        name: bank-steward-1
        type: VALIDATOR
        genesis: true
        publicIp: 3.221.78.194    # IP address of current organization in current␣
↪availability zone
        node:
          port: 9711
          targetPort: 9711
          ambassador: 9711        # Port for ambassador service
        client:
          port: 9712
          targetPort: 9712
          ambassador: 9712        # Port for ambassador service
      endorsers:
      - endorser:
        name: bank-endorser
        full_name: Some Decentralized Identity Mobile Services Provider
        avatar: http://bank.com/avatar.png
```

Following items must be added/updated to the network.yaml used to add new organizations

Also, ensure that `organization.org_status` is set to `existing` for existing orgs and `new` for the new org.

Run playbook

The add-new-organization.yaml playbook is used to add a new organization to the existing Bevel managed network by running the following command

```
ansible-playbook platforms/shared/configuration/add-new-organization.yaml -e "@path-
↪to-network.yaml"
```

Add a new validator organization to network managed outside of Bevel

Create Configuration File

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organization` details.

For reference, sample `network.yaml` file looks like below (but always check the latest network-indy-newnode-to-non-bevel-network.yaml at `platforms/hyperledger-indy/configuration/samples`):

```
---
# This is a sample configuration file for hyperledger indy which can be reused for␣
↪adding of new org with 1 validator node to an existing non-Bevel managed network.
# It has 1 organization:
# - new organization "bank" with 1 steward and 1 endorser

network:
  # Network level configuration specifies the attributes required for each␣
↪organization
  # to join an existing network.
  type: indy
  version: 1.11.0                         # Supported versions 1.11.0 and 1.12.1

  #Environment section for Kubernetes setup
  env:
    type: indy              # tag for the environment. Important to run multiple flux␣
↪on single cluster
    proxy: ambassador                 # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for Indy
    ambassadorPorts:
      portRange:              # For a range of ports
        from: 9711
        to: 9712
    loadBalancerSourceRanges: # (Optional) Default value is '0.0.0.0/0', this value␣
↪can be changed to any other IP adres or list (comma-separated without spaces) of IP␣
↪adresses, this is valid only if proxy='ambassador'
    retry_count: 40                   # Retry count for the checks
    external_dns: enabled             # Should be enabled if using external-dns for␣
↪automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "ghcr.io/hyperledger"
    username: "docker_username"
```

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```
    password: "docker_password"

  # It's used as the Indy network name (has impact e.g. on paths where the Indy nodes␣
↪look for crypto files on their local filesystem)
  name: bevel

  # Information about pool transaction genesis and domain transactions genesis
  # All the fields below in the genesis section are MANDATORY
  genesis:
    state: present              # must be present when add_new_org is true
    pool: /path/to/pool_transactions_genesis         # path where pool_transactions_
↪genesis from existing network has been stored locally
    domain: /path/to/domain_transactions_genesis     # path where domain_transactions_
↪genesis from existing has been stored locally

  # Allows specification of one or many organizations that will be connecting to a␣
↪network.
  organizations:
  - organization:
    name: bank
    type: peer
    org_status: new # Status of the organization for the existing network, can be new␣
↪/ existing
    cloud_provider: aws
    external_url_suffix: indy.blockchaincloudpoc.com  # Provide the external dns␣
↪suffix. Only used when Indy webserver/Clients are deployed.

    aws:
      access_key: "aws_access_key"            # AWS Access key
      secret_key: "aws_secret_key"            # AWS Secret key
      encryption_key: "encryption_key_id"     # AWS encryption key. If present, it's␣
↪used as the KMS key id for K8S storage class encryption.
      zone: "availability_zone"               # AWS availability zone
      region: "region"                        # AWS region

    publicIps: ["3.221.78.194"]               # List of all public IP addresses of␣
↪each availability zone from all organizations in the same k8s cluster              ␣
↪         # List of all public IP addresses of each availability zone

    # Kubernetes cluster deployment variables. The config file path has to be␣
↪provided in case
    # the cluster has already been created.
    k8s:
      config_file: "/path/to/cluster_config"
      context: "kubernetes-admin@kubernetes"

    # Hashicorp Vault server address and root-token. Vault should be unsealed.
    # Do not check-in root_token
    vault:
      url: "vault_addr"
      root_token: "vault_root_token"

    # Git Repo details which will be used by GitOps/Flux.
    # Do not check-in git_access_token
    gitops:
      git_protocol: "https" # Option for git over https or ssh
      git_url: "https://github.com/<username>/bevel.git"                   # Gitops␣
↪https or ssh url for flux value files
```

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```
      branch: "develop"                      # Git branch where release is being made
      release_dir: "platforms/hyperledger-indy/releases/dev"           # Relative␣
↪Path in the Git repo for flux sync per environment.
      chart_source: "platforms/hyperledger-indy/charts"               # Relative Path␣
↪where the Helm charts are stored in Git repo
      git_repo: "github.com/<username>/bevel.git"           # Gitops git repository␣
↪URL for git push
      username: "git_username"                    # Git Service user who has rights␣
↪to check-in in all branches
      password: "git_access_token"                    # Git Server user password
      email: "git@email.com"                          # Email to use in git config
      private_key: "path_to_private_key"          # Path to private key file which␣
↪has write-access to the git repo (Optional for https; Required for ssh)

    # Services maps to the pods that will be deployed on the k8s cluster
    # This sample has trustee, 2 stewards and endoorser
    services:
      stewards:
      - steward:
        name: bank-steward-1
        type: VALIDATOR
        genesis: true
        publicIp: 3.221.78.194    # IP address of current organization in current␣
↪availability zone
        node:
          port: 9711
          targetPort: 9711
          ambassador: 9711        # Port for ambassador service
        client:
          port: 9712
          targetPort: 9712
          ambassador: 9712        # Port for ambassador service
      endorsers:
      - endorser:
        name: bank-endorser
        full_name: Some Decentralized Identity Mobile Services Provider
        avatar: http://bank.com/avatar.png
```

Following items must be added/updated to the network.yaml used to add new organizations

Also, ensure that `organization.org_status` is set to `new` for the new org.

Run playbook up-to genesis config map creation

The add-new-organization.yaml playbook is used with additional parameters specifying that a TRUSTEE identity is not present in the network configuration file and also NYMs (identities) of the new organization are not yet present on the domain ledger. This is achieved by running the following command

```
ansible-playbook platforms/shared/configuration/add-new-organization.yaml -e "@path-
↪to-network.yaml" \
                                                                          -e "add_new_
↪org_network_trustee_present=false" \
                                                                          -e "add_new_
↪org_new_nyms_on_ledger_present=false"
```

Provide public STEWARD identity crypto to network manager

Share the following public crypto with an organization admin (TRUSTEE identity owner), check full Vault structure *here*.

Please wait for the organization admin to confirm that the identity has been added to the domain ledger with a STEWARD role until you proceed with the final step.

Run rest of playbook

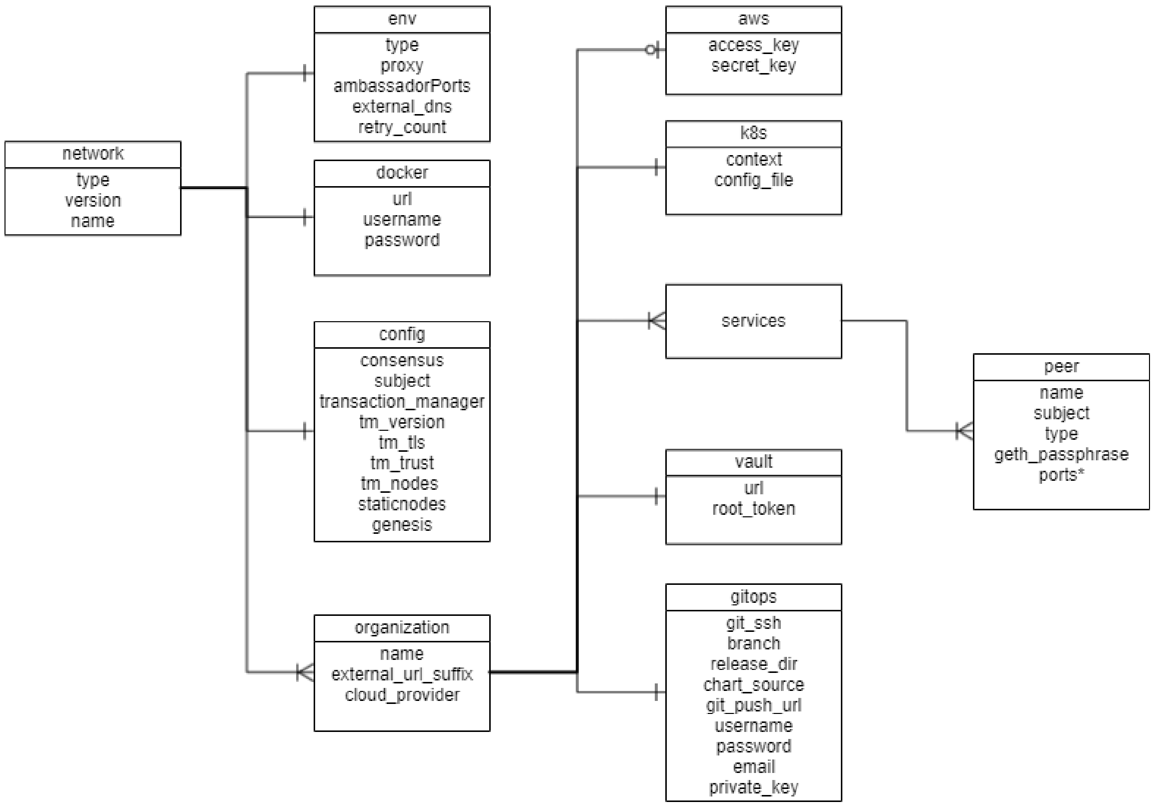
The add-new-organization.yaml playbook is used with additional parameters specifying that a TRUSTEE identity is not present in the network configuration file and also NYMs (identities) of the new organization are already present on the domain ledger. This is achieved by running the following command

```
ansible-playbook platforms/shared/configuration/add-new-organization.yaml -e "@path-
↪to-network.yaml" \
                                                                            -e "add_new_
↪org_network_trustee_present=false" \
                                                                            -e "add_new_
↪org_new_nyms_on_ledger_present=true"
```

5.6 Quorum operations

5.6.1 Configuration file specification: Quorum

A network.yaml file is the base configuration file designed in Hyperledger Bevel for setting up a Quorum DLT network. This file contains all the configurations related to the network that has to be deployed. Below shows its structure.



Before setting up a Quorum DLT/Blockchain network, this file needs to be updated with the required specifications.

A sample configuration file is provided in the repo path:`platforms/quorum/configuration/samples/network-quorum.yaml`

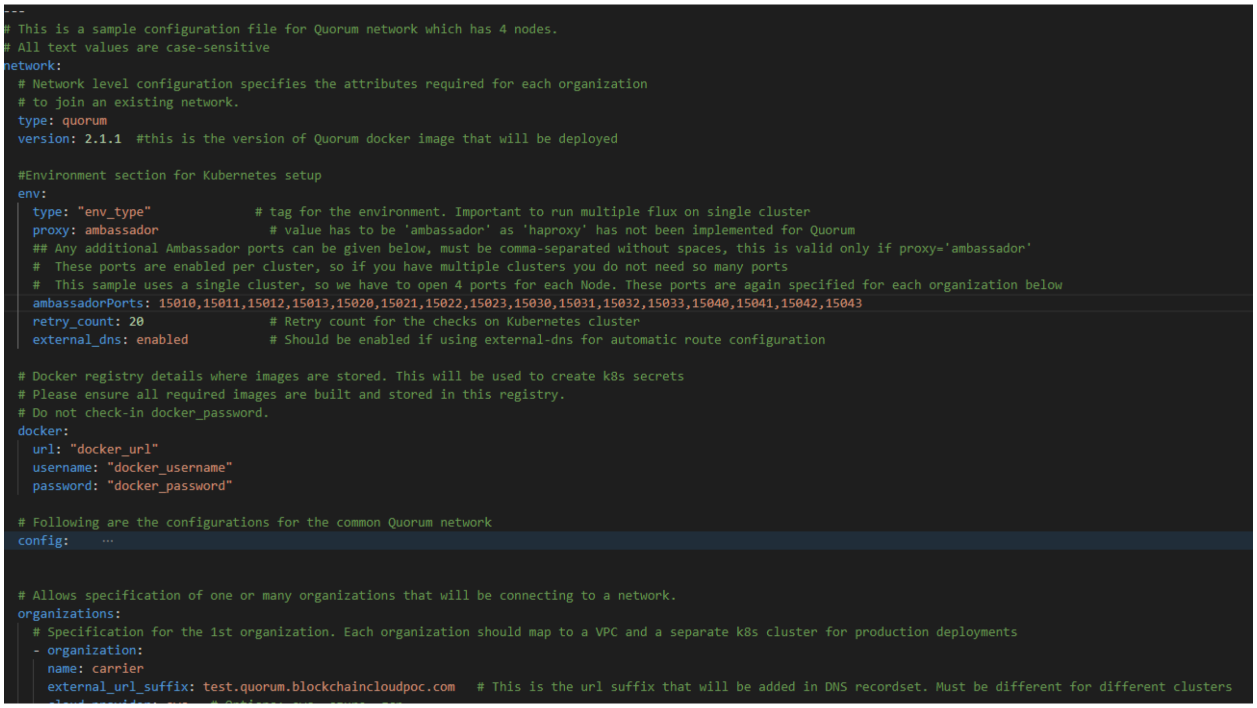
A json-schema definition is provided in `platforms/network-schema.json` to assist with semantic validations and lints. You can use your favorite yaml lint plugin compatible with json-schema specification, like `redhat.vscode-yaml` for VSCode. You need to adjust the directive in template located in the first line based on your actual build directory:

```
# yaml-language-server: $schema=../platforms/network-schema.json
```

The configurations are grouped in the following sections for better understanding.

- type
- version
- env
- docker
- config
- organizations

Here is the snapshot from the sample configuration file



```
---
# This is a sample configuration file for Quorum network which has 4 nodes.
# All text values are case-sensitive
network:
  # Network level configuration specifies the attributes required for each organization
  # to join an existing network.
  type: quorum
  version: 2.1.1  #this is the version of Quorum docker image that will be deployed

  #Environment section for Kubernetes setup
  env:
    type: "env_type"              # tag for the environment. Important to run multiple flux on single cluster
    proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has not been implemented for Quorum
    ## Any additional Ambassador ports can be given below, must be comma-separated without spaces, this is valid only if proxy='ambassador'
    #  These ports are enabled per cluster, so if you have multiple clusters you do not need so many ports
    #  This sample uses a single cluster, so we have to open 4 ports for each Node. These ports are again specified for each organization below
    ambassadorPorts: 15010,15011,15012,15013,15020,15021,15022,15023,15030,15031,15032,15033,15040,15041,15042,15043
    retry_count: 20                 # Retry count for the checks on Kubernetes cluster
    external_dns: enabled           # Should be enabled if using external-dns for automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "docker_url"
    username: "docker_username"
    password: "docker_password"

  # Following are the configurations for the common Quorum network
  config:   ···


  # Allows specification of one or many organizations that will be connecting to a network.
  organizations:
    # Specification for the 1st organization. Each organization should map to a VPC and a separate k8s cluster for production deployments
    - organization:
      name: carrier
      external_url_suffix: test.quorum.blockchaincloudpoc.com   # This is the url suffix that will be added in DNS recordset. Must be different for different clusters
```

The sections in the sample configuration file are

`type` defines the platform choice like corda/fabric/indy/quorum, here in the example its **quorum**.

`version` defines the version of platform being used. The current Quorum version support is only for **21.4.2**

NOTE: Use Quorum Version 21.4.2 if you are deploying Supplychain smartcontracts from examples.

`env` section contains the environment type and additional (other than 8443) Ambassador port configuration. Vaule for proxy field under this section can be 'ambassador' or 'haproxy'

The snapshot of the `env` section with example value is below

```
  env:
    type: "env-type"              # tag for the environment. Important to run␣
↪multiple flux on single cluster
    proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for Quorum
    #  These ports are enabled per cluster, so if you have multiple clusters you do␣
↪not need so many ports
    #  This sample uses a single cluster, so we have to open 4 ports for each Node.␣
↪These ports are again specified for each organization below
    ambassadorPorts:                # Any additional Ambassador ports can be given␣
↪here, this is valid only if proxy='ambassador'
      portRange:              # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021      # For specific ports
    loadBalancerSourceRanges: 0.0.0.0/0 # Default value is '0.0.0.0/0', this value␣
↪can be changed to any other IP adres or list (comma-separated without spaces) of IP␣
↪adresses, this is valid only if proxy='ambassador'
```

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```
    retry_count: 50                 # Retry count for the checks
    external_dns: enabled            # Should be enabled if using external-dns for␣
↪automatic route configuration
```

The fields under `env` section are

`docker` section contains the credentials of the repository where all the required images are built and stored.

The snapshot of the `docker` section with example values is below

```
  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "docker_url"
    username: "docker_username"
    password: "docker_password"
```

The fields under `docker` section are

`config` section contains the common configurations for the Quorum network.

The snapshot of the `config` section with example values is below

```
  config:
    consensus: "raft"                 # Options are "raft" and "ibft"
    ## Certificate subject for the root CA of the network.
    #  This is for development usage only where we create self-signed certificates␣
↪and the truststores are generated automatically.
    #  Production systems should generate proper certificates and configure␣
↪truststores accordingly.
    subject: "CN=DLT Root CA,OU=DLT,O=DLT,L=London,C=GB"
    transaction_manager: "tessera"     # Options are "tessera" and "constellation"
    # This is the version of "tessera" or "constellation" docker image that will be␣
↪deployed
    # Supported versions #
    # constellation: 0.3.2 (For all versions of quorum)
    tm_version: "21.7.3"               # This is the version of "tessera" and
↪"constellation" docker image that will be deployed
    tm_tls: "strict"                  # Options are "strict" and "off"
    tm_trust: "tofu"                  # Options are: "ca-or-tofu", "ca", "tofu"
    ## Transaction Manager nodes public addresses should be provided.
    #  For "tessera", all participating nodes should be provided
    #  For "constellation", only one is bootnode should be provided
    #
    # For constellation, use following. This will be the bootnode for all nodes
    #  - "http://carrier.test.quorum.blockchaincloudpoc.com:15012/"  #NOTE the end /␣
↪is necessary and should not be missed
    # The above domain name is formed by the http://(peer.name).(org.external_url_
↪suffix):(ambassador constellation port)/
    # In the example (for tessera ) below, the domain name is formed by the https://
↪(peer.name).(org.external_url_suffix):(ambassador default port)
    tm_nodes:
      - "https://carrier.test.quorum.blockchaincloudpoc.com:8443"
      - "https://manufacturer.test.quorum.blockchaincloudpoc.com:8443"
      - "https://store.test.quorum.blockchaincloudpoc.com:8443"
      - "https://warehouse.test.quorum.blockchaincloudpoc.com:8443"
```

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```
    staticnodes: "/home/user/bevel/build/quorum_staticnodes" # Location where␣
↪staticnodes will be saved
    genesis: "/home/user/bevel/build/quorum_genesis"    # Location where genesis file␣
↪will be saved
    # NOTE for the above paths, the directories should exist
    ##### Following keys are only used when adding new Node(s) to existing network␣
↪and should NOT be used to create new network.
    bootnode:
      #name of the bootnode that matches one from existing node
      name: carrier
      #ambassador url of the bootnode
      url: carrier.test.quorum.blockchaincloudpoc.com
      #rpc port of the bootnode
      rpcport: 15011
      #id of the bootnode
      nodeid: 1
```

The fields under `config` are

The `organizations` section contains the specifications of each organization.

In the sample configuration example, we have four organization under the `organizations` section.

The snapshot of an organization field with sample values is below

```
  organizations:
    # Specification for the 1st organization. Each organization maps to a VPC and a␣
↪separate k8s cluster
    - organization:
      name: carrier
      external_url_suffix: test.quorum.blockchaincloudpoc.com   # This is the url␣
↪suffix that will be added in DNS recordset. Must be different for different clusters
      cloud_provider: aws   # Options: aws, azure, gcp, minikube
```

Each `organization` under the `organizations` section has the following fields.

For the `aws` and `k8s` field the snapshot with sample values is below

```
      aws:
        access_key: "<aws_access_key>"    # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "<aws_secret>"        # AWS Secret key, only used when cloud_
↪provider=aws

      # Kubernetes cluster deployment variables.
      k8s:
        context: "<cluster_context>"
        config_file: "<path_to_k8s_config_file>"
```

The `aws` field under each organization contains: (This will be ignored if cloud_provider is not `aws`)

The `k8s` field under each organization contains

For gitops fields the snapshot from the sample configuration file with the example values is below

```
      # Git Repo details which will be used by GitOps/Flux.
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "https://github.com/<username>/bevel.git" # Gitops htpps or ssh url␣
↪for flux value files
```

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```
        branch: "<branch_name>"                                                   #␣
↪Git branch where release is being made
        release_dir: "platforms/Quorum/releases/dev" # Relative Path in the Git repo␣
↪for flux sync per environment.
        chart_source: "platforms/Quorum/charts"      # Relative Path where the Helm␣
↪charts are stored in Git repo
        git_repo: "github.com/<username>/bevel.git" # without https://
        username: "<username>"           # Git Service user who has rights to check-in␣
↪in all branches
        password: "<password>"           # Git Server user password/personal token␣
↪(Optional for ssh; Required for https)
        email: "<git_email>"               # Email to use in git config
        private_key: "<path to gitops private key>" # Path to private key (Optional␣
↪for https; Required for ssh)
```

The gitops field under each organization contains

The services field for each organization under `organizations` section of Quorum contains list of `services` which could be only peers as of now.

Each organization with type as peer will have a peers service. The snapshot of peers service with example values is below

```
        peers:
        - peer:
          name: carrier
          subject: "O=Carrier,OU=Carrier,L=51.50/-0.13/London,C=GB" # This is the␣
↪node subject. L=lat/long is mandatory for supplychain sample app
          type: validator          # value can be validator or member, only applicable␣
↪if consensus = 'ibft'
          geth_passphrase: 12345  # Passphrase to be used to generate geth account
          p2p:
            port: 21000
            ambassador: 15010       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8546
            ambassador: 15011       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          transaction_manager:
            port: 8443            # use port: 9001 when transaction_manager =
↪"constellation"
            ambassador: 8443    # use ambassador: 15012 when transaction_manager =
↪"constellation"
          raft:                     # Only used if consensus = 'raft'
            port: 50401
            ambassador: 15013
          db:                       # Only used if transaction_manager = "tessera"
            port: 3306
```

The fields under `peer` service are

*** feature is in future scope

5.6.2 Adding a new node in Quorum

- *Prerequisites*

- *Create Configuration File*
- *Run playbook*

Prerequisites

To add a new organization in Quorum, an existing quorum network should be running, enode information of all existing nodes present in the network should be available, genesis block should be available in base64 encoding and the geth information of a node should be available and that node account should be unlocked prior adding the new node to the existing quorum network.

NOTE: Addition of a new organization has been tested on an existing network which is created by Bevel. Networks created using other methods may be suitable but this has not been tested by Bevel team.

Create Configuration File

Refer this guide for details on editing the configuration file.

The `network.yaml` file should contain the specific `network.organization` details along with the enode information, genesis block in base64 encoding and geth account details

---

NOTE: Make sure that the genesis block information is given in base64 encoding. Also, if you are adding node to the same cluster as of another node, make sure that you add the ambassador ports of the existing node present in the cluster to the network.yaml

---

For reference, sample `network.yaml` file looks like below for RAFT consensus (but always check the latest network-quorum-newnode.yaml at `platforms/quourm/configuration/samples`):

```
---
# This is a sample configuration file for Quorum network which has 4 nodes.
# All text values are case-sensitive
network:
  # Network level configuration specifies the attributes required for each␣
↪organization
  # to join an existing network.
  type: quorum
  version: 21.4.2  #this is the version of Quorum docker image that will be deployed.␣
↪older version 2.1.1 is not compatible with supplychain contracts

  #Environment section for Kubernetes setup
  env:
    type: "dev"              # tag for the environment. Important to run multiple␣
↪flux on single cluster
    proxy: ambassador               # value has to be 'ambassador' as 'haproxy' has␣
↪not been implemented for Quorum
    #  These ports are enabled per cluster, so if you have multiple clusters you do␣
↪not need so many ports
    #  This sample uses a single cluster, so we have to open 4 ports for each Node.␣
↪These ports are again specified for each organization below
```

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```
    ambassadorPorts:                # Any additional Ambassador ports can be given␣
↪here, this is valid only if proxy='ambassador'
      portRange:              # For a range of ports
        from: 15010
        to: 15043
    # ports: 15020,15021      # For specific ports
    retry_count: 20                 # Retry count for the checks on Kubernetes cluster
    external_dns: enabled           # Should be enabled if using external-dns for␣
↪automatic route configuration

  # Docker registry details where images are stored. This will be used to create k8s␣
↪secrets
  # Please ensure all required images are built and stored in this registry.
  # Do not check-in docker_password.
  docker:
    url: "ghcr.io/hyperledger"
    username: "docker_username"
    password: "docker_password"

  # Following are the configurations for the common Quorum network
  config:
    consensus: "raft"                 # Options are "raft" and "ibft"
    ## Certificate subject for the root CA of the network.
    #  This is for development usage only where we create self-signed certificates␣
↪and the truststores are generated automatically.
    #  Production systems should generate proper certificates and configure␣
↪truststores accordingly.
    subject: "CN=DLT Root CA,OU=DLT,O=DLT,L=London,C=GB"
    transaction_manager: "tessera"    # Options are "tessera" and "constellation"
    # This is the version of "tessera" or "constellation" docker image that will be␣
↪deployed
    # Supported versions #
    # constellation: 0.3.2 (For all versions of quorum)
    tm_version: "21.7.3"
    tm_tls: "strict"                  # Options are "strict" and "off"
    tm_trust: "tofu"                  # Options are: "ca-or-tofu", "ca", "tofu"
    ## Transaction Manager nodes public addresses should be provided.
    #  For "tessera", all participating nodes should be provided
    #  For "constellation", only one is bootnode should be provided
    #
    # For constellation, use following. This will be the bootnode for all nodes
    #  - "http://carrier.test.quorum.blockchaincloudpoc.com:15012/"  #NOTE the end /␣
↪is necessary and should not be missed
    # The above domain name is formed by the http://(peer.name).(org.external_url_
↪suffix):(ambassador constellation port)/
    # In the example (for tessera ) below, the domain name is formed by the https://
↪(peer.name).(org.external_url_suffix):(ambassador default port)
    tm_nodes:
      - "https://carrier.test.quorum.blockchaincloudpoc.com:8443"
      - "https://manufacturer.test.quorum.blockchaincloudpoc.com:8443"
      - "https://store.test.quorum.blockchaincloudpoc.com:8443"
      - "https://warehouse.test.quorum.blockchaincloudpoc.com:8443"
    ##### Following keys are used only to add new Node(s) to existing network.
    staticnodes:                # Existing network's static nodes file path needs to␣
↪be given
    genesis:                    # Existing network's genesis.json file path needs to␣
↪be given
```

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```
    # make sure that the account is unlocked prior to adding a new node
    bootnode:
      #name of the node
      name: carrier
      #ambassador url of the node
      url: carrier.test.quorum.blockchaincloudpoc.com
      #rpc port of the node
      rpcport: 15011
      #id of the node.
      nodeid: 1

  # Allows specification of one or many organizations that will be connecting to a␣
↪network.
  organizations:
    # Specification for the 1st organization. Each organization should map to a VPC␣
↪and a separate k8s cluster for production deployments
    - organization:
      name: neworg
      external_url_suffix: test.quorum.blockchaincloudpoc.com   # This is the url␣
↪suffix that will be added in DNS recordset. Must be different for different clusters
      cloud_provider: aws   # Options: aws, azure, gcp
      aws:
        access_key: "aws_access_key"        # AWS Access key, only used when cloud_
↪provider=aws
        secret_key: "aws_secret_key"        # AWS Secret key, only used when cloud_
↪provider=aws
      # Kubernetes cluster deployment variables. The config file path and name has to␣
↪be provided in case
      # the cluster has already been created.
      k8s:
        context: "cluster_context"
        config_file: "cluster_config"
      # Hashicorp Vault server address and root-token. Vault should be unsealed.
      # Do not check-in root_token
      vault:
        url: "vault_addr"
        root_token: "vault_root_token"
      # Git Repo details which will be used by GitOps/Flux.
      # Do not check-in git_access_token
      gitops:
        git_protocol: "https" # Option for git over https or ssh
        git_url: "https://github.com/<username>/bevel.git"         # Gitops https or␣
↪ssh url for flux value files
        branch: "develop"           # Git branch where release is being made
        release_dir: "platforms/quorum/releases/dev" # Relative Path in the Git repo␣
↪for flux sync per environment.
        chart_source: "platforms/quorum/charts"     # Relative Path where the Helm␣
↪charts are stored in Git repo
        git_repo: "github.com/<username>/bevel.git"   # Gitops git repository URL for␣
↪git push
        username: "git_username"          # Git Service user who has rights to check-
↪in in all branches
        password: "git_access_token"      # Git Server user access token (Optional␣
↪for ssh; Required for https)
        email: "git_email"                # Email to use in git config
        private_key: "path_to_private_key"          # Path to private key file which␣
↪has write-access to the git repo (Optional for https; Required for ssh)
```

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```
      # The participating nodes are named as peers
      services:
        peers:
        - peer:
          name: neworg
          subject: "O=Neworg,OU=Neworg,L=51.50/-0.13/London,C=GB" # This is the node␣
↪subject. L=lat/long is mandatory for supplychain sample app
          type: validator         # value can be validator or member, only applicable␣
↪if consensus = 'ibft'
          geth_passphrase: 12345  # Passphrase to be used to generate geth account
          p2p:
            port: 21000
            ambassador: 15010       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          rpc:
            port: 8546
            ambassador: 15011       #Port exposed on ambassador service (use one port␣
↪per org if using single cluster)
          transaction_manager:
            port: 8443          # use port: 9001 when transaction_manager =
↪"constellation"
            ambassador: 8443    # use ambassador: 15012 when transaction_manager =
↪"constellation"
          raft:                     # Only used if consensus = 'raft'
            port: 50401
            ambassador: 15013
          db:                       # Only used if transaction_manager = "tessera"
            port: 3306
```

Below three new sections are added to the network.yaml

The `network.config.bootnode` field contains:

Run playbook

The site.yaml playbook is used to add a new organization to the existing network. This can be done using the following command

```
ansible-playbook platforms/shared/configuration/site.yaml --extra-vars "@path-to-
↪network.yaml"
```

Verify network deployment

For instructions on how to verify or troubleshoot network, read *How to debug a Bevel deployment*

5.7 Generic operations

5.7.1 Setting up a DLT/Blockchain network

Pre-requisites

To create a Production DLT/Blockchain network, ensure you have the following:

1. One running Kubernetes Cluster and the Config file (kubeconfig.yaml) per Organization.
2. One running Hashicorp Vault server per Organization. Unsealed and configured as per guidance here.
3. Domain Name(s) configured as per guidance here.
4. Private key file per Organization for GitOps with write-access to the Git repo as per guidance here.
5. Git user details per Organization as per *pre-requisites*.
6. Ansible controller configured as per guidance here.

NOTE: All commands are executed from the `bevel` directory which is the default directory created when you clone our Git repo.

Prepare build folder

If not already done, clone the git repository on your Ansible controller.

```
git clone https://github.com/<your username>/bevel.git
```

Create a folder called `build` inside `bevel`.

```
cd bevel
mkdir build
```

Copy the following files inside `build` folder:

- All the Kubernetes config files (kubeconfig.yaml).
- All the private key files.

Edit the configuration file

Depending on your choice of DLT/Blockchain Platform, select a network.yaml and copy it to `build` folder.

```
# eg for Fabric
cp platforms/hyperledger-fabric/configuration/samples/network-fabricv2.yaml build/
↪network.yaml
```

Open and update the `network.yaml` according to the following Platform specific guides.

Platform-specific configuration files

- Hyperledger-Fabric
- R3-Corda
- Hyperledger-Indy
- Quorum

- Hyperledger-Besu

In summary, you will need to update the following:

1. `docker` url, username and password.
2. `external_url_suffix` depending on your Domain Name(s).
3. All DNS addresses depending on your Domain Name(s).
4. `cloud_provider`
5. `k8s` section depending on your Kubernetes zone/cluster name/config filepath.
6. `vault`
7. `gitops` section depending on your git username, tokens and private key filepath.

Executing provisioning script

After all the configurations are updated in the `network.yaml`, execute the following to create the DLT network

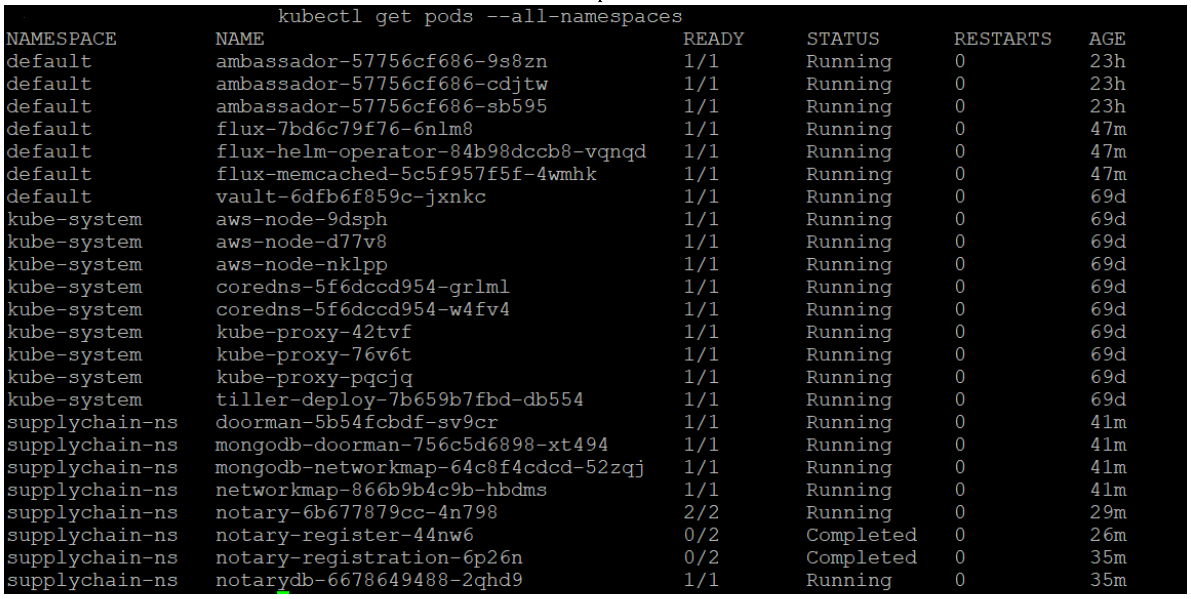
```
# Run the provisioning scripts
ansible-playbook platforms/shared/configuration/site.yaml -e "@./build/network.yaml"
```

The `site.yaml` playbook, in turn calls various playbooks depending on the configuration file and sets up your DLT/Blockchain network.

Verify successful configuration of DLT/Blockchain network

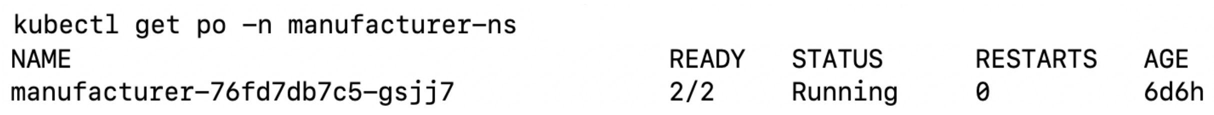
To verify if the network is successfully configured or not check if all the kubernetes pods are up and running or not. Below are some commands to check the pod's status:

- `Kubectl get pods --all-namespaces` : To get list of all the pods and their status across all the namespaces. It will look as below -



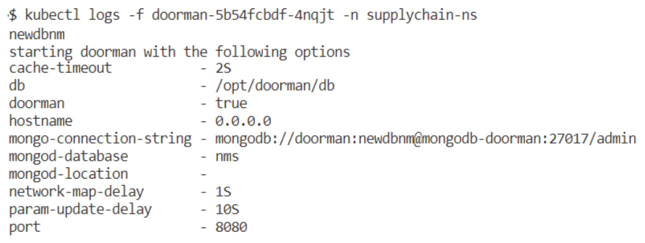
```
                     kubectl get pods --all-namespaces
NAMESPACE        NAME                                   READY     STATUS      RESTARTS   AGE
default          ambassador-57756cf686-9s8zn            1/1       Running     0          23h
default          ambassador-57756cf686-cdjtw            1/1       Running     0          23h
default          ambassador-57756cf686-sb595            1/1       Running     0          23h
default          flux-7bd6c79f76-6nlm8                  1/1       Running     0          47m
default          flux-helm-operator-84b98dccb8-vqnqd    1/1       Running     0          47m
default          flux-memcached-5c5f957f5f-4wmhk        1/1       Running     0          47m
default          vault-6dfb6f859c-jxnkc                 1/1       Running     0          69d
kube-system      aws-node-9dsph                         1/1       Running     0          69d
kube-system      aws-node-d77v8                         1/1       Running     0          69d
kube-system      aws-node-nklpp                         1/1       Running     0          69d
kube-system      coredns-5f6dccd954-grlml               1/1       Running     0          69d
kube-system      coredns-5f6dccd954-w4fv4               1/1       Running     0          69d
kube-system      kube-proxy-42tvf                       1/1       Running     0          69d
kube-system      kube-proxy-76v6t                       1/1       Running     0          69d
kube-system      kube-proxy-pqcjq                       1/1       Running     0          69d
kube-system      tiller-deploy-7b659b7fbd-db554         1/1       Running     0          69d
supplychain-ns   doorman-5b54fcbdf-sv9cr                1/1       Running     0          41m
supplychain-ns   mongodb-doorman-756c5d6898-xt494       1/1       Running     0          41m
supplychain-ns   mongodb-networkmap-64c8f4cdcd-52zqj    1/1       Running     0          41m
supplychain-ns   networkmap-866b9b4c9b-hbdms            1/1       Running     0          41m
supplychain-ns   notary-6b677879cc-4n798                2/2       Running     0          29m
supplychain-ns   notary-register-44nw6                  0/2       Completed   0          26m
supplychain-ns   notary-registration-6p26n              0/2       Completed   0          35m
supplychain-ns   notarydb-6678649488-2qhd9              1/1       Running     0          35m
```

- `Kubectl get pods -n xxxxx` : To check status of pods of a single namespace mentioned in place of xxxxx. Example



```
kubectl get po -n manufacturer-ns
NAME                              READY   STATUS    RESTARTS   AGE
manufacturer-76fd7db7c5-gsjj7     2/2     Running   0          6d6h
```

- `Kubectl logs -f <PODNAME> -n <NAMESPACE>` : To check logs of a pod by giving required pod name and namespace in the command. Example-



```
$ kubectl logs -f doorman-5b54fcbdf-4nqjt -n supplychain-ns
newdbnm
starting doorman with the following options
cache-timeout           - 2S
db                      - /opt/doorman/db
doorman                 - true
hostname                - 0.0.0.0
mongo-connection-string - mongodb://doorman:newdbnm@mongodb-doorman:27017/admin
mongod-database         - nms
mongod-location         -
network-map-delay       - 1S
param-update-delay      - 10S
port                    - 8080
```

For a successful setup of DLT Network all the pods should be in running state.

For detailed instructions on how to verify or troubleshoot network, read *How to debug a Bevel deployment*

Deleting an existing DLT/Blockchain network

The above mentioned playbook site.yaml (ReadMe) can be run to reset the network using the network configuration file having the specifications which was used to setup the network using the following command:

```
ansible-playbook platforms/shared/configuration/site.yaml -e "@./build/network.yaml" -
↪e "reset=true"
```

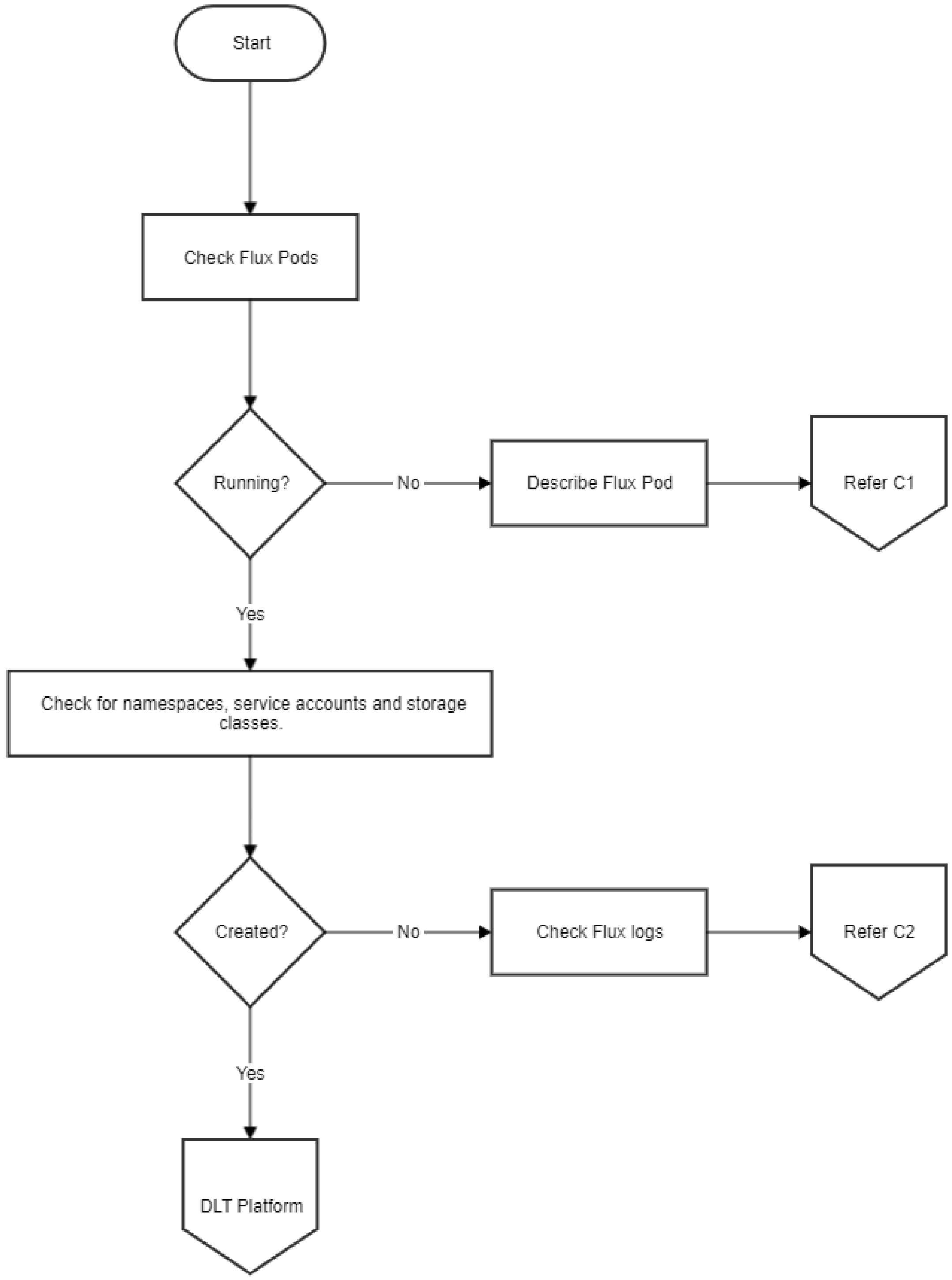
5.7.2 How to debug a Bevel deployment

While deploying a DLT/Blockchain network using Bevel, the pods and other components take some time to start. The Bevel automation (Ansible component) waits for the components to be at a “Running” or “Completed” state before proceeding with further steps. This is where you can see the message “FAILED - RETRYING: . . . “

Each component has a retry count which can be configured in the configuration file (network.yaml). When everything is fine, the components are usually up in 10-15 retries. Meanwhile, you can check the components while the retries occurs to avoid unnecessary wait time till the error/Failed message occurs in Ansible logs.

Bevel Deployment Flowchart

This flow chart shows the Bevel Deployment process flow. To verify the steps of deployment, follow the flow chart and check verification table ‘C’ to troubleshoot the general errors.



Common Troubleshooting

Table 'C'

NOTE:

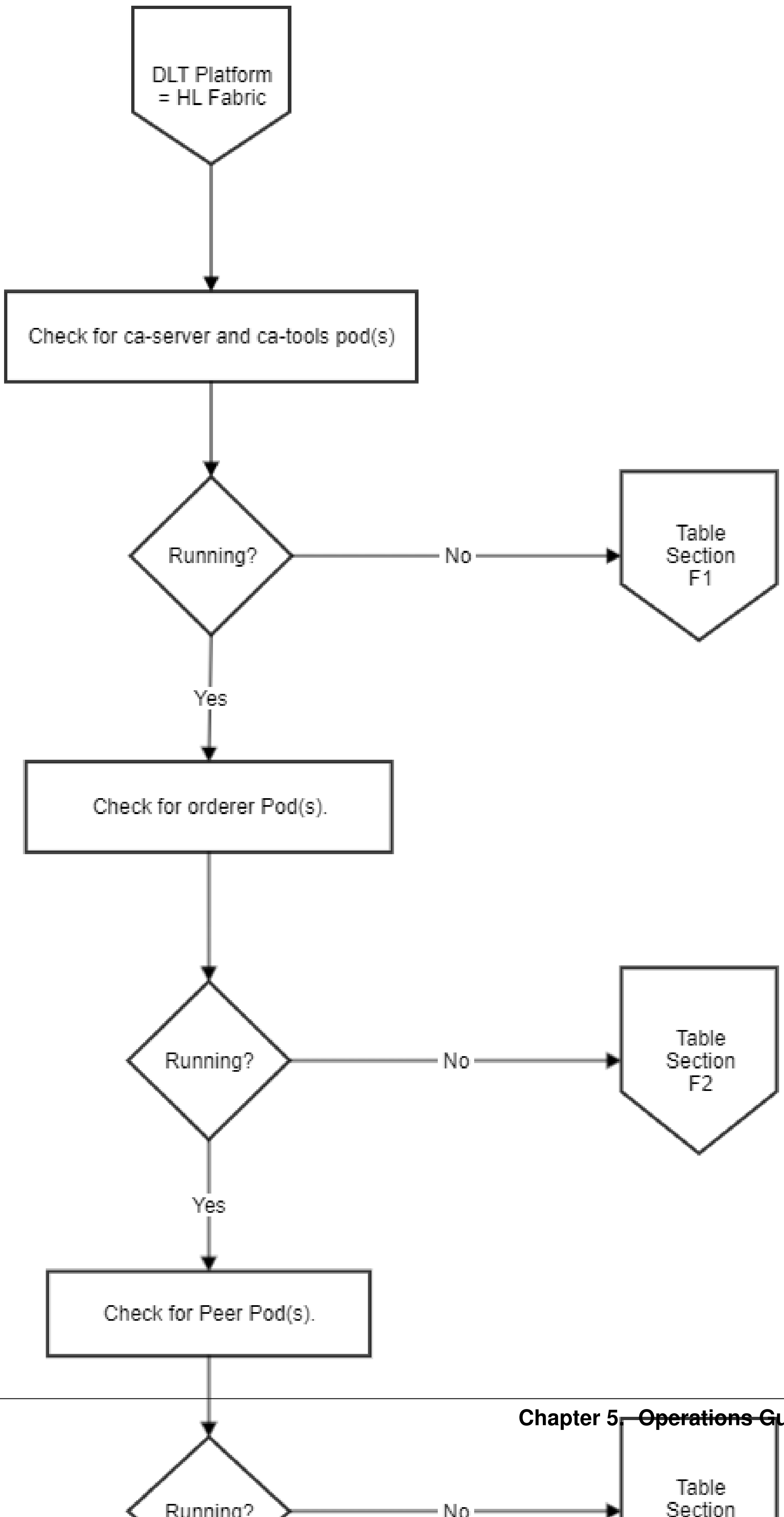
If the components are not able to connect to each other, there could be some issue with load balancer. Check the haproxy or external DNS logs for more debugging. Also verify the security groups for any possible conflicts.

If any pod/component of the network is not running (in crashloopbackoff or in error state) or is absent in the get pods list.

Check the flux logs if it has been deployed or not. Check the helm release. Check the status as well as if the key-values are generated properly. For further debugging check for pod/container logs. If components are there but not able to talk to each, check whether the ambasssador/ haproxy is working properly, urls are properly mapped and ports are opened for communication or not.

Hyperledger Fabric Checks

The flow chart shows the Fabric Deployment process. To verify the steps of deployment, follow the verification Table 'F', to troubleshoot the general errors.


DLT Platform = HL Fabric
Check for ca-server and ca-tools pod(s)
Running?
No
Table Section F1
Yes
Check for orderer Pod(s).
Running?
No
Table Section F2
Yes
Check for Peer Pod(s).
Running?
No
Table Section

Fabric Troubleshooting

Table 'F'

Final network validy check

For final checking of the validity of the fabric network.

- Create a CLI pod for any organization. (Now Peer CLI can be enabled from network.yaml itself. Check the *sample network.yaml* for reference)

  Use this sample template.

```
metadata:
  namespace: ORG_NAME-net
images:
  fabrictools: hyperledger/fabric-tools:2.0
  alpineutils: ghcr.io/hyperledger/alpine-utils:1.0
storage:
  class: ORG_NAMEsc
  size: 256Mi
vault:
  role: ault-role
  address: VAULT_ADDR
  authpath: ORG_NAME-net-auth
  adminsecretprefix: secretsv2/crypto/peerOrganizations/ORG_NAME-net/users/admin
  orderersecretprefix: secretsv2/crypto/peerOrganizations/ORG_NAME-net/orderer
  serviceaccountname: vault-auth
  imagesecretname: regcred
  tls: false
peer:
  name: PEER_NAME
  localmspid: ORG_NAMEMSP
  tlsstatus: true
  address: PEER_NAME.ORG_NAME-net.EXTERNAL_URL_SUFFIX:8443
orderer:
  address: ORDERER_NAME
```

- To install the CLI

```
helm install -f cli.yaml /bevel/platforms/hyperledger-fabric/charts/fabric_cli/ -
↪n <CLI_NAME>
```

- Get the CLI pod

```
export ORG1_NS=ORG_NAME-net
export CLI=$(kubectl get po -n ${ORG1_NS} | grep "cli" | awk '{print $1}')
```

- Copy the CLI pod name from the output list and enter the CLI using.

```
kubectl exec -it $CLI -n ORG_NAME-net -- bash
```

- To see which chaincodes are installed

```
peer chaincode list --installed (after exec into the CLI)
```

- Check if the chaincode is instantiated or not

```
peer chaincode list --instantiated -C allchannel (after exec into the CLI)
```

- Execute a transaction

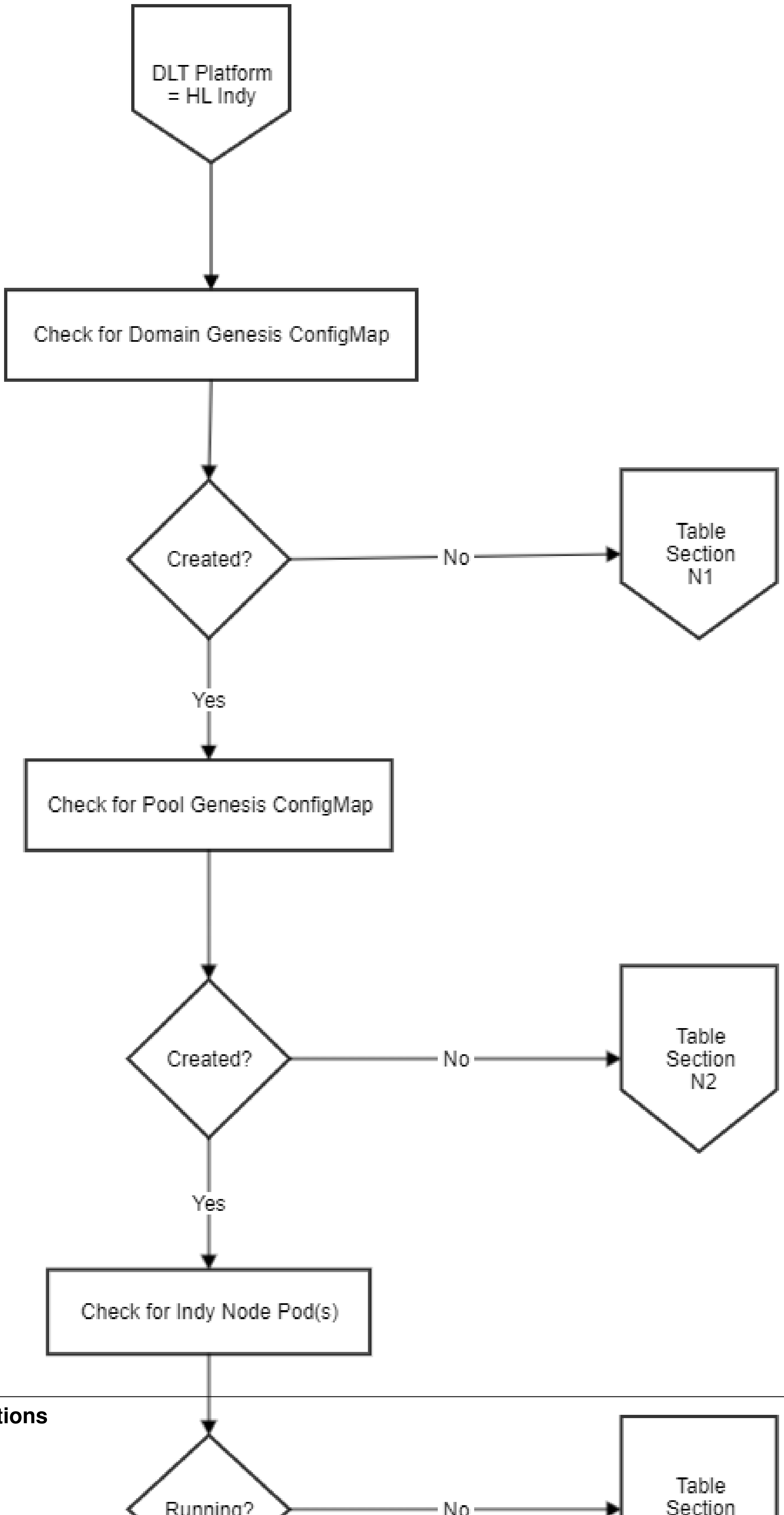
  For init:

```
peer chaincode invoke -o <orderer url> --tls true --cafile <path of orderer tls␣
↪cert> -C <channel name> -n <chaincode name> -c '{"Args":[<CHAINCODE_
↪INSTANTIATION_ARGUMENT>]}' (after exec into the cli)
```

Upon successful invocation, should display a `status 200` msg.

Hyperledger Indy Checks

The flow chart shows the Indy Deployment process. To verify the steps of deployment, follow the Verification Table 'N', to troubleshoot the general errors.


DLT Platform = HL Indy
Check for Domain Genesis ConfigMap
Created?
No
Table Section N1
Yes
Check for Pool Genesis ConfigMap
Created?
No
Table Section N2
Yes
Check for Indy Node Pod(s)
Running?
No
Table Section

Indy Troubleshooting

Table 'N'

Final network validity check

For final checking of the validity of the indy network.

- Please find the generated pool genesis inside your releases/**ReleaseName/OrgName/OrgName-ptg** folder as pool_genesis.yaml.

  ```
  NOTE: All the organisations will have the same pool genesis. Hence, you
  can pick from any organization
  ```

  The sample ConfigMap:

```yaml
apiVersion: helm.fluxcd.io/v1
kind: HelmRelease
metadata:
  name: employer-ptg
  annotations:
    fluxcd.io/automated: "false"
  namespace: employer-ns
spec:
  releaseName: employer-ptg
  chart:
    path: platforms/hyperledger-indy/charts/indy-pool-genesis
    git: https://github.com/<username>/bevel.git
    ref: main
  values:
    metadata:
      name: employer-ptg
      namespace: employer-ns
    organization:
      name: employer
    configmap:
      poolGenesis: |-
        {"reqSignature":{},"txn":{"data":{"data":{"alias":"university-steward-1",
↪"blskey":
↪"3oYpr4xXDp1bgEKM6kJ8iaM66cpkHRe6vChvcEj52sFKforRkYbSq2G8ZF8dCSU4a8CdZWUJw6hJUYzY48zTKELYAgJr
↪","blskey_pop":
↪"RBS3XRtmErE6w1SEwHv69b7eSuHhnYh5tTs1A3NAjnAQwmk5SXeHUt3GNuSTB84L6MJskaziP8s7N6no34My4dizxkSby
↪","client_ip":"127.0.0.1","client_port":15012,"node_ip":"127.0.0.1","node_port
↪":15011,"services":["VALIDATOR"]},"dest":
↪"Cj79w18ViZ7Q7gfb9iXPxYchHo4K4iVtL1oFjWbnrzBf"},"metadata":{"from":
↪"NWpkXoWjzq9oQUTBiezzHi"},"type":"0"},"txnMetadata":{"seqNo":1,"txnId":
↪"16bcef3d14020eac552e3f893b83f00847420a02cbfdc80517425023b75f124e"},"ver":"1"}
        {"reqSignature":{},"txn":{"data":{"data":{"alias":"university-steward-2",
↪"blskey":
↪"4R1x9mGMVHu4vsWxiTgQEvQzPizyh2XspKH1KBr11WDNXt9dhbAVkSZBy2wgEzodjH9BcMzSjjVpHXQA3fJHgZJaGejH5
↪","blskey_pop":
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↪","client_ip":"127.0.0.1","client_port":15022,"node_ip":"127.0.0.1","node_port
↪":15021,"services":["VALIDATOR"]},"dest":
↪"ETdTNU6xrRwxuV4nPrXAecYsFGP6v8L5PpfGBnriC4Ao"},"metadata":{"from":
↪"RhFtCjqTXAGbAhqJoVLrGe"},"type":"0"},"txnMetadata":{"seqNo":2,"txnId":
↪"ab3146fcbe19c6525fc9c325771d6d6474f8ddec0f2da425774a1687a4afe949"},"ver":"1"}
```

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```
        {"reqSignature":{},"txn":{"data":{"data":{"alias":"employer-steward-1",
↪"blskey":
↪"2LieBpwUyP8gUVb16k7hGCUnZRNHdqazHVLbN2K2CgeE2cXt3ZC3yt8Gd8NheNHVdCU7cHcsEq5e1XKBS3LFXNQctiL6w
↪","blskey_pop":
↪"R9q58hsWHaVenRefuwh44fnhX8TcJMskiBX1Mf5ue7DEH8SGTajUcWVUbE3kT7mNeK2TeUMeXDcmboeSCkbpqtX2289ec
↪","client_ip":"127.0.0.1","client_port":15032,"node_ip":"127.0.0.1","node_port
↪":15031,"services":["VALIDATOR"]},"dest":
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↪"MKMbzGYtfpLk2NVhYSeSRN"},"type":"0"},"txnMetadata":{"seqNo":3,"txnId":
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        {"reqSignature":{},"txn":{"data":{"data":{"alias":"employer-steward-2",
↪"blskey":
↪"36q2aZbJBp8Dpo16wzHqWGbsDs6zZvjxZwxxrD1hp1iJXyGBsbyfqMXVNZRokkNiD811naXrbqc8AfZET5sB5McQXni5a
↪","blskey_pop":
↪"QkYzAXabCzgbF3AZYzKQJE4sC5BpAFx1t32T9MWyxf7r1YkX2nMEZToAd5kmKcwhzbQZViu6CdkHTWrWMKjUHyVgdkta1
↪","client_ip":"127.0.0.1","client_port":15042,"node_ip":"127.0.0.1","node_port
↪":15041,"services":["VALIDATOR"]},"dest":
↪"D2m1rwJHDo17nnCUSNvd7m1qRCiV6qCvEXxgGfuxtKZh"},"metadata":{"from":
↪"P5DH5NEGC3agMBssdEMJxv"},"type":"0"},"txnMetadata":{"seqNo":4,"txnId":
↪"1b0dca5cd6ffe526ab65f1704b34ec24096b75f79d4c0468a625229ed686f42a"},"ver":"1"}
```

- Copy the genesis block to a new file, say **pool_genesis.txt**

```
pool_genesis.txt >>

{"reqSignature":{},"txn":{"data":{"data":{"alias":"university-steward-1","blskey":
↪"3oYpr4xXDp1bgEKM6kJ8iaM66cpkHRe6vChvcEj52sFKforRkYbSq2G8ZF8dCSU4a8CdZWUJw6hJUYzY48zTKELYAgJrQ
↪","blskey_pop":
↪"RBS3XRtmErE6w1SEwHv69b7eSuHhnYh5tTs1A3NAjnAQwmk5SXeHUt3GNuSTB84L6MJskaziP8s7N6no34My4dizxkSby
↪","client_ip":"127.0.0.1","client_port":15012,"node_ip":"127.0.0.1","node_port
↪":15011,"services":["VALIDATOR"]},"dest":
↪"Cj79w18ViZ7Q7gfb9iXPxYchHo4K4iVtL1oFjWbnrzBf"},"metadata":{"from":
↪"NWpkXoWjzq9oQUTBiezzHi"},"type":"0"},"txnMetadata":{"seqNo":1,"txnId":
↪"16bcef3d14020eac552e3f893b83f00847420a02cbfdc80517425023b75f124e"},"ver":"1"}
{"reqSignature":{},"txn":{"data":{"data":{"alias":"university-steward-2","blskey":
↪"4R1x9mGMVHu4vsWxiTgQEvQzPizyh2XspKH1KBr11WDNXt9dhbAVkSZBy2wgEzodjH9BcMzSjjVpHXQA3fJHgZJaGejH5
↪","blskey_pop":
↪"R14qoTS4urnSeNAMSgZzp2ryhi5kFLi1KCxK2ZP8Lk3Pa7FNFoqp6LrPanZxsdELVazsCEQv2B7fmexo3JGj3f2vtp2ZR
↪","client_ip":"127.0.0.1","client_port":15022,"node_ip":"127.0.0.1","node_port
↪":15021,"services":["VALIDATOR"]},"dest":
↪"ETdTNU6xrRwxuV4nPrXAecYsFGP6v8L5PpfGBnriC4Ao"},"metadata":{"from":
↪"RhFtCjqTXAGbAhqJoVLrGe"},"type":"0"},"txnMetadata":{"seqNo":2,"txnId":
↪"ab3146fcbe19c6525fc9c325771d6d6474f8ddec0f2da425774a1687a4afe949"},"ver":"1"}
{"reqSignature":{},"txn":{"data":{"data":{"alias":"employer-steward-1","blskey":
↪"2LieBpwUyP8gUVb16k7hGCUnZRNHdqazHVLbN2K2CgeE2cXt3ZC3yt8Gd8NheNHVdCU7cHcsEq5e1XKBS3LFXNQctiL6w
↪","blskey_pop":
↪"R9q58hsWHaVenRefuwh44fnhX8TcJMskiBX1Mf5ue7DEH8SGTajUcWVUbE3kT7mNeK2TeUMeXDcmboeSCkbpqtX2289ec
↪","client_ip":"127.0.0.1","client_port":15032,"node_ip":"127.0.0.1","node_port
↪":15031,"services":["VALIDATOR"]},"dest":
↪"C5F8eDsQZYQcUx1NPENenr9A1Jqr9ZCAXrcAoAcGkutY"},"metadata":{"from":
↪"MKMbzGYtfpLk2NVhYSeSRN"},"type":"0"},"txnMetadata":{"seqNo":3,"txnId":
↪"d85334ed1fb537b2ff8627b8cc4bcf2596d5da62c6d85244b80675ebae91fd07"},"ver":"1"}
{"reqSignature":{},"txn":{"data":{"data":{"alias":"employer-steward-2","blskey":
↪"36q2aZbJBp8Dpo16wzHqWGbsDs6zZvjxZwxxrD1hp1iJXyGBsbyfqMXVNZRokkNiD811naXrbqc8AfZET5sB5McQXni5a
↪","blskey_pop":
↪"QkYzAXabCzgbF3AZYzKQJE4sC5BpAFx1t32T9MWyxf7r1YkX2nMEZToAd5kmKcwhzbQZViu6CdkHTWrWMKjUHyVgdkta1
↪","client_ip":"127.0.0.1","client_port":15042,"node_ip":"127.0.0.1","node_port
↪":15041,"services":["VALIDATOR"]},"dest":
↪"D2m1rwJHDo17nnCUSNvd7m1qRCiV6qCvEXxgGfuxtKZh"},"metadata":{"from":
↪"P5DH5NEGC3agMBssdEMJxv"},"type":"0"},"txnMetadata":{"seqNo":4,"txnId":
↪"1b0dca5cd6ffe526ab65f1704b34ec24096b75f79d4c0468a625229ed686f42a"},"ver":"1"}
```

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- Install indy-CLI, in case not installed already, follow the official installation steps.
- Open the indy-CLI terminal

```
~$ indy-cli
```

- Create a pool

```
indy> pool create <POOL_ALIAS> gen_txn_file=<Path to pool_genesis.txt>
```

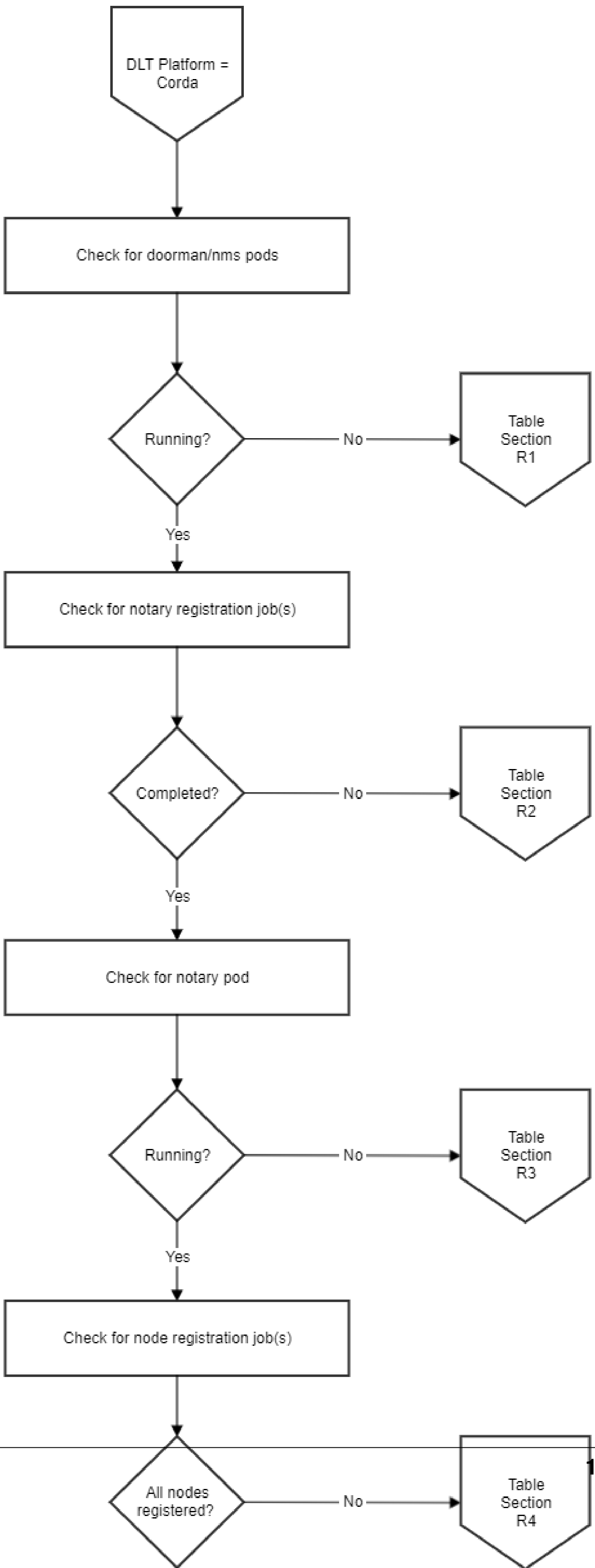
- Connect to indy pool

```
indy> pool connect <POOL_ALIAS>
```

Upon successful connection, should display a `Pool Connected Successfully` msg.

R3 Corda Checks

The flow chart shows the R3 Corda process. To verify the steps of deployment, follow the Verification Table 'R', to troubleshoot the general errors.


DLT Platform = Corda
Check for doorman/nms pods
Running?
No
Table Section R1
Yes
Check for notary registration job(s)
Completed?
No
Table Section R2
Yes
Check for notary pod
Running?
No
Table Section R3
Yes
Check for node registration job(s)
All nodes registered?
No
Table Section R4

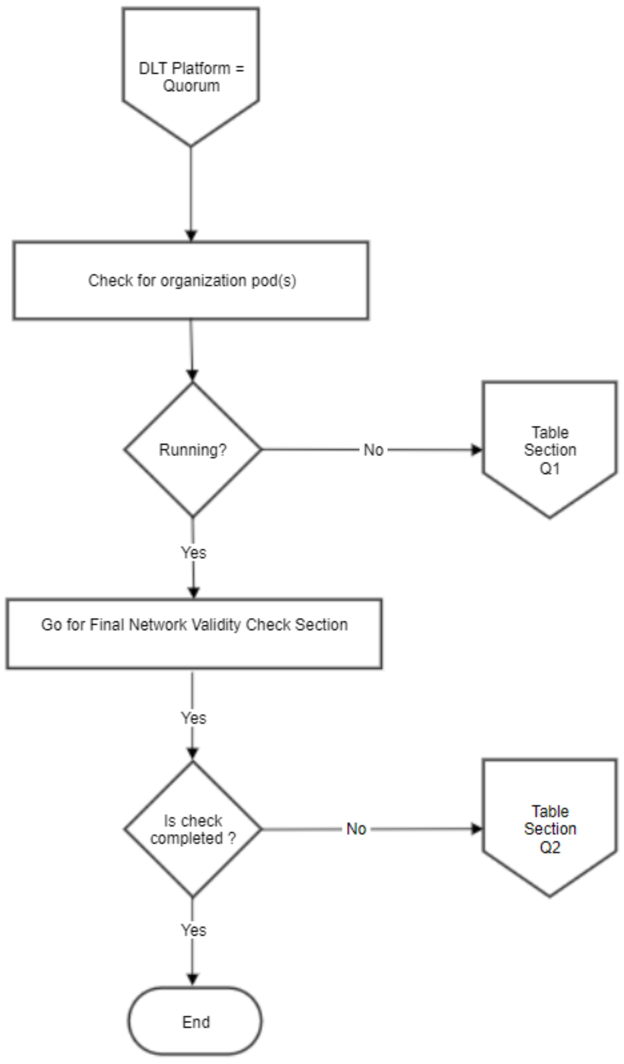
R3 Corda Troubleshooting

Table 'N'

Final R3 Corda (Network) Validation

Quorum Checks

The flow chart shows the Quorum Deployment process. To verify the steps of deployment, follow the verification Table 'Q', to troubleshoot the general errors.



Quorum Troubleshooting

Table 'Q'

Final network validity check

For final checking of the validity of the quorum network.

- Start interactive java script console to the node by doing geth attach

```
geth attach http://<peer.name>.<external_url_suffix>:<ambassador rpc port>
```

- Use admin.peers to get a list of the currently connected peers to ensure all the nodes are up and connected as per the configuration on geth console.

```
$ admin.peers
```

- Use '/upcheck' endpoint to check the health of transaction manager

```
$ curl --location --request GET 'https://<peer.name>.<external_url_suffix>:
↪<ambassador port>/upcheck' -k
```

Upon successfull connection, response should be `200 I'm up!`

`NOTE: Use /partyinfo endpoint to know connected transaction manager,last connect time and public keys`

5.7.3 Adding a new storageclass

As storageclass templates vary as per requirements and cloud provider specifications, this guide will help in using a new storageclass which is not supported by Hyperledger Bevel

- *Adding a new storage class for Hyperledger Fabric*
- *Adding a new storage class for R3-Corda*
- *Adding a new storage class for Hyperledger Indy*
- *Adding a new storage class for Quorum*

Adding a new storage class for Hyperledger Fabric

To add a new storageclass for Hyperledger Fabric, perform the following steps:

1. Add the new storageclass template `sample_sc.tpl`, under `platforms/hyperledger-fabric/configuration/roles/create/storageclass/templates` with `metadata.name` (storageclass name) as the variable `sc_name`. For example,

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: {{ sc_name }}
provisioner: kubernetes.io/aws-ebs
parameters:
  type: gp2
  encrypted: "true"
```

1. Mention the template file, which you created above, under `platforms/hyperledger-fabric/configuration/roles/create/storageclass/vars/main.yaml` with a variable reference. For example,

```
sc_templates:
  sample-sc: sample_sc.tpl
```

1. Set the `type` variable to `sample-sc` (variable created in step 2) in the task `Create Storage Class value file for orderers` and `Create Storage Class value file for Organizations`, located in `platforms/hyperledger-fabric/configuration/roles/create/storageclass/tasks/main.yaml`

Adding a new storage class for R3-Corda

To add a new storageclass for R3-Corda, perform the following steps:

1. Add the new storageclass template `sample_sc.tpl`, under `platforms/r3-corda/configuration/roles/create/k8_component/templates` with `metadata.name` (storageclass name) as the variable `component_name`. For example,

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: {{ component_name }}
provisioner: kubernetes.io/aws-ebs
reclaimPolicy: Delete
volumeBindingMode: Immediate
parameters:
  encrypted: "true"
```

1. Mention the template file, which you created above, under `platforms/r3-corda/configuration/roles/create/k8_component/vars/main.yaml` with a variable reference. For example,

```
dlt_templates:
  sample-sc: sample_sc.tpl
```

1. Set the `component_type` and `component_name` variable to `sample-sc` (variable created in step 2) in the task `Create storageclass`, located in `platforms/r3-corda/configuration/roles/create/storageclass/tasks/main.yaml`

Adding a new storage class for Hyperledger Indy

To add a new storageclass for Hyplerledger Indy, perform the following steps:

1. Add the new storageclass template `sample_sc.tpl`, under `platforms/hyperledger-indy/configuration/roles/create/k8_component/templates` with `metadata.name` (storageclass name) as the variable `component_name`. For example,

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: {{ component_name }}
provisioner: kubernetes.io/aws-ebs
reclaimPolicy: Delete
volumeBindingMode: Immediate
```

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```
parameters:
  encrypted: "true"
```

1. Mention the template file, which you created above, under `platforms/hyperledger-indy/configuration/roles/create/k8_component/vars/main.yaml` with a variable reference. For example,

```
k8_templates:
  sample-sc: sample_sc.tpl
```

1. Set the `component_name` variable to `sample-sc` (variable created in step 2) in the task `Create Storage Class`, located in `platforms/hyperledger-indy/configuration/deploy-network.yaml`

Adding a new storage class for Quorum

To add a new storageclass for Quorum, perform the following steps:

1. Add the new storageclass template `sample_sc.tpl`, under `platforms/quorum/configuration/roles/create/k8_component/templates` with `metadata.name` (storageclass name) as the variable `component_name`. For example,

```
kind: StorageClass
apiVersion: storage.k8s.io/v1
metadata:
  name: {{ component_name }}
provisioner: kubernetes.io/aws-ebs
reclaimPolicy: Delete
volumeBindingMode: Immediate
parameters:
  encrypted: "true"
```

1. Mention the template file, which you created above, under `platforms/quorum/configuration/roles/create/k8_component/vars/main.yaml` with a variable reference. For example,

```
dlt_templates:
  sample-sc: sample_sc.tpl
```

1. Set the `component_type` and `component_name` variable to `sample-sc` (variable created in step 2) in the task `Create storageclass`, located in `platforms/quorum/configuration/roles/create/storageclass/tasks/main.yaml`

5.7.4 Upgrading a running helm2 Bevel deployment to helm3

This guide enables an operator to upgrade an existing Bevel helm2 deployment to helm3

- *Prerequisites*
- *Deleting the existing flux deployment*
- *Upgrade the helm deployments from Helm v2 to v3*
- *Re-deployment of flux*

Prerequisites

```
a. A running Bevel deployment based on helm v2
b. Helm v2 binary in place and added to the path (accessible by the name `helm`)
c. Bevel repository with the latest code
```

Deleting the existing flux deployment

The flux deployment has changed for helm v3, thus the older flux should be deleted. Also, the older flux will interfere with the upgradation process, hence its removal or de-sync is necessary.

To delete the existing flux deployment, run:

```
helm del --purge flux-{{ network.env.type }}
```

Upgrade the helm deployments from Helm v2 to v3

Perform the following steps to upgrade the deployments

```
# Download helm3 binary
wget https://get.helm.sh/helm-v3.2.4-linux-amd64.tar.gz

# Extract the binary
tar -xvf helm-v3.2.4-linux-amd64.tar.gz

# Move helm binary to the current folder
mv linux-amd64/helm helm3

# Download the helm 2to3 plugin
./helm3 plugin install https://github.com/helm/helm-2to3

# Convert all the releases to helm3 using
helm ls | awk '{print $1}' | xargs -n1 helm3 2to3 convert --delete-v2-releases

# To convert a single helm release
./helm3 2to3 convert RELEASE_NAME --delete-v2-releases
```

NOTE: After migration, you can view the helm3 releases using the command,

```
./helm3 ls --all-namespaces
```

Re-deployment of flux

With the lastest Bevel repo clone and the network.yaml, you can redeploy flux using

```
ansible-playbook platforms/shared/configuration/kubernetes-env-setup.yaml -e @<PATH_
↪TO_NETWORK_YAML>
```

CHAPTER 6

Developer Guide

6.1 Quickstart Guides

6.1.1 Developer Prerequisites

The following mandatory pre-requisites must be completed to set up a development environment for Bevel.

The process of setting up developer pre-requisites can be done manually or via an automation script (currently script is for windows OS only)

Script Based Setup

You can use the scripts here to setup developer prerequisites for Windows or Mac systems.

NOTE: You need to run the script with admin rights. This can be done by right clicking the script and selecting 'Run as admininstrator'.

Manual Setup

The estimated total effort is 55 mins.

NOTE: You will need at least 8GB RAM to run Bevel on local machine.

Setting up Git on your machine

Estimated Time: 10 minutes

To use Git, you need to install the software on your local machine.

1. Download and install **git bash** from http://git-scm.com/downloads.
2. Open 'git bash' (For Windows, Start > Run, `C:\Program Files (x86)\Git\bin\sh.exe --login -i`)
3. After the install has completed you can test whether Git has installed correctly by running the command `git --version`
4. If this works successfully you will need to configure your Git instance by specifying your username and email address. This is done with the following two commands (Use your GitHub username and email address, if you already have a Github Account):

```
git config --global user.name "<username>"
git config --global user.email "<useremail>"
```

5. To verify that the username and password was entered correctly, check by running

```
git config user.name
git config user.email
```

6. Windows users should additionally execute the following so that the EOLs are not updated to Windows CRLF.

```
git config --global core.autocrlf false
```

Setting up Github

Estimated Time: 5 minutes

GitHub is a web-based Git repository hosting service. It offers all of the distributed revision control and source code management (SCM) functionality of Git as well as adding its own features. You can create projects and repositories for you and your teams' need.

Complete the following steps to download and configure Bevel repository on your local machine.

1. If you already have an account from previously, you can use the same account. If you don't have an account, create one.
2. Go to bevel on GitHub and click **Fork** button on top right. This will create a copy of the repo to your own GitHub account.
3. In git bash, write and execute the command:

```
ssh-keygen -q -N "" -f ~/.ssh/gitops
```

This generates an SSH key-pair in your user/.ssh directory: gitops (private key) and gitops.pub (public key).

4. Add the public key contents from gitops.pub (starts with ssh-rsa) as an Access Key (with read-write permissions) in your Github repository by following this guide.
5. Execute the following command to add the key to your ssh-agent

```
eval "$(ssh-agent)"
ssh-add ~/.ssh/gitops
```

6. Create a `project` directory in your home directory and clone the forked repository to your local machine.

```
mkdir ~/project
cd ~/project
git clone git@github.com:<githubuser>/bevel.git
```

7. Checkout the develop branch.

```
cd bevel
git checkout develop
```

NOTE: If you have 2-Factor Authentication enabled on your GitHub account, you have to use GitHub token. Otherwise, password is fine.

1. On GitHub page, click your profile icon and then click **Settings**.
2. On the sidebar, click **Developer settings**.
3. On the sidebar, click **Personal access tokens**.
4. Click **Generate new token**.
5. Add a token description, enable suitable access and click **Generate token**.
6. Copy the token to a secure location or password management app.

For security reasons, after you leave the page, you can no longer see the token again.

Setting up Docker

Estimated Time: 10 minutes

Install Docker Toolbox to make sure your local environment has the capbility to execute `docker` commands. You can check the version of Docker you have installed with the following command from a terminal prompt:

```
docker --version
```

NOTE: For Windows, you MUST use Docker Toolbox with VirtualBox. Do not use Docker Desktop for Windows. Also HyperV should be DISABLED for Mac and Windows.

Setting up HashiCorp Vault

Estimated Time: 15 minutes

We need Hashicorp Vault for the certificate and key storage.

1. To install the precompiled binary, download the appropriate package for your system.
2. Once the zip is downloaded, unzip it into any directory. The `vault` binary inside is all that is necessary to run Vault (or `vault.exe` for Windows). Any additional files, if any, aren't required to run Vault.
3. Create a directory `project/bin` and copy the binary there. Add `project/bin` directory to your `PATH`. Run following from git bash.

```
mkdir ~/project/bin
mv vault.exe ~/project/bin
export PATH=~/project/bin:$PATH
```

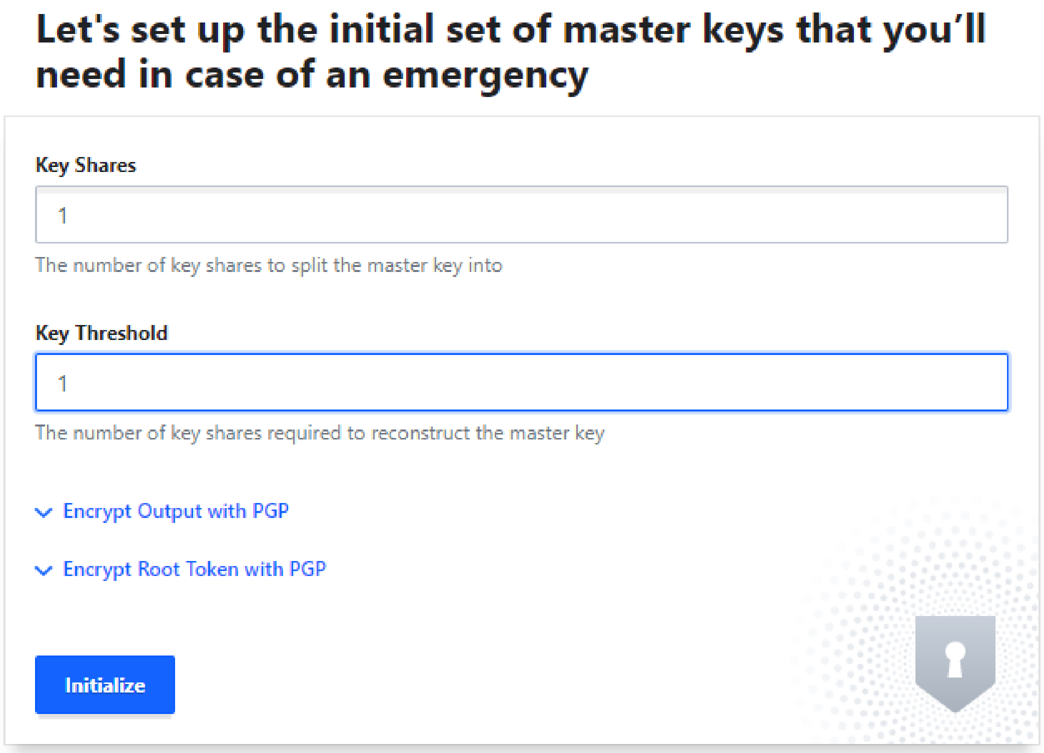
4. Create a `config.hcl` file in the `project` directory with the following contents (use a file path in the `path` attribute which exists on your local machine)

```
ui = true
storage "file" {
   path     = "~/project/data"
}
listener "tcp" {
   address     = "0.0.0.0:8200"
   tls_disable = 1
}
```

5. Start the Vault server by executing (this will occupy one terminal). Do not close this terminal.

```
vault server -config=config.hcl
```

6. Open browser at http://localhost:8200/. And initialize the Vault by providing your choice of key shares and threshold. (below example uses 1)


Let's set up the initial set of master keys that you'll need in case of an emergency

Key Shares
1
The number of key shares to split the master key into

Key Threshold
1
The number of key shares required to reconstruct the master key

7. Click **Download Keys** or copy the keys, you will need them. Then click **Continue to Unseal**. Provide the unseal key first and then the root token to login.
8. In a new terminal, execute the following (assuming `vault` is in your `PATH`):

```
export VAULT_ADDR='http://<Your Vault local IP address>:8200' #e.g. http://192.
↪168.0.1:8200
export VAULT_TOKEN="<Your Vault root token>"

# enable Secrets v1
vault secrets enable -version=1 -path=secret kv
```

Setting up Minikube

Estimated Time: 15 minutes

For development environment, minikube can be used as the Kubernetes cluster on which the DLT network will be deployed.

1. Follow platform specific instructions to install minikube on your local machine. Also install Virtualbox as the Hypervisor. (If you already have **HyperV** it should be removed or disabled.)
2. Minikube is also a binary, so move it into your `~/project/bin` directory as it is already added to `PATH`.
3. Configure minikube to use 4GB memory and default kubernetes version

```
minikube config set memory 4096
minikube config set kubernetes-version v1.19.15
```

4. Then start minikube. This will take longer the first time.

```
minikube start --vm-driver=virtualbox
```

5. Check status of minikube by running

```
minikube status
```

   The Kubernetes config file is generated at `~/.kube/config`

6. To stop (do not delete) minikube execute the following

```
minikube stop
```

   Now your development environment is ready!

NOTE: Minikube uses port in range 30000-32767. If you would like to change it, use the following command:

```
minikube start --vm-driver=virtualbox --extra-config=apiserver.service-node-port-
↪range=15000-20000
```

Troubleshooting

At Step 5, if you get the following error:

```
2020-03-10T17:00:21.664Z [ERROR] core: failed to initialize barrier: error="failed to␣
↪persist keyring: mkdir /project: permission denied"
```

Update the `path` in Vault `config.hcl` to absolute path:

```
storage "file" {
   path    = "/full/path/to/project/vault"
}
```

For example, `/home/users/Desktop/project/vault`.

6.1.2 Running Bevel DLT network on Minikube

Pre-requisites

Before proceeding, first make sure that you've completed Developer Pre-requisites.

Clone forked repo

1. If you have not already done so, fork bevel and clone the forked repo to your machine.

   ```
   cd ~/project
   git clone git@github.com:<githubuser>/bevel.git
   ```

2. Add a "local" branch to your machine

   ```
   cd ~/project/bevel
   git checkout -b local
   git push --set-upstream origin local
   ```

Update kubeconfig file

1. Create a `build` folder inside your Bevel repository:

   ```
   cd ~/project/bevel
   mkdir build
   ```

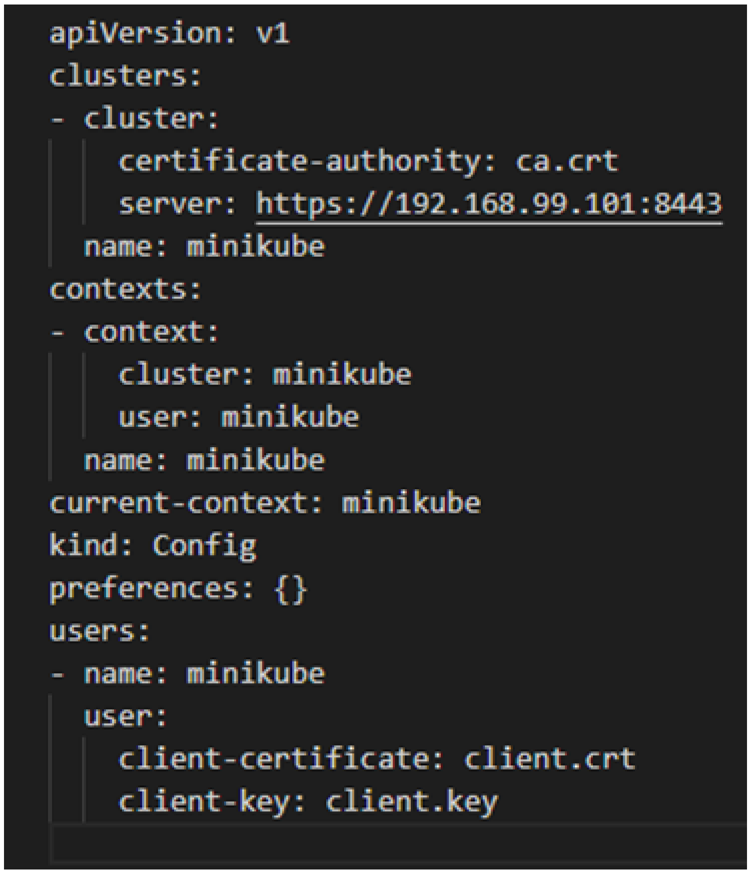
2. Copy ca.crt, client.key, client.crt from `~/.minikube` to build:

   ```
   cp ~/.minikube/ca.crt build/
   cp ~/.minikube/client.key build/
   cp ~/.minikube/client.crt build/
   ```

3. Copy `~/.kube/config` file to build:

   ```
   cp ~/.kube/config build/
   ```

4. Open the above config file and remove the paths for certificate-authority, client-certificate and client-key as in the figure below.



```
apiVersion: v1
clusters:
- cluster:
    certificate-authority: ca.crt
    server: https://192.168.99.101:8443
  name: minikube
contexts:
- context:
    cluster: minikube
    user: minikube
  name: minikube
current-context: minikube
kind: Config
preferences: {}
users:
- name: minikube
  user:
    client-certificate: client.crt
    client-key: client.key
```

NOTE: If you ever delete and recreate minikube, the above steps have to be repeated.

5. Copy gitops file from ~/.ssh to build. (This is the private key file which you used to authenticate to your GitHub in pre-requisites)

```
cp ~/.ssh/gitops build/
```

Additional Windows configurations

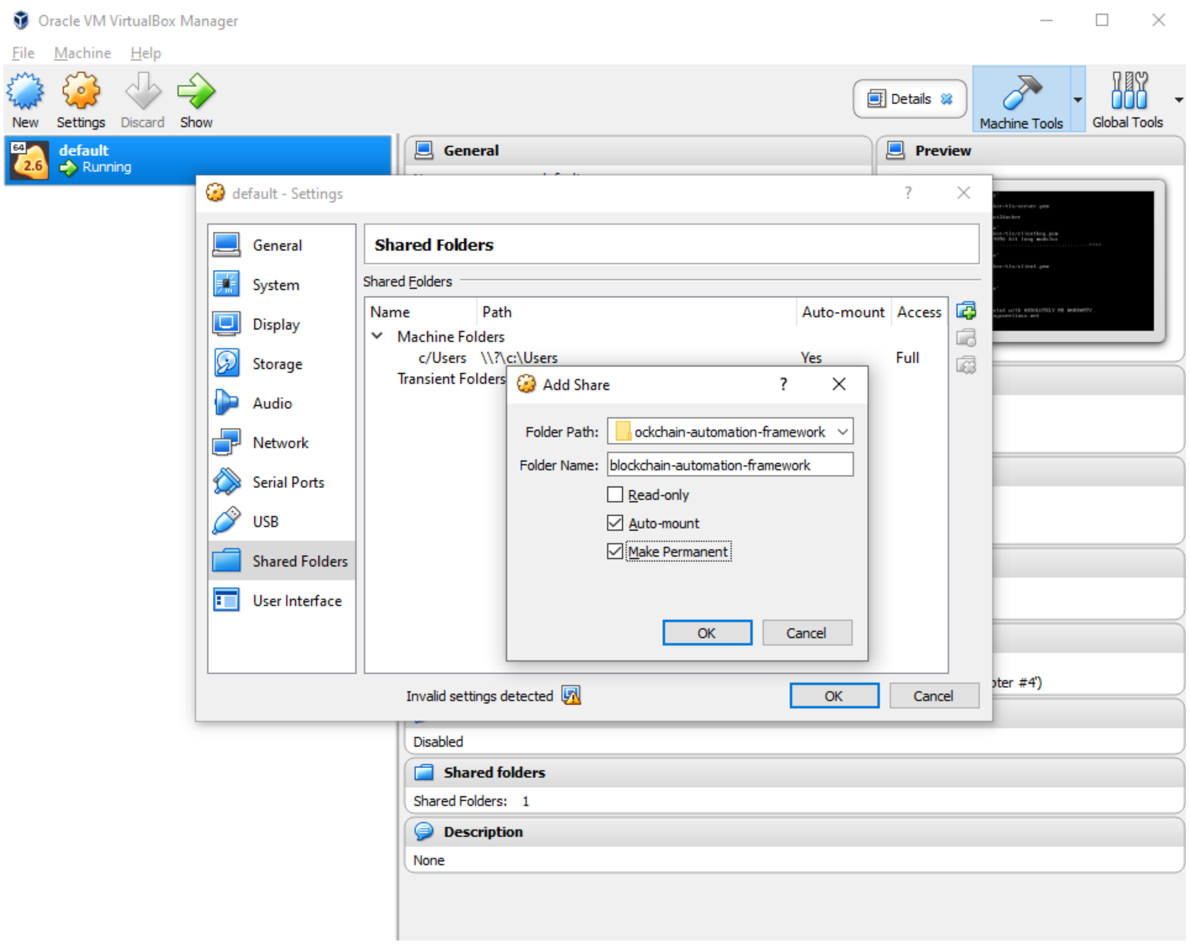
1. Ensure that you have set the following git config before cloning the repo.

```
git config --global core.autocrlf false
```

2. If not, update the EOL to LF for platforms/hyperledger-fabric/scripts/*.sh files.
3. Execute following to correctly set docker environment.

```
eval $('docker-machine.exe' env)
```

4. Mount windows local folder (bevel folder) to VirtualBox docker VM (the machine named "default" by default) from right-click menu, Settings -> Shared Folders. All paths in network.yaml should be the mounted path. Shut down and restart the "default" machine after this.



Shared Folders

Shared Folders

Name	Path	Auto-mount	Access
Machine Folders			
c/Users	\\?\c:\Users	Yes	Full
Transient Folders			

Add Share

Folder Path: ockchain-automation-framework

Folder Name: blockchain-automation-framework

[ ] Read-only
[✓] Auto-mount
[✓] Make Permanent

Shared folders

Shared Folders: 1

Description

None

Edit the configuration file

1. Choose the DLT/Blockchain platform you want to run and copy the relevant sample network.yaml to build folder; rename it to network.yaml.

```
cd ~/project/bevel
cp platforms/hyperledger-fabric/configuration/samples/network-minikube.yaml build/
↪network.yaml
```

2. Update Docker configurations:

```
docker:
  url: "ghcr.io/hyperledger"
  # Comment username and password as it is public repo
  #username: "<your docker username>"
  #password: "<your docker password/token>"
```

3. For each `organization`, update ONLY the following and leave everything else as is:

```
vault:
  url: "http://<Your Vault local IP address>:8200" # Use the local IP address␣
↪rather than localhost e.g. http://192.168.0.1:8200
  root_token: "<your vault_root_token>"
gitops:
```

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```
  git_url: "<https/ssh url of your forked repo>" #e.g. "https://github.com/
↪hyperledger/bevel.git"
  git_repo: "<https url of your forked repo without the https://>" #e.g. "github.
↪com/hyperledger/bevel.git"
  username: "<github_username>"
  password: "<github token/password>"
  email: "<github_email>"
```

If you need help, you can use each platform's sample network-minikube.yaml:

- For Fabric, use `platforms/hyperledger-fabric/configuration/samples/network-minikube.yaml`
- For Quorum, use `platforms/quorum/configuration/samples/network-minikube.yaml`
- For Corda, use `platforms/r3-corda/configuration/samples/network-minikube.yaml`

And simply replace the placeholder values.

NOTE: If you have 2-Factor Authentication enabled on your GitHub account, you have to use GitHub token. Otherwise, password is fine.

1. On GitHub page, click your profile icon and then click **Settings**.
2. On the sidebar, click **Developer settings**.
3. On the sidebar, click **Personal access tokens**.
4. Click **Generate new token**.
5. Add a token description, enable suitable access and click **Generate token**.
6. Copy the token to a secure location or password management app.

For security reasons, after you leave the page, you can no longer see the token again.

---

1. Deploying the sample "supplychain" chaincode is optional, so you can delete the "chaincode" section. If deploying chaincode, update the following for the peers.

```
chaincode:
  repository:
    username: "<github_username>"
    password: "<github_token>"
```

Execute

Make sure that Minikube and Vault server are running. Double-check by running:

```
minikube status
vault status
```

Now run the following to deploy Bevel Fabric on minikube:

```
docker run -it -v $(pwd):/home/bevel/ --network="host" ghcr.io/hyperledger/bevel-
↪build:latest
```

Windows users should use following (make sure that the local volume was mounted as per *this step*):

```
docker run -it -v /bevel:/home/bevel/ --network="host" ghcr.io/hyperledger/bevel-
↪build:latest
```

Meanwhile you can also check if pods are being deployed:

```
kubectl get pods --all-namespaces -w
```

NOTE: If you need public address for nodes in your `network.yaml` file, you can use the output of `minikube ip`.

NOTE. baf-build image is using jdk14 but Corda and Corda Enterprise requires jdk8. In this case, you can use the prebuild image tag *jdk8* ghcr.io/hyperledger/bevel-build:jdk8-latest

Troubleshooting

`Failed to establish a new connection: [Errno 111] Connection refused`

This is because you have re-created minikube but have not updated K8s `config` file. Repeat *"Update kubeconfig file"* steps 3 - 4 and try again.

`kubernetes.config.config_exception.ConfigException: File does not exists: /Users/.minikube/ca.crt`

This is because you have not removed the absolute paths to the certificates in `config` file. Repeat *"Update kubeconfig file"* step 4 and try again.

`error during connect: Get http://%2F%2F.%2Fpipe%2Fdocker_engine/v1.40/version: open //./pipe/docker_engine: The system cannot find the file specified. In the default daemon configuration on Windows, the docker client must be run elevated to connect. This error may also indicate that the docker daemon is not running`

This is because docker isn't running. To start it, just close all the instances of Docker Quickstart Terminal and open again.

`ERROR! the playbook: /home/bevel/platforms/shared/configuration/site.yaml could not be found`

This is because the bevel repository isn't mounted to the default VM. Check *this step*.

6.1.3 DLT Blockchain Network deployment using Docker

Hyperledger Bevel is targeted for Production systems, but for quick developer deployments, you can create the containerized Ansible controller to deploy the dev DLT/Blockchain network.

Prerequisites

Follow instructions to *install* and *configure* common prerequisites. In summary, you should have details of the following:

1. A machine (aka host machine) on which you can run docker commands i.e. which has docker command line installed and is connected to a docker daemon.
2. At least one Kubernetes cluster (with connectivity to the host machine).
3. At least one Hashicorp Vault server (with connectivity to the host machine).

4. Read-write access to the Git repo (either ssh private key or https token).

Steps to use the bevel-build container

1. Clone the git repo to host machine, call this the project folder

   ```
   git clone https://github.com/hyperledger/bevel
   ```

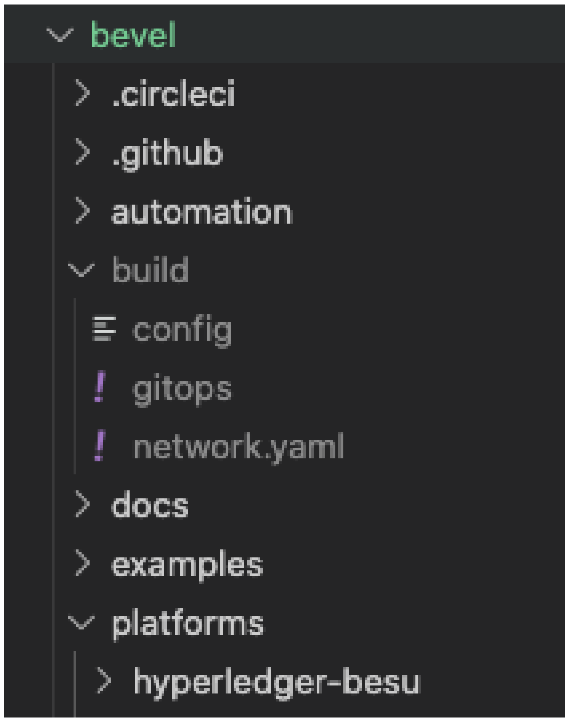
2. Depending on your platform of choice, there can be some differences in the configuration file. Please follow platform specific links below to learn more on updating the configuration file.

   - *R3 Corda Configuration File*
   - *Hyperledger Fabric Configuration File*
   - *Hyperledger Indy Configuration File*
   - *Quorum Configuration File*
   - *Hyperledger Besu Configuration File*

3. Create a build folder in the project folder; this build folder should have the following files:

   a) K8s config file as configb) Network specific configuration file as network.yamlc) If using SSH for Gitops, Private key file which has write-access to the git repo

   Screen shot of the folder structure is below:

   ```
   bevel
     .circleci
     .github
     automation
     build
       config
       gitops
       network.yaml
     docs
     examples
     platforms
       hyperledger-besu
   ```

4. Ensure the configuration file (`./build/network.yaml`) has been updated with the DLT network that you want to configure.

5. Run the following command to run the provisioning scripts, the command needs to be run from the project folder. The command also binds and mounts a volume, in this case it binds the repository

```
docker run -it -v $(pwd):/home/bevel/ --network="host" ghcr.io/hyperledger/bevel-
↪build:latest

# For Corda use jdk8 version
docker run -it -v $(pwd):/home/bevel/ --network="host" ghcr.io/hyperledger/bevel-
↪build:jdk8-latest
```

6. In case you have failures and need to debug, login to the bash shell

```
docker run -it -v $(pwd):/home/bevel/ --network="host" ghcr.io/hyperledger/bevel-
↪build:latest bash

# go to bevel directory
cd bevel
# Run the provisioning scripts
ansible-playbook  platforms/shared/configuration/site.yaml -e "@./build/network.
↪yaml"
```

7. For instructions on how to verify or troubleshoot network, read *How to debug a Bevel deployment*

6.2 Additional Developer prerequisites

- *Sphinx tool*
- *Molecule*

6.2.1 Sphinx tool

Sphinx is a tool that makes it easy to create intelligent and beautiful documentation. This tool is needed to build Hyperledger Bevel documentation from `docs` folder.

- Sphinx version used 2.1.1

Sphinx installation: Follow the link to install sphinx documentation tool.

All Hyperledger Bevel documentation and Sphinx Configuration files (`conf.py`) are located in docs/source folder. To build the documentation, execute the following command from *docs* directory:

```
make html
# or for Windows
.\Make.bat html
```

6.2.2 Molecule

Molecule is designed to aid in the development and testing of Ansible roles. In Bevel, Molecule is used to check for common coding standards, yaml errors and unit testing Ansible code/roles.

- Molecule version used 2.22

Requirements

- Docker Engine
- Python3 (and pip configured with python3)

Molecule installation Please refer to the Virtual environment documentation for installation best practices. If not using a virtual environment, please consider passing the widely recommended '–user' flag when invoking `pip`.

```
$ pip install --user 'molecule[docker]'
```

The existing test scenarios are found in the *molecule* folder under configuration of each platform e.g. platforms/shared/configuration/molecule folder.

6.3 Ansible Roles and Playbooks

6.3.1 Common Configurations

Hyperledger Bevel installs the common pre-requisites when the `site.yaml` playbook is run. To read more about setting up DLT/Blockchain networks, refer *Setting up a Blockchain/DLT network*.

Following playbooks can be executed independently to setup the enviornment and can be found here

1. **enviornment-setup.yaml** Playbook enviornment-setup.yaml executes the roles which has tasks to install the binaries for:
   - kubectl
   - helm
   - vault client
   - aws-authenticator
2. **kubernetes-env-setup.yaml** Playbook kubernetes-env-setup.yaml executes the roles which has tasks to configure the following on each Kubernetes cluster:
   - flux
   - ambassador (if chosen)
   - haproxy-ingress (if chosen)

All the common Ansible roles can be found at platforms/shared/configuration/roles

- setup/ambassador
- setup/aws-auth
- setup/aws-cli
- setup/flux
- setup/haproxy-ingress
- setup/helm
- setup/kubectl
- setup/vault

Follow Readme for detailed information on each of these roles.

6.3.2 Corda Configurations

In Hyperledger Bevel project, ansible is used to automate the certificate generation, putting them in vault and generate value files, which are then pushed to the repository for deployment, using GitOps. This is achieved using Ansible playbooks. Ansible playbooks contains a series of roles and tasks which run in sequential order to achieve the automation.

```
/r3-corda
|-- charts
|   |-- doorman
|   |-- doorman-tls
|   |-- h2
|   |-- h2-addUser
|   |-- h2-password-change
|   |-- mongodb
|   |-- mongodb-tls
|   |-- nms
|   |-- nms-tls
|   |-- node
|   |-- node-initial-registration
|   |-- notary
|   |-- notary-initial-registration
|   |-- storage
|-- images
|-- configuration
|   |-- roles/
|   |-- samples/
|   |-- playbook(s)
|   |-- openssl.conf
|-- releases
|   |-- dev/
|-- scripts
```

For R3-Corda, the ansible roles and playbooks are located at `/platforms/r3-corda/configuration/` Some of the common roles and playbooks between Hyperledger-Fabric, Hyperledger-Indy, Hyperledger-Besu, R3 Corda and Quorum are located at `/platforms/shared/configurations/`

Roles for setting up Corda Network

Roles in ansible are a combination of logically inter-related tasks.

Below is the single playbook that you need to execute to setup complete corda network.

deploy_network

This is the main ansible playbook which call all the roles in below sequence to setup corda network.

- Create Storage Class
- Create namespace and vault auth
- Deploy Doorman service node
- Deploy Networkmap service node
- Check that network service uri are reachable
- Deploy notary
- Deploy nodes
- Remove build directory

Follow Readme for detailed information.

Below are the roles that deploy_network playbook calls to complete the setup process.

setup/nms

- Perform all the prerequisites (namespace, Vault auth, rbac, imagepullsecret)
- Create nms helm value files
- Check-in to git repo

Follow Readme for detailed information.

setup/doorman

- Perform all the prerequisites (namespace, Vault auth, rbac, imagepullsecret)
- Create doorman and mongodb helm value files
- Check-in to git repo

Follow Readme for detailed information.

create/certificates

- Generate root certificates for doorman and nms

Follow Readme for detailed information.

setup/notary

- Perform all the prerequisites (namespace, Vault auth, rbac, imagepullsecret)
- Get crypto from doorman/nms, store in Vault
- Create notary db helm value files
- Create notary initial registration helm value files
- Create notary value files
- Check-in to git repo

Follow Readme for detailed information.

setup/node

- Perform all the prerequisites (namespace, Vault auth, rbac, imagepullsecret)
- Get crypto from doorman/nms, store in Vault
- Create node db helm value files
- Create node initial registration helm value files
- Create node value files
- Check-in to git repo

Follow Readme for detailed information.

deploy/cordapps

- Deploy cordapps into each node and notary

Follow Readme for detailed information.

setup/springboot_services

- Create springboot webserver helm value files for each node
- Check-in to git repo

Follow Readme for detailed information.

setup/get_crypto

- Ensure admincerts directory exists
- Save the cert file
- Save the key file
- Save the root keychain
- Save root cert
- Save root key

Follow Readme for detailed information.

6.3.3 Corda Enterprise Configurations

In Hyperledger Bevel project, Ansible is used to automate the certificate generation, putting them in vault and generate value files, which are then pushed to the git repository for deployment, using GitOps. This is achieved using Ansible playbooks. Ansible playbooks contains a series of roles and tasks which run in sequential order to achieve the automation. For R3-Corda Enterprise, the ansible roles and playbooks are located at `platforms/r3-corda-ent/configuration/` Some of the common roles and playbooks between Hyperledger-Fabric, Hyperledger-Indy, Hyperledger-Besu, R3 Corda and Quorum are located at `platforms/shared/configurations/`

```
platforms/r3-corda-ent/configuration
├── deploy-network.yaml
├── deploy-nodes.yaml
├── openssl.conf
├── README.md
├── reset-network.yaml
├── roles
│   ├── create
│   │   ├── certificates
│   │   ├── k8_component
│   │   ├── namespace_serviceaccount
│   │   └── storageclass
│   ├── delete
│   │   ├── flux_releases
│   │   ├── gitops_files
│   │   └── vault_secrets
│   ├── helm_component
│   │   ├── Readme.md
│   │   │
```

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```
│    │    ├── tasks
│    │    ├── templates
│    │    └── vars
│    └── setup
│         ├── auth
│         ├── bridge
│         ├── cenm
│         ├── credentials
│         ├── float
│         ├── float-environment
│         ├── gateway
│         ├── get_crypto
│         ├── idman
│         ├── nmap
│         ├── node
│         ├── node_registration
│         ├── notary
│         ├── notary-initial-registration
│         ├── pki-generator
│         ├── pki-generator-node
│         ├── signer
│         ├── tlscerts
│         ├── vault_kubernetes
│         └── zone
└── samples
     ├── network-cordaent.yaml
│    ├── network-addNotary.yaml
     └── README.md
```

Playbooks for setting up Corda Enterprise Network

Below are the playbooks availabe for the network operations.

deploy_network.yaml

This is the main ansible playbook which call all the roles in below sequence to setup Corda Enterprise network.

- Remove build directory
- Create Storage Class
- Create namespace and vault auth
- Deploy CENM services
- Check that network service uri are reachable
- Deploy nodes

deploy_nodes.yaml

This ansible playbook should be used when deploying only the nodes. This can be used when the CENM Services are already up and managed by a different network.yaml. This calls the below supporting roles in sequence.

- Remove build directory
- Create Storage Class
- Create namespace and vault auth
- Check that network service uri are reachable
- Deploy nodes

reset_network.yaml

This ansible playbook is used when deleting the network. This calls the below supporting roles in sequence.

- Deletes the Gitops release files
- Deletes the Vault secrets and authpaths
- Uninstalls Flux
- Deletes the helm releases from Kubernetes
- Remove build directory

Follow Readme for detailed information.

Roles defined for Corda Enterprise

Roles in ansible are a combination of logically inter-related tasks. Below are the roles that are defined for Corda Enterprise.

create/certificates/cenm

- Creates the Ambassador Proxy TLS Certificates for CENM components
- Saves them to Vault
- Creates Kubernetes secrets to be used by Ambassador pods

Follow Readme for detailed information.

create/certificates/node

- Creates the Ambassador Proxy TLS Certificates for Corda Nodes
- Saves them to Vault
- Creates Kubernetes secrets to be used by Ambassador pods

Follow Readme for detailed information.

create/k8_component

- Creates various Kubernetes components based on the `templates`
- Checks-in to git repo

Add new tpl files in `templates` folder when defining new storageclass.

Follow Readme for detailed information.

create/namespace_serviceaccount

- Creates the namespace, serviceaccounts and clusterrolebinding
- Checks-in to git repo

create/storageclass

- Creates the storageclass template with name "cordaentsc"
- Checks-in to git repo

Follow Readme for detailed information.

delete/flux_releases

- Deletes all helmreleases in the namespace
- Deletes the namespace

Follow Readme for detailed information.

delete/gitops_files

- Deletes all gitops files from release folder
- Checks-in to git repo

Follow Readme for detailed information.

delete/vault_secrets

- Deletes all contents of Vault
- Deletes the related Kubernetes secrets
- Deletes Vault access policies

Follow Readme for detailed information.

helm_component

- Creates various Helmrelease components based on the `templates`
- Performs helm lint (when true)

Most default values are in the tpl files in `templates` folder. If any need to be changed, these tpl files need to be edited.

Follow Readme for detailed information.

setup/auth

- Wait for pki-generator job to "Complete"
- Create helmrelease files for Auth component
- Check-in to git repo

Follow Readme for detailed information.

setup/bridge

- Create helmrelease files for Bridge component
- Check-in to git repo

Follow Readme for detailed information.

setup/cenm

- Checks all the prerequisite namespaces and serviceaccounts are created
- Creates vault access for cenm organization
- Calls setup/pki-generator role to generate network crypto.
- Calls setup/auth role to generate network crypto.
- Calls setup/gateway role to generate network crypto.
- Calls setup/zone role to generate network crypto.
- Calls setup/signer role to deploy signer service.
- Calls setup/idman role to deploy idman service.
- Calls setup/nmap role to deploy nmap service.
- Calls setup/notary role to deploy notary service.

Follow Readme for detailed information.

setup/credentials

- Writes keystore, truststore, ssl passwords for CENM services
- Writes node keystore, node truststore, network root-truststore passwords for CENM services

Follow Readme for detailed information.

setup/float

- Create helmrelease files for Float component
- Check-in to git repo

Follow Readme for detailed information.

setup/gateway

- Wait for pki-generator job to "Complete"
- Create gateway ambassador certificates
- Create helmrelease files for Gateway component
- Check-in to git repo

Follow Readme for detailed information.

setup/get_crypto

- Saves the Ambassador cert and key file to local file from Vault when playbook is re-run.

Follow Readme for detailed information.

setup/idman

- Wait for Signer pod to be "Running"
- Creates Ambassador certs by calling create/certificates/cenm role
- Create idman value files
- Check-in to git repo

setup/nmap

- Wait for PKI Job to "Complete" if certificates are not on Vault
- Creates Ambassador certs by calling create/certificates/cenm role
- Gets network-root-truststore.jks from Vault to save to local
- Create Notary-registration Job if not done already
- Wait forNotary-registration Job to "Complete" if not done already
- Create nmap value files
- Check-in to git repo

Follow Readme for detailed information.

setup/node

- Wait for all the prerequisites (namespace, Vault auth, rbac, imagepullsecret)
- Create Vault access using setup/vault_kubernetes role
- Create ambassador certificates by calling create/certificates/node
- Save idman/networkmap tls certs to Vault for this org
- Create node initial registration by calling setup/node_registration role
- Create node value files
- Create bridge, if enabled, by calling setup/bridge

- Create float, if enabled, by calling setup/float
- Check-in to git repo

Follow Readme for detailed information.

setup/node_registration

- Create node db helm value files
- Create node initial registration helm value files, if not registered already
- Check-in to git repo

Follow Readme for detailed information.

setup/notary

- Wait for networkmap pod to be "Running"
- Create ambassador certificates by calling create/certificates/cenm
- Create notary value files
- Check-in to git repo

Follow Readme for detailed information.

setup/notary-initial-registration

- Wait for idman pod to be "Running"
- Create notary db helm value files
- Create notary initial registration helm value files, if not registered already
- Check-in to git repo

Follow Readme for detailed information.

setup/pki-generator

- Create pki-generator value files, if values are not in Vault
- Check-in to git repo

Follow Readme for detailed information.

setup/pki-generator-node

- Create pki-generator value files, if values are not in Vault
- Check-in to git repo

Follow Readme for detailed information.

setup/signer

- Wait for pki-generator Job to be "Completed"
- Create signer value files
- Check-in to git repo

Follow Readme for detailed information.

setup/tlscerts

- Copies the idman/nmap certificates and truststore to each node's Vault

Follow Readme for detailed information.

setup/vault_kubernetes

- Creates vault auth path if it does not exist
- Gets Kubernetes CA certs
- Enables Kubernetes and Vault authentication
- Creates Vault policies if they do not exist
- Creates docker credentials if they do not exist

If the Vault policies need to be changed, then this role will need to be edited.

Follow Readme for detailed information.

setup/zone

- Wait for pki-generator job to "Complete"
- Create zone helmrelease files
- Check-in to git repo

Follow Readme for detailed information.

6.3.4 Fabric Configurations

In Hyperledger Bevel project, ansible is used to automate the certificate generation, putting them in vault and generate value files, which are then pushed to the repository for deployment, using GitOps. This is achieved using Ansible playbooks. Ansible playbooks contains a series of roles and tasks which run in sequential order to achieve the automation.

```
/hyperledger-fabric
|-- charts
|    |-- ca
|    |-- catools
|    |-- zkkafka
|    |-- orderernode
|    |-- peernode
|    |-- create_channel
|    |-- join_channel
```

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```
|    |-- install_chaincode
|    |-- instantiate_chaincode
|    |-- upgrade_chaincode
|-- images
|-- configuration
|    |-- roles/
|    |-- samples/
|    |-- playbook(s)
|    |-- openssl.conf
|-- releases
|    |-- dev/
|-- scripts
```

For Hyperledger-Fabric, the ansible roles and playbooks are located at `/platforms/hyperledger-fabric/configuration/` Some of the common roles and playbooks between Hyperledger-Fabric, Hyperledger-Indy, Hyperledger-Besu, R3 Corda and Quorum are located at `/platforms/shared/configurations/`

Roles for setting up Fabric Network

Roles in ansible are a combination of logically inter-related tasks.

Below is the single playbook that you need to execute to setup complete fabric network.

create/anchorpeer

- Call nested_anchorpeer for each organization
- Check join channel job is done
- Creating value file of anchor peer for {{ channel_name }}
- Git Push

Follow Readme for detailed information.

create/ca_server

- Check if CA certs already created
- Ensures crypto dir exists
- Get CA certs and key
- Generate the CA certificate
- Copy the crypto material to Vault
- Check if CA admin credentials are already created
- Write the CA server admin credentials to Vault
- Check Ambassador cred exists
- Create the Ambassador credentials
- Create CA server values for Orderer

- Create CA server values for Organisations
- Git Push

Follow Readme for detailed information.

create/ca_tools

- Check CA-server is available
- Create CA-tools Values file
- Git Push

Follow Readme for detailed information.

create/chaincode/install

- Create value file for chaincode installation
- Check/Wait for anchorpeer update job
- Check for install-chaincode job
- Write the git credentials to Vault
- Create value file for chaincode installation (nested)
- Git Push

Follow Readme for detailed information.

create/chaincode/instantiate

- Create value file for chaincode instantiation
- Check/Wait for install-chaincode job
- Check for instantiate-chaincode job
- Create value file for chaincode instantiaiton (nested)
- Git Push

Follow Readme for detailed information.

create/chaincode/invoke

- Create value file for chaincode invocation
- Check/Wait for install-chaincode job
- Create value file for chaincode invocation (nested)
- Git Push

Follow Readme for detailed information.

create/chaincode/upgrade

- Check/Wait for install-chaincode job
- Create value file for chaincode upgrade
- Git Push

Follow Readme for detailed information.

create/channel_artifacts

- Check configtxgen
- Geting the configtxgen binary tar
- Unzipping the downloaded file
- Moving the configtxgen from the extracted folder and place in it path
- Creating channel-artifacts folder
- Write BASE64 encoded genesis block to Vault
- Remove old channel block
- Creating channels
- Creating Anchor artifacts
- Creating JSON configration for new organization

Follow Readme for detailed information.

create/genesis

- Remove old genesis block
- Creating genesis block
- Write genesis block to Vault

Follow README for more information.

create/channels

- Call valuefile when participant is creator
- Check orderer pod is up
- Check peer pod is up
- Create Create_Channel value file
- Git Push

Follow Readme for detailed information.

create/channels_join

- Call nested_channel_join for each peer
- Check create channel job is done
- “join channel {{ channel_name }}”
- Git Push
- Call check for each peer
- Check join channel job is done

Follow Readme for detailed information.

create/configtx

- Remove old configtx file
- Create configtx file
- Adding init patch to configtx.yaml
- Adding organization patch to configtx.yaml
- Adding orderer patch to configtx.yaml
- Adding profile patch to configtx.yaml

Follow Readme for detailed information.

create/crypto/orderer

- Call orderercheck.yaml for orderer
- Check if CA-tools is running
- Ensure CA directory exists
- Check if CA certs already created
- Check if CA key already created
- Call orderer.yaml for each orderer
- Check if orderer msp already created
- Get MSP info
- Check if orderer tls already created
- Ensure tls directory exists
- Get Orderer tls crt
- Create directory path on CA Tools
- Copy generate-usercrypto.sh to destination directory
- Changing the permission of msp files
- Copy the generate_crypto.sh file into the CA Tools
- Generate crypto material for organization orderers

- Copy the crypto config folder from the CA tools
- Copy the crypto material for orderer
- Check Ambassador cred exists
- Check if orderer ambassador secrets already created
- Get Orderer ambassador info
- Generate the orderer certificate
- Create the Ambassador credentials
- Copy the crypto material to Vault

Follow Readme for detailed information.

create/crypto/peer

- Check if CA-tools is running
- Ensure CA directory exists
- Check if CA certs already created
- Check if CA key already created
- Call peercheck.yaml for each peer
- Check if peer msp already created
- Get MSP info
- Call common.yaml for each peer
- Create directory path on CA Tools
- Copy generate-usercrypto.sh to destination directory
- Changing the permission of msp files
- Copy the generate_crypto.sh file into the CA Tools
- Generate crypto material for organization peers
- Copy the crypto config folder from the CA tools
- Check that orderer-certificate file exists
- Ensure orderer tls cert directory exists
- Copy tls ca.crt from auto-generated path to given path
- Check if Orderer certs exist in Vault
- Save Orderer certs if not in Vault
- Copy organization level certificates for orderers
- Check if admin msp already created
- Copy organization level certificates for orgs
- Check if user msp already created
- Copy user certificates for orgs

Follow Readme for detailed information.

create/crypto_script

- Create generate_crypto script file for orderers
- Create generate_crypto script file for organizations

Follow Readme for detailed information.

create/namespace_vaultauth

- Check namespace is created
- Create namespaces
- Create vault reviewer service account for Organizations
- Create vault auth service account for Organizations
- Create clusterrolebinding for Orderers
- Git Push

Follow Readme for detailed information.

create/new_organisation/create_block

- Call nested_create_json for each peer
- Ensure channel-artifacts dir exists
- Remove old anchor file
- Creating new anchor file
- adding new org peers anchor peer information
- Create create-block-{{ channel_name }}.sh script file for new organisations

Follow Readme for detailed information.

create/orderers

- create kafka clusters
- create orderers
- Git push

Follow Readme for detailed information.

create/peers

- Write the couchdb credentials to Vault
- Create Value files for Organization Peers
- Git Push

Follow Readme for detailed information.

create/storageclass

- Check if storage class created
- Ensures "*component_type*" dir exists
- Create Storage class for Orderer
- Create Storage class for Organizations
- Git push

Follow Readme for detailed information.

delete/flux_releases

- Deletes all the helmreleases CRD
- Remove all Helm releases
- Deletes namespaces

Follow Readme for detailed information.

delete/gitops_files

- Delete release files
- Git push

Follow Readme for detailed information.

delete/vault_secrets

- Delete docker creds
- Delete Ambassador creds
- Delete vault-auth path
- Delete Crypto for orderers
- Delete Crypto for peers
- Delete policy

Follow Readme for detailed information.

helm_component

- Ensures value directory exist
- Create value file
- Helm lint

Follow Readme for detailed information.

k8_component

- Ensures value directory exist
- Create value file

Follow Readme for detailed information.

setup/config_block/fetch

- Call nested_create_cli for the peer
- create valuefile for cli {{ peer.name }}-{{ participant.name }}-{{ channel_name }}
- Call nested_fetch_role for the peer
- start cli
- fetch and copy the configuration block from the blockchain
- delete cli

Follow Readme for detailed information.

setup/config_block/sign_and_update

- Call valuefile when participant is new
- Check peer pod is up
- Call nested_sign_and_update for each peer
- create cli value files for {{peer.name}}-{{ org.name }} for signing the modified configuration block
- start cli {{peer.name}}-{{ org.name }}
- Check if fabric cli is present
- signing from the admin of {{ org.name }}
- delete cli {{ peer.name }}-{{ participant.name }}-cli
- Call nested_update_channel for the peer
- start cli for {{ peer.name }}-{{ org.name }} for updating the channel
- Check if fabric cli is present
- updating the channel with the new configuration block
- delete cli {{ peer.name }}-{{ participant.name }}-cli

Follow Readme for detailed information.

setup/get_ambassador_crypto

- Ensure ambassador secrets directory exists
- Save keys
- Save certs
- Ensure ambassador secrets directory exists

- Save keys
- Save certs
- signing from the admin of {{ org.name }}
- delete cli {{ peer.name }}-{{ participant.name }}-cli
- Call nested_update_channel for the peer
- start cli for {{ peer.name }}-{{ org.name }} for updating the channel
- Check if fabric cli is present
- updating the channel with the new configuration block
- delete cli {{ peer.name }}-{{ participant.name }}-cli

setup/get_crypto

- Ensure admincerts directory exists
- Save admincerts
- Ensure cacerts directory exists
- Save cacerts
- Ensure tlscacerts directory exists
- Save tlscacerts

Follow Readme for detailed information.

setup/vault_kubernetes

- Check if namespace is created
- Ensures build dir exists
- Check if Kubernetes-auth already created for Organization
- Enable and configure Kubernetes-auth for Organization
- Get Kubernetes cert files for organizations
- Write reviewer token for Organisations
- Check if policy exists
- Create policy for Orderer Access Control
- Create policy for Organisations Access Control
- Write policy for vault
- Create Vault auth role
- Check docker cred exists
- Create the docker pull credentials

Follow Readme for detailed information.

6.3.5 Indy Configurations

In Hyperledger Bevel project, ansible is used to automate the certificate generation, putting them in vault and generate value files, which are then pushed to the repository for deployment, using GitOps. This is achieved using Ansible playbooks. Ansible playbooks contains a series of roles and tasks which run in sequential order to achieve the automation.

```
/hyperledger-indy
|-- charts
|    |-- indy-auth-job
|    |-- indy-cli
|    |-- indy-domain-genesis
|    |-- indy-domain-genesis
|    |-- indy-key-mgmt
|    |-- indy-ledger-txn
|    |-- indy-node
|    |-- indy-pool-genesis
|-- images
|-- configuration
|    |-- roles/
|    |-- samples/
|    |-- playbook(s)
|    |-- cleanup.yaml
|-- releases
|    |-- dev/
|-- scripts
|    |-- indy_nym_txn
|    |-- setup indy cluster
```

For Hyperledger-Indy, the ansible roles and playbooks are located at `/platforms/hyperledger-indy/configuration/` Some of the common roles and playbooks between Hyperledger-Fabric, Hyperledger-Indy, Hyperledger-Besu, R3 Corda and Quorum are located at `/platforms/shared/configurations/`

Roles for setting up Indy Network

Roles in ansible are a combination of logically inter-related tasks.

To deploy the indy network, run the deploy-network.yaml in `bevel\platforms\hyperledger-indy\configuration\` The roles included in the file are as follows.

check/crypto

This role is checking if all crypto jobs are completed and all crypto data are in Vault.

- Check if Indy Key management pod for trustee is completed
- Check if Indy Key management pod for stewards is completed
- Check if Indy Key management pod for endorser is completed
- Check trustee in vault
- Check stewards in vault
- Check endorser in vault

Follow Readme for detailed information.

check/k8_component

This role is used for waiting to kubernetes component.

- Wait for {{ component_type }} {{ component_name }}
- Wait for {{ component_type }} {{ component_name }}
- Wait for {{ component_type }} {{ component_name }}
- Get a ServiceAccount token for {{ component_name }}
- Store token

Follow Readme for detailed information.

check/validation

This role checks for validation of network.yaml

- Check Validation
  - Counting Genesis Steward
  - Set trustee count to zero
  - Counting trustees per Org
  - Print error and end playbook if trustee count limit fails
  - Counting Endorsers
  - Print error abd end playbook if endorser count limit fails
  - Reset Endorser count
- Print error and end playbook if genesis steward count limit fails
- Print error and end playbook if total trustee count limit fails

Follow Readme for detailed information.

clean/flux

The role deletes the Helm release of Flux and git authentication secret from Kubernetes.

- Delete Helm release
- Wait for deleting of Helm release flux-{{ network.env.type }}

Follow Readme for detailed information.

clean/gitops

This role deletes all the gitops release files

- Delete release files
- Git push

Follow Readme for detailed information.

clean/k8s_resourses

The role deletes all running Kubernetes components and Helm releases of all organizations.

- Remove all Helm releases of organization {{ organization }}
- Get all existing Cluster Role Bindings of organization {{ organization }}
- Remove an existing Cluster Role Binding of {{ organization }}
- Remove an existing Namespace {{ organization_ns }}
- Remove an existing Storage Class of {{ organization }}

Follow Readme for detailed information.

clean/vault

This role get vault root token for organization and remove Indy crypto from vault

- Remove Indy Crypto of {{ organization }}
- Remove Policies of trustees
- Remove Policies of stewards
- Remove Policies of endorsers
- Remove Policies of {{ organization }}
- Remove Kubernetes Authentication Methods of {{ organization }}
- Remove Kubernetes Authentication Methods of {{ organization }} of trustees
- Remove Kubernetes Authentication Methods of {{ organization }} of stewards
- Remove Kubernetes Authentication Methods of {{ organization }} of endorsers

Follow Readme for detailed information.

create/helm_component/auth_job

This role create the job value file for creating Vault auth methods

This role creates the job value file for stewards

- Ensures {{ release_dir }}/{{ component_type }}/{{ component_name }} dir exists
- Get the kubernetes server url
- Trustee vault policy and role generating
- Stewards vault policy and role generating
- Endorser vault policy and role generating
- bevel-ac vault policy and role generating

Follow Readme for detailed information.

create/helm_component/crypto

This role create the job value file for creating Hyperledger Indy Crypto

This role creates the job value file for stewards

- Ensures {{ release_dir }}/{{ component_type }}/{{ component_name }} dir exists
- Trustee crypto generating
- Stewards crypto generating
- Endorser crypto generating

Follow Readme for detailed information.

create/helm_component/domain_genesis

This role create the config map value file for storing domain genesis for Indy cluster.

This role creates the domain genesis file for organization

- Ensures {{ release_dir }}/{{ component_type }}/{{ component_name }} dir exists
- Generate domain genesis for organization
- create value file for {{ component_name }} {{ component_type }}

Follow Readme for detailed information.

create/helm_component/ledger_txn

This role create the job value file for Indy NYM ledger transactions

This role create the job value file for Indy NYM ledger transactions

- Ensures {{ release_dir }}/{{ component_type }}/{{ component_name }} dir exists
- Create HelmRelease file
  - Ensures {{ release_dir }}/{{ component_type }}/{{ component_name }} dir exists
  - Get identity data from vault
  - Inserting file into Variable
  - create value file for {{ new_component_name }} {{ component_type }}
  - Delete file
  - Helm lint

Follow Readme for detailed information.

create/helm_component/node

This role creates value file for Helm Release of stewards.

This role creates the job value file for stewards

- Ensures {{ release_dir }}/{{ component_name }} dir exists
- create value file for {{ component_name }} {{ component_type }}

Follow Readme for detailed information.

create/helm_component/pool_genesis

This role creates the pool genesis file for organization

- Ensures {{ release_dir }}/{{ component_type }}/{{ component_name }} dir exists
- Generate pool genesis for organization
- create value file for {{ component_name }} {{ component_type }}

Follow Readme for detailed information.

create/imagepullsecret

This role creates secret in Kubernetes for pull docker images from repository.

This role creates the docker pull registry secret within each namespace

- Check for ImagePullSecret for {{ organization }}
- Create the docker pull registry secret for {{ component_ns }}

Follow Readme for detailed information.

create/k8_component

This role create value file for kubernetes component by inserted type.

This role generates value files for various k8 components

- Ensures {{ component_type_name }} dir exists
- create {{ component_type }} file for {{ component_type_name }}

Follow Readme for detailed information.

create/namespace

This role creates value files for namespaces of organizations

- Check namespace is created
- Create namespaces
- Git Push

Follow Readme for detailed information.

create/serviceaccount/by_identities

This role creates value files for service account

- Check if service account for {{ component_name }} exists
- Create service account for {{ component_name }}
- Check cluster role binding for {{ component_name }}
- Get component_name to var
- Get organization and admin string to var
- Create cluster role binding for {{ component_name }}
- Create admin cluster role binding for {{ component_name }}

Follow Readme for detailed information.

create/serviceaccount/main

This role creates value files for service account for vault

- Create service account for trustees [{{ organization }}]
- Create service account for stewards [{{ organization }}]
- Create service account for endorsers [{{ organization }}]
- Create service account for organization [{{ organization }}]
- Create service account for read only public crypto [{{ organization }}]
- Push the created deployment files to repository
- Waiting for trustees accounts and cluster binding roles
- Waiting for stewards accounts and cluster binding roles
- Waiting for endorsers accounts and cluster binding roles
- Waiting for organization accounts and cluster binding roles
- Waiting for organization read only account and cluster binding role

Follow Readme for detailed information.

create/serviceaccount/waiting

This role is waiting for create inserted ServiceAccounts or ClusterRoleBinding.

- Wait for creation for service account
- Wait for creation for cluster role binding

Follow Readme for detailed information.

create/storageclass

This role creates value files for storage class

- Check if storageclass exists
- Create storageclass
- Push the created deployment files to repository
- Wait for Storageclass creation for {{ component_name }}

Follow Readme for detailed information.

setup/auth_job

This role generates Helm releases of kubernetes jobs, which create Auth Methods into HashiCorp Vault for getting Vault token by Kubernetes Service Accounts

- Wait for namespace creation for stewards
- Create auth_job of stewards, trustee and endorser
- Push the created deployment files to repository
- Check if auth job finished correctly

Follow Readme for detailed information.

setup/crypto

This role creates the deployment files for indy crypto generate job and pushes them to repository

- Wait for namespace creation for stewards
- Create image pull secret for stewards
- Create crypto of stewards, trustee and endorser
- Push the created deployment files to repository
- Check Vault for Indy crypto

Follow Readme for detailed information.

setup/domain_genesis

This role creates the values files for organizations domain genesis and pushes them to repository

- Create domain genesis
- Push the created deployment files to repository
- Wait until domain genesis configmap are created

Follow Readme for detailed information.

setup/endorsers

This role creates the deployment files for endorsers and pushes them to repository

- Wait for namespace creation
- Create image pull secret for identities
- Create Deployment files for Identities
  - Select Admin Identity for Organisation {{ component_name }}
  - Inserting file into Variable
  - Calling Helm Release Development Role…
  - Delete file
  - Push the created deployment files to repository
- Wait until identities are creating

Follow Readme for detailed information.

setup/node

This role creates the deployment files for stewards and pushes them to repository

- Wait for namespace creation for stewards
- Create image pull secret for stewards
- Create steward deployment file
- Push the created deployment files to repository
- Wait until steward pods are running

Follow Readme for detailed information.

setup/pool_genesis

This role creates the values files for organizations domain genesis and pushes them to repository

- Create pool genesis
- Push the created deployment files to repository
- Wait until pool genesis configmap are created

Follow Readme for detailed information.

setup/trustees

This role creates the deployment files for adding new trustees to existing network

- Wait for namespace creation
- Create image pull secret for identities
- Create Deployment files for Identities
  - Select Admin Identity for Organisation {{ component_name }}

  - Inserting file into Variable
  - Calling Helm Release Development Role…
  - Delete file
  - Push the created deployment files to repository
- Wait until identities are creating

Follow Readme for detailed information.

setup/stewards

This role creates the deployment files for adding new stewards to existing network

- Wait for namespace creation
- Create image pull secret for identities
- Create Deployment files for Identities
  - Select Admin Identity for Organisation {{ component_name }}
  - Inserting file into Variable
  - Calling Helm Release Development Role…
  - Delete file
  - Push the created deployment files to repository
- Wait until identities are creating

Follow Readme for detailed information.

setup/vault_kubernetes

This role setups communication between the vault and kubernetes cluster and install neccessary configurations.

- Check namespace is created
- Ensures build dir exists
- Check if Kubernetes-auth already created for Organization
- Enable and configure Kubernetes-auth for Organization
- Get Kubernetes cert files for organizations
- Write reviewer token for Organizations
- Check if policy exists
- Create policy for Access Control
- Write Policy to Vault
- Create Vault auth role

Follow Readme for detailed information.

6.3.6 Quorum Configurations

In Hyperledger Bevel project, ansible is used to automate the certificate generation, putting them in vault and generate value files, which are then pushed to the repository for deployment, using GitOps. This is achieved using Ansible playbooks. Ansible playbooks contains a series of roles and tasks which run in sequential order to achieve the automation.

```
/quorum
|-- charts
|    |-- node_constellation
|    |-- node_tessera
|-- images
|-- configuration
|    |-- roles/
|    |-- samples/
|    |-- deploy-network.yaml
|-- releases
|    |-- dev/
|-- scripts
```

For Quorum, the ansible roles and playbooks are located at `/platforms/quorum/configuration/` Some of the common roles and playbooks between Hyperledger-Fabric, Hyperledger-Indy, Hyperledger-Besu, R3 Corda and Quorum are located at `/platforms/shared/configurations/`

Roles for setting up a Quorum Network

Roles in ansible are a combination of logically inter-related tasks.

To deploy the quorum network, run the deploy-network.yaml in `bevel\platforms\quorum\configuration\` The roles included in the file are as follows:

**check/k8_component

This role checks for the k8s resources in the cluster

- Wait for {{ component_type }} {{ component_name }}
- Wait for {{ component_type }} {{ component_name }} Follow Readme for detailed information.

**check/node_component

This role checks for the k8s resources in the cluster

- Wait for {{ component_type }} {{ component_name }}
- Wait for {{ component_type }} {{ component_name }} Follow Readme for detailed information.

create/certificates/ambassador

This role calls for ambassador certificate creation for each node.

- Create Ambassador certificates
- Ensure rootCA dir exists

- Ensure ambassador tls dir exists
- Check if certs already created
- Get root certs
- check root certs
- Generate CAroot certificate
- Check if ambassador tls already created
- Get ambassador tls certs
- Generate openssl conf file
- Generate ambassador tls certs
- Putting certs to vault
- Check Ambassador cred exists
- Create the Ambassador credentials Follow Readme for detailed information.

create/crypto/constellation

This role creates crypto for constellation.

- Create Crypto material for each node for constellation
- Check tm key is present the vault
- Create build directory
- Generate Crypto for constellation
- Copy the crypto into vault

Follow Readme for detailed information.

create/crypto/ibft

This role creates crypto for ibft.

- Create crypto material for each peer with IBFT consensus
- Check if nodekey already present in the vault
- Create build directory if it does not exist
- Generate enode url for each node and create a geth account and keystore
- Copy the crypto material to Vault

Follow Readme for detailed information.

create/crypto/raft

This role creates crypto for raft.

- Create crypto material for each peer with RAFT consensus
- Check if nodekey already present in the vault
- Create build directory if it does not exist

- Generate crypto for raft consensus
- Copy the crypto material to Vault

Follow Readme for detailed information.

create/crypto/tessera

This role creates crypto for tessera.

- Create tessera tm crypto material for each peer
- Check if tm key is already present in the vault
- Create build directory if it does not exist
- Check if tessera jar file exists
- Download tessera jar
- Generate node tm keys
- Copy the crypto material to Vault

Follow Readme for detailed information.

create/genesis_nodekey

This role creates genesis nodekey.

- Check if nodekey is present in vault
- Call nested check for each node
- Check if nodekey already present in the vault
- vault_check variable
- Fetching data of validator nodes in the network from network.yaml
- Get validator node data
- Create build directory if it does not exist
- Generate istanbul files
- Rename the directories created above with the elements of validator_node_list
- Delete the numbered directories

Follow Readme for detailed information.

create/k8_component

This role creates deployment files for nodes, namespace storageclass, service accounts and clusterrolebinding. Deployment file for a node is created in a directory with name=nodeName, nodeName is stored in component_name

- "Ensures {{ release_dir }}/{{ component_name }} dir exists"
- create {{ component_type }} file for {{ component_name }}
- Helm lint

Follow Readme for detailed information.

create/namespace_serviceaccount

This role creates the deployment files for namespaces, vault-auth, vault-reviewer and clusterrolebinding for each node

- Check if namespace exists
- Create namespace for {{ organisation }}
- Create vault auth service account for {{ organisation }}
- Create vault reviewer for {{ organisation }}
- Create clusterrolebinding for {{ organisation }}
- Push the created deployment files to repository

Follow Readme for detailed information.

create/storageclass

This role creates value files for storage class

- Check if storageclass exists
- Create storageclass
- Push the created deployment files to repository
- Wait for Storageclass creation for {{ component_name }}

Follow Readme for detailed information.

create/tessera

- Set enode_data_list to []
- Get enode data for each node of all organization
- Get enode data
- Check if enode is present in the build directory or not
- Create build directory if it does not exist
- Get the nodekey from vault and generate the enode
- Get enode_data
- Get validator node data
- Git Push

Follow Readme for detailed information.

helm_component

This role generates the value file for the helm releases.

- Ensures {{ values_dir }}/{{ name }} dir exists
- create value file for {{ component_name }}
- Helm lint

Follow Readme for detailed information.

setup/bootnode

This role is used to setup bootnode.

- Check bootnode
- Check quorum repo dir exists
- Clone the git repo
- Make bootnode
- Create bin directory
- Copy bootnode binary to destination directory

Follow Readme for detailed information.

setup/constellation-node

This role is used to setup constellation-node.

- Register temporary directory
- check constellation
- Finding the release for os
- Release version
- Download the constellation-node binary
- Unarchive the file.
- Create the bin directory
- This task puts the constellation-node binary into the bin directory

Follow Readme for detailed information.

setup/get_crypto

This role saves the crypto from Vault into ansible_provisioner.

- Ensure directory exists
- Save cert
- Save key
- Save root keychain
- Extracting root certificate from .jks

Follow Readme for detailed information.

setup/geth

This role setups geth.

- Check geth
- Check quorum repo dir exists
- Clone the git repo
- Make geth
- Create bin directory
- Copy geth binary to destination directory

Follow Readme for detailed information.

setup/golang

This role setups geth.

- Register temporary directory
- Check go
- Download golang tar
- Extract the Go tarball
- Create bin directory
- Copy go binary to destination directory
- Test go installation

Follow Readme for detailed information.

setup/istanbul

This role setups instanbul.

- Register temporary directory
- Check istanbul
- Clone the istanbul-tools git repo
- Make istanbul
- Create bin directory
- Copy istanbul binary to destination directory

Follow Readme for detailed information.

setup/vault_kubernetes

This role setups communication between the vault and kubernetes cluster and install neccessary configurations.

- Check namespace is created
- Ensures build dir exists

- Check if Kubernetes-auth already created for Organization
- Vault Auth enable for organisation
- Get Kubernetes cert files for organizations
- Write reviewer token
- Check if secret-path already created for Organization
- Create Vault secrets path
- Check if policy exists
- Create policy for Access Control
- Create Vault auth role
- Create the docker pull credentials

Follow Readme for detailed information.

delete/flux_releases

This role deletes the helm releases and uninstalls Flux

- Uninstall flux
- Delete the helmrelease for each peer
- Remove node helm releases
- Deletes namespaces

Follow Readme for detailed information.

delete/gitops_files

This role deletes all the gitops release files

- Delete release files
- Delete release files (namespaces)
- Git Push

Follow Readme for detailed information.

delete/vault_secrets

This role deletes the Vault configurations

- Delete docker creds
- Delete Ambassador creds
- Delete vault-auth path
- Delete Crypto material
- Delete Access policies

Follow Readme for detailed information.

deploy-network.yaml

This playbook deploys a DLT/Blockchain network on existing Kubernetes clusters. The Kubernetes clusters should already be created and the infomation to connect to the clusters be updated in the network.yaml file that is used as an input to this playbook. It calls the following roles.

- create/namespace_serviceaccount
- create/storageclass
- setup/vault_kubernetes
- create/certificates/ambassador
- create/crypto/raft
- create/genesis_raft
- setup/istanbul
- create/genesis_nodekey
- create/crypto/ibft
- create/crypto/tessera
- create/crypto/constellation
- create/tessera
- create/constellation

reset-network.yaml

This playbook deletes the DLT/Blockchain network on existing Kubernetes clusters which has been created using Hyperledger Bevel. It calls the following roles. THIS PLAYBOOK DELETES EVERYTHING, EVEN NAMESPACES and FLUX.

- delete/vault_secrets
- delete/flux_releases
- delete/gitops_files
- Remove build directory

6.3.7 Hyperledger Besu Configurations

In Hyperledger Bevel project, ansible is used to automate the certificate generation, put them in the vault and generate value files, which are then pushed to the repository for deployment, using GitOps. This is achieved using Ansible playbooks. Ansible playbooks contains a series of roles and tasks which run in sequential order to achieve the automation.

```
/hyperledger-besu
|-- charts
|    |-- node_orion
|-- images
|-- configurations
|    |-- roles/
|    |-- samples/
|    |-- deploy-network.yaml
```

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```
|-- releases
|   |-- dev/
|-- scripts
```

For Hyperledger Besu, the ansible roles and playbooks are located at `/platforms/hyperledger-besu/configuration/`. Some of the common roles and playbooks between Hyperledger-Fabric, Hyperledger-Indy, Hyperledger-Besu, R3 Corda and Quorum are located at `/platforms/shared/configurations/`

Roles for setting up a Hyperledger Besu Network

Roles in ansible are a combination of logically inter-related tasks.

To deploy the Hyperledger-Besu network, run the deploy-network.yaml in `bevel\platforms\hyperledger-besu\configuration\` The roles included in the files are as follows:

create/certificates/ambassador

This role calls for ambassador certificate creation for each node.

- Create Ambassador certificates
- Ensure rootCA dir exists
- Ensure ambassador tls dir exists
- Check if certs already created
- Get root certs
- check root certs
- Generate CAroot certificate
- Check if ambassador tls already created
- Get ambassador tls certs
- Generate openssl conf file
- Generate ambassador tls certs
- Putting certs to vault
- Check Ambassador cred exists
- Create the Ambassador credentials Follow Readme for detailed information.

create/crypto/ibft

This role creates crypto for ibft.

- Create crypto material for each peer with IBFT consensus
- Check if nodekey already present in the vault
- Create build directory if it does not exist
- Generate enode url for each node and create a geth account and keystore

- Copy the crypto material to Vault

Follow Readme for detailed information.

create/crypto/clique

This role creates crypto for clique.

- Create crypto material for each peer with CLIQUE consensus
- Check if nodekey already present in the vault
- Create build directory if it does not exist
- Generate enode url for each node and create a geth account and keystore
- Copy the crypto material to Vault

Follow Readme for detailed information.

create/k8_component

This role creates deployment files for nodes, namespace storageclass, service accounts and clusterrolebinding. Deployment file for a node is created in a directory with name=nodeName, nodeName is stored in component_name

- "Ensures {{ release_dir }}/{{ component_name }} dir exists"
- create {{ component_type }} file for {{ component_name }}
- Helm lint

Follow Readme for detailed information.

create/namespace_serviceaccount

This role creates the deployment files for namespaces, vault-auth, vault-reviewer and clusterrolebinding for each node

- Check if namespace exists
- Create namespace for {{ organisation }}
- Create vault auth service account for {{ organisation }}
- Create vault reviewer for {{ organisation }}
- Create clusterrolebinding for {{ organisation }}
- Push the created deployment files to repository

Follow Readme for detailed information.

create/storageclass

This role creates value files for storage class

- Check if storageclass exists
- Create storageclass
- Push the created deployment files to repository
- Wait for Storageclass creation for {{ component_name }}

Follow Readme for detailed information.

setup/get_crypto

This role saves the crypto from Vault into ansible_provisioner.

- Ensure directory exists
- Save cert
- Save key
- Save root keychain
- Extracting root certificate from .jks

Follow Readme for detailed information.

setup/vault_kubernetes

This role setups communication between the vault and kubernetes cluster and install neccessary configurations.

- Check namespace is created
- Ensures build dir exists
- Check if Kubernetes-auth already created for Organization
- Vault Auth enable for organisation
- Get Kubernetes cert files for organizations
- Write reviewer token
- Check if secret-path already created for Organization
- Create Vault secrets path
- Check if policy exists
- Create policy for Access Control
- Create Vault auth role
- Create the docker pull credentials

Follow Readme for detailed information.

6.4 Helm Charts

6.4.1 Common Charts

6.4.2 Corda Charts

The structure below represents the Chart structure for R3 Corda components in Hyperledger Bevel implementation.

```
/r3-corda
|-- charts
|    |-- doorman
|    |-- doorman-tls
|    |-- h2
|    |-- h2-addUser
|    |-- h2-password-change
|    |-- mongodb
|    |-- mongodb-tls
|    |-- nms
|    |-- nms-tls
|    |-- node
|    |-- node-initial-registration
|    |-- notary
|    |-- notary-initial-registration
|    |-- storage
```

Pre-requisites

`helm` to be installed and configured on the cluster.

doorman

About

This folder consists of Doorman helm charts which are used by the ansible playbooks for the deployment of Doorman component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/doorman
|-- templates
|    |-- pvc.yaml
|    |-- deployment.yaml
|    |-- service.tpl
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Doorman implementation.
- This folder contains following template files for Doorman implementation

- deployment.yaml:

  This file is used as a basic manifest for creating a Kubernetes deployment for Doorman. The file basically describes the container and volume specifications of the Doorman. The file defines container where doorman container is defined with corda image and corda jar details. The init container init-creds creates doorman db root password and user credentials at mount path, init-certificates init container basically configures doorman keys.jks by fetching certsecretprefix from the vault, change permissions init-containers provides permissions to base directory and db-healthcheck init-container checks for db is up or not.

- pvc.yaml:

  This yaml is used to create persistent volumes claim for the Doorman deployment.A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates persistentVolumeClaim for Doorman pvc.

- service.yaml:

  This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates CA service endpoint. The file basically specifies service type and kind of service ports for doorman server.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

doorman-tls

About

This folder consists of Doorman helm charts which are used by the ansible playbooks for the deployment of Doorman component when TLS is on for the doorman. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/doorman-tls
|-- templates
|   |-- pvc.yaml
|   |-- deployment.yaml
|   |-- service.tpl
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Doorman implementation.
- This folder contains following template files for Doorman implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment for Doorman. The file basically describes the container and volume specifications of the Doorman. The file defines container where doorman container is defined with corda image and corda jar details. The init container init-creds creates doorman db root password and user credentials at mount path, init-certificates init container basically configures doorman keys.jks by fetching certsecretprefix from the vault, change permissions init-containers provides permissions to base directory and db-healthcheck init-container checks if db is up or not.
  - pvc.yaml:

    This yaml is used to create persistent volumes claim for the Doorman deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates persistentVolumeClaim for Doorman pvc.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates CA service endpoint. The file basically specifies service type and kind of service ports for doorman server.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

nms

About

This folder consists of networkmapservice helm charts which are used by the ansible playbooks for the deployment of networkmapservice component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/nms
|-- templates
|   |-- volume.yaml
|   |-- deployment.yaml
|   |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for nms implementation.
- This folder contains following template files for nms implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment for NMS . The file basically describes the container and volume specifications of the NMS. The file defines containers where NMS container is defined with corda image and corda jar details. The init container init-certificates-creds creates NMS db root password and user credentials at mount path, init-certificates init container basically configures NMS keys.jks by fetching certsecretprefix from the vault, changepermissions init-containers provides permissions to base directory and db-healthcheck init-container checks for db is up or not.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates nms service endpoint. The file basically specifies service type and kind of service ports for the nms server.
  - volume.yaml:

    This yaml is used to create persistent volumes claim for the nms deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates nms pvc for, the volume claim for nms.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

nms-tls

About

This folder consists of networkmapservice helm charts that establish a TLS connection with mongodb, which are used by the ansible playbooks for the deployment of networkmapservice component. This chart is deployed when TLS is on for nms. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/nms-tls
|-- templates
|    |-- volume.yaml
|    |-- deployment.yaml
|    |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for nms implementation.
- This folder contains following template files for nms implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment for NMS. The file basically describes the container and volume specifications of the NMS. The file defines containers where NMS container is defined with corda image and corda jar details. The init container init-certificates-creds creates NMS db root password and user credentials at mount path, init-certificates init container basically configures NMS keys.jks by fetching certsecretprefix from the vault, changepermissions init-containers provides permissions to base directory and db-healthcheck init-container checks for db is up or not.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates nms service endpoint. The file basically specifies service type and kind of service ports for the nms server.
  - volume.yaml:

    This yaml is used to create persistent volumes claim for the nms deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates nms pvc for, the volume claim for nms.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

h2 (database)

About

This folder consists of H2 helm charts which are used by the ansible playbooks for the deployment of the H2 database. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/h2
|-- templates
|   |-- pvc.yaml
|   |-- deployment.yaml
|   |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for H2 implementation.
- This folder contains following template files for H2 implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment.For the H2 node, this file creates H2 deployment.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates H2 service endpoint
  - pvc.yaml:

    This yaml is used to create persistent volumes claim for the H2 deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates h2-pvc for , the volume claim for H2.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

h2-addUser

About

This folder consists of H2-adduser helm charts which are used by the ansible playbooks for the deployment of the Peer component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/h2-addUser
|-- templates
|    |-- job.yaml
|-- Chart.yaml
|-- values.yaml
```

Pre-requisites

helm to be installed and configured

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for h2 add user implementation.
- This folder contains following template file for adding users to h2 implementation
  - job.yaml:

    The job.yaml file through template engine runs create h2-add-user container and thus runs newuser.sql to create users and create passwords for new users.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

h2-password-change

About

This folder consists of H2-password-change helm charts which are used by the ansible playbooks for the deployment of the Peer component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/h2-password-change
|-- templates
|    |-- job.yaml
|-- Chart.yaml
|-- values.yaml
```

Pre-requisites

helm to be installed and configured

Charts description

templates

- This folder contains template structures which when combined with values ,will generate valid Kubernetes manifest files for h2 password change implementation.
- This folder contains following template file for changing h2 password implementation
  - job.yaml:

    The job.yaml file through template engine runs create h2-add-user container and thus runs newuser.sql to create users and create passwords for new users.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

mongodb

About

This folder consists of Mongodb helm charts which are used by the ansible playbooks for the deployment of the Mongodb component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/mongodb
|-- templates
|    |-- pvc.yaml
|    |-- deployment.yaml
|    |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Mongodb implementation.
- This folder contains following template files for Mongodb implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment.For the Mongodb node, this file creates Mongodb deployment.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates Mongodb service endpoint
  - pvc.yaml:

    This yaml is used to create persistent volumes claim for the Mongodb deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud enviornment. This file creates mongodb-pvc for, the volume claim for mongodb.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

mongodb-tls

About

This folder consists of Mongodb helm charts which are used by the ansible playbooks for the deployment of the Mongodb component. It allows for TLS connection. When TLS is on for nms or doorman, this chart is deployed for them else mongodb chart is deployed. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/mongodb-tls
|-- templates
|   |-- pvc.yaml
|   |-- deployment.yaml
|   |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Mongodb implementation.
- This folder contains following template files for Mongodb implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment.For the Mongodb node, this file creates Mongodb deployment.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates Mongodb service endpoint
  - pvc.yaml:

    This yaml is used to create persistent volumes claim for the Mongodb deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud enviornment. This file creates mongodb-pvc for, the volume claim for mongodb.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

node

About

This folder consists of node helm charts which are used by the ansible playbooks for the deployment of the corda node component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/node
|-- templates
|   |-- deployment.yaml
|   |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for R3 Corda node implementation.
- This folder contains following template files for node implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment. For the corda node, this file creates a node deployment. The file defines containers where node container is defined with corda image and corda jar details and corda-logs container is used for logging purpose. The init container init-nodeconf defines node.conf file for node, init-certificates init container basically configures networkmap.crt, doorman.crt, SSLKEYSTORE and TRUSTSTORE at mount path for node by fetching certsecretprefix from the vault and init-healthcheck init-container checks for h2 database. Certificates and notary server database are defined on the volume mount paths.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates node service endpoint.The file basically specifies service type and kind of service ports for the corda nodes.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

node-initial-registration

About

This folder contains node-initial-registration helm charts which are used by the ansible playbooks for the deployment of the install_chaincode component. The folder contains a templates folder, a chart file and the corresponding value file.

Folder Structure

```
/node-initial-registration
|-- templates
|    |--job.yaml
|    |--_helpers.tpl
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for node-initial-registration implementation.
- This folder contains following template files for node-initial-registration implementation
  - job.yaml:It is used as a basic manifest for creating a Kubernetes deployment for initial node registration. The file basically describes the container and volume specifications of the node. corda-node container is used for running corda jar.store-certs-in-vault container is used for putting certificate into the vault. init container is used for creating node.conf which is used by corda node, download corda jar, download certificate from vault,getting passwords of keystore from vault and also performs health checks
  - _helpers.tpl:A place to put template helpers that you can re-use throughout the chart.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

notary

About

This folder consists of Notary helm charts, which are used by the ansible playbooks for the deployment of the Notary component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/notary
|-- templates
|    |-- deployment.tpl
|    |-- service.yaml
```

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```
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Notary implementation.
- This folder contains following template files for Notary implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment. For the corda notary, this file creates a notary deployment. The file defines containers where notary container is defined with corda image and corda jar details also registers the notary with nms and corda-logs container is used for logging purpose. The init container init-nodeconf defines node.conf file for notary, init-certificates init container basically configures networkmap.crt, doorman.crt, SSLKEYSTORE and TRUSTSTORE at mount path by fetching certsecretprefix from vault and db-healthcheck init-container checks for h2 database. Certificates and notary server database are defined on the volume mount paths.
  - service.yaml

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates Notary service endpoint. The file basically specifies service type and kind of service ports for Notary.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

notary-initial-registration

About

This folder consists of notary-initial-registration helm charts, which are used by the ansible playbooks for the deployment of the initial notary components. The folder contains a templates folder, a chart file and a corresponding value file.

Folder Structure

```
/notary-initial-registration
|-- templates
|    |--job.yaml
|    |--_helpers.tpl
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for registering notary components.
- This folder contains following template files for initializing notary implementation.
  - job.yaml:

    It is used as a basic manifest for creating a Kubernetes deployment for initial notary registration. The file basically describes the container and volume specifications of the notary. corda-node container is used for running corda jar.store-certs-in-vault container is used for putting certificate into the vault. init container is used for creating node.conf which is used by corda node, download corda jar, download certificate from vault,getting passwords of keystore from vault and also performs health checks.
  - _helpers.tpl:

    A place to put template helpers that you can re-use throughout the chart.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

springbootwebserver

About

This folder consists of springbootwebserver helm charts which are used by the ansible playbooks for the deployment of the springbootwebserver component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/springbootwebserver
|-- templates
|    |-- deployment.yaml
|    |-- pvc.yaml
|    |-- service.yaml
```

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```
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for springbootwebserver implementation.
- This folder contains following template files for springbootwebserver implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment. For the corda springbootwebserver, this file creates a springbootwebserver deployment. The file defines containers where springbootwebserver container is defined with corda image and app jar details and the init container basically creates app.properties file, configures the vault with various vault parameters. Certificates and springbootwebserver database are defined on the volume mount paths.
  - pvc.yaml:

    This yaml is used to create persistent volumes claim for the springbootwebserver deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud enviornment. This file creates springbootwebserver-pvc for , the volume claim for springbootwebserver.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates springbootwebserver service endpoint.The file basically specifies service type and kind of service ports for the corda springbootwebserver.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

storage

About

This folder consists of storage helm charts, which are used by the ansible playbooks for the deployment of the storage component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/storage
|-- templates
|   |-- storageclass.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for storageclass implementation.
- This folder contains following template files for storageclass implementation
  - storageclass.yaml: This yaml file basically creates storageclass. We define provisioner, storagename and namespace from value file.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

webserver Chart

About

This folder consists of webserver helm charts which are used by the ansible playbooks for the deployment of the webserver component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/webserver
|-- templates
|   |-- pvc.yaml
|   |-- deployment.yaml
|   |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for webserver implementation.
- This folder contains following template files for webserver implementation
  - deployment.yaml:

    This file is used as a basic manifest for creating a Kubernetes deployment. For the webserver node, this file creates webserver deployment.
  - service.yaml:

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates webserver service endpoint
  - pvc.yaml:

    This yaml is used to create persistent volumes claim for the webserver deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud enviornment. This file creates webserver-pvc for, the volume claim for webserver.
  - volume.yaml:

    This yaml is used to create persistent volumes claim for the webserver deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates webserver pvc for, the volume claim for webserver.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

6.4.3 Corda Enterprise Helm Charts

Following are the helm charts used for R3 Corda Enterprise in Hyperledger Bevel.

```
platforms/r3-corda-ent/charts
├── auth
├── bridge
├── float
├── gateway
├── generate-pki
├── generate-pki-node
├── h2
├── idman
├── nmap
```

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```
├── node
├── node-initial-registration
├── notary
├── notary-initial-registration
├── signer
└── zone
```

Pre-requisites

`helm` version 2.x.x to be installed and configured on the cluster.

Auth

About

This chart deploys the Auth component of Corda Enterprise Network Manager. The folder contents are below:

Folder Structure

```
├── auth
│   ├── Chart.yaml
│   ├── files
│   │   └── authservice.conf
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── deployment.yaml
│   │   ├── _helpers.tpl
│   │   ├── pvc.yaml
│   │   └── service.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for auth.
  - authservice.conf: The main configuration file for auth service.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Auth Service implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains one init-container `init-certificates` to download the keys/certs from Vault, `init-jwt` container which generates the JWT signing key and one `main` containers which executes the auth service.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVC used by auth service
  - service.yaml: This creates the auth service endpoint.

values.yaml

- This file contains the default values for the chart.

Bridge

About

This chart deploys the Bridge component of Corda Enterprise filewall. The folder contents are below:

Folder Structure

```
├── bridge
│   ├── Chart.yaml
│   ├── files
│   │   └── firewall.conf
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── deployment.yaml
│   │   ├── _helpers.tpl
│   │   ├── pvc.yaml
│   │   └── service.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for bridge.
  - firewall.conf: The main configuration file for firewall.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Corda Firewall implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains one init-container `init-certificates` to download the keys/certs from Vault, and one `main` containers which executes the firewall service.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVC used by firwall
  - service.yaml: This creates the firewall service endpoint.

values.yaml

- This file contains the default values for the chart.

Float

About

This chart deploys the Float component of Corda Enterprise filewall. The folder contents are below:

Folder Structure

```
├── float
│   ├── Chart.yaml
│   ├── files
│   │   └── firewall.conf
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── deployment.yaml
│   │   ├── _helpers.tpl
│   │   ├── pvc.yaml
│   │   └── service.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for float.
  - firewall.conf: The main configuration file for firewall.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Corda Firewall implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains one init-container `init-certificates` to download the keys/certs from Vault, and one `main` containers which executes the firewall service.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVC used by firwall
  - service.yaml: This creates the firewall service endpoint.

values.yaml

- This file contains the default values for the chart.

Gateway

About

This chart deploys the Gateway service of Corda Enterprise Network Manager. The folder contents are below:

Folder Structure

```
├── gateway
│   ├── Chart.yaml
│   ├── files
│   │   ├── setupAuth.sh
│   │   └── gateway.conf
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── deployment.yaml
```

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```
│    │    ├── job.yaml
│    │    ├── _helpers.tpl
│    │    ├── pvc.yaml
│    │    └── service.yaml
│    └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for gateway service.
  - gateway.conf: The main configuration file for gateway.
  - setupAuth.sh: The script to create users, groups and assign roles to groups for authentication.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Corda Gateway service implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains one init-container `init-certificates` to download the keys/certs from Vault, and one `main` containers which executes the gateway service.
  - job.yaml: This creates the main Kubernetes job. It contains one `check-auth` container which establishes connection with auth service, and one `main` container which executes the setupAuth script to create users, groups and assign roles to groups.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVC used by gateway service
  - service.yaml: This creates the gateway service endpoint.

values.yaml

- This file contains the default values for the chart.

Generate-pki

About

This chart deploys the Generate-PKI job on Kubernetes. The folder contents are below:

Folder Structure

```
├── generate-pki
│   ├── Chart.yaml
│   ├── files
│   │   └── pki.conf
│   ├── README.md
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── _helpers.tpl
│   │   └── job.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for PKI.
  - pki.conf: The main configuration file for generate-pki.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for PKI job. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - job.yaml: This creates the main Kubernetes job. It contains a `main` container which runs the pkitool to generate the certificates and keystores, and a `store-certs` container to upload the certificates/keystores to Vault.

values.yaml

- This file contains the default values for the chart.

---

h2 (database)

About

This chart deploys the H2 database pod on Kubernetes. The folder contents are below:

Folder Structure

```
├── h2
│   ├── Chart.yaml
│   ├── templates
│   │   ├── deployment.yaml
│   │   ├── pvc.yaml
│   │   └── service.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for H2 implementation. This folder contains following template files:
  - deployment.yaml: This file is used as a basic manifest for creating a Kubernetes deployment. For the H2 node, this file creates H2 pod.
  - pvc.yaml: This yaml is used to create persistent volumes claim for the H2 deployment. This file creates h2-pvc for, the volume claim for H2.
  - service.yaml: This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates H2 service endpoint.

values.yaml

- This file contains the default configuration values for the chart.

---

idman

About

This chart deploys the Idman component of Corda CENM. The folder contents are below:

Folder Structure

```
├── idman
│   ├── Chart.yaml
│   ├── files
│   │   ├── idman.conf
│   │   └── run.sh
```

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```
│       ├── templates
│       │   ├── configmap.yaml
│       │   ├── deployment.yaml
│       │   ├── _helpers.tpl
│       │   ├── pvc.yaml
│       │   └── service.yaml
│       └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for idman.
  - idman.conf: The main configuration file for idman.
  - run.sh: The executable file to run the idman service in the kubernetes pod.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Idman implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains one init-container `init-certificates` to download the keys/certs from Vault, and two main containers: `idman` and `logs`.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVCs used by idman: one for logs and one for the file H2 database.
  - service.yaml: This creates the idman service endpoint with Ambassador proxy configurations.

values.yaml

- This file contains the default values for the chart.

---

nmap

About

This chart deploys the NetworkMap component of Corda CENM. The folder contents are below:

Folder Structure

```
├── nmap
│   ├── Chart.yaml
│   ├── files
│   │   ├── nmap.conf
│   │   ├── run.sh
│   │   └── set-network-parameters.sh
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── deployment.yaml
│   │   ├── _helpers.tpl
│   │   ├── pvc.yaml
│   │   └── service.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for nmap.
  - nmap.conf: The main configuration file for nmap.
  - run.sh: The executable file to run the nmap service in the kubernetes pod.
  - set-network-parameters.sh: This executable file which creates the initial network-parameters.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for NetworkMap implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains a init-container `init-certificates` to download the keys/certs from Vault, a `setnparam` container to set the network-parameters, and two main containers: `main` and `logs`.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVCs used by nmap: one for logs and one for the file H2 database.
  - service.yaml: This creates the nmap service endpoint with Ambassador proxy configurations.

values.yaml

- This file contains the default values for the chart.

node

About

This chart deploys the Node component of Corda Enterprise. The folder contents are below:

Folder Structure

```
├── node
│   ├── Chart.yaml
│   ├── files
│   │   ├── node.conf
│   │   └── run.sh
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── deployment.yaml
│   │   ├── _helpers.tpl
│   │   ├── pvc.yaml
│   │   └── service.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for Corda node.
  - node.conf: The main configuration file for node.
  - run.sh: The executable file to run the node service in the kubernetes pod.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Corda Node implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains three init-containers: `init-check-registration` to check if node-initial-registration was completed, `init-certificates` to download the keys/certs from Vault, and a `db-healthcheck` container to check if the database service is reachable, and two main containers: `node` and `logs`.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVC used by the node.
  - service.yaml: This creates the node service endpoint with Ambassador proxy configurations.

values.yaml

- This file contains the default values for the chart.

---

node-initial-registration

About

This chart deploys the Node-Registration job for Corda Enterprise. The folder contents are below:

Folder Structure

```
├── node-initial-registration
│   ├── Chart.yaml
│   ├── files
│   │   ├── node.conf
│   │   └── node-initial-registration.sh
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── _helpers.tpl
│   │   └── job.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for Corda node.
  - node.conf: The main configuration file for node.
  - node-initial-registration.sh: The executable file to run the node initial-registration.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for registration job. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - job.yaml: This creates the main Kubernetes job. It contains two init-containers: `init-certificates` to download the keys/certs from Vault, and a `db-healthcheck` container to check if the database service is reachable, and two main containers: `registration` for the actual registration and `store-certs` to upload the certificates to Vault.

values.yaml

- This file contains the default values for the chart.

---

notary

About

This chart deploys the Notary component of Corda Enterprise. The folder contents are below:

Folder Structure

```
├── notary
│   ├── Chart.yaml
│   ├── files
│   │   ├── notary.conf
│   │   └── run.sh
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── deployment.yaml
│   │   ├── _helpers.tpl
│   │   ├── pvc.yaml
│   │   └── service.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for Corda Notary.
  - notary.conf: The main configuration file for notary.
  - run.sh: The executable file to run the notary service in the kubernetes pod.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Corda Notary implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.

  - deployment.yaml: This creates the main Kubernetes deployment. It contains three init-containers: `init-check-registration` to check if notary-initial-registration was completed, `init-certificates` to download the keys/certs from Vault, and a `db-healthcheck` container to check if the database service is reachable, and two main containers: `notary` and `logs`.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVC used by the notary.
  - service.yaml: This creates the notary service endpoint with Ambassador proxy configurations.

values.yaml

- This file contains the default values for the chart.

---

notary-initial-registration

About

This chart deploys the Notary-Registration job for Corda Enterprise. The folder contents are below:

Folder Structure

```
├── notary-initial-registration
│   ├── Chart.yaml
│   ├── files
│   │   ├── create-network-parameters-file.sh
│   │   ├── notary.conf
│   │   └── notary-initial-registration.sh
│   ├── templates
│   │   ├── configmap.yaml
│   │   ├── _helpers.tpl
│   │   └── job.yaml
│   └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for Corda Notary.
  - create-network-parameters-file.sh: Creates the network parameters file.
  - notary.conf: The main configuration file for notary.
  - notary-initial-registration.sh: The executable file to run the notary initial-registration.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Notary registration job. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - job.yaml: This creates the main Kubernetes job. It contains two init-containers: `init-certificates` to download the keys/certs from Vault, and a `db-healthcheck` container to check if the database service is reachable, and two main containers: `registration` for the actual registration and `store-certs` to upload the certificates to Vault.

values.yaml

- This file contains the default values for the chart.

---

signer

About

This chart deploys the Signer component of Corda CENM. The folder contents are below:

Folder Structure

```
└── signer
    ├── Chart.yaml
    ├── files
    │   └── signer.conf
    ├── README.md
    ├── templates
    │   ├── configmap.yaml
    │   ├── deployment.yaml
    │   ├── _helpers.tpl
    │   └── service.yaml
    └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for signer.
  - signer.conf: The main configuration file for signer.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Signer implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains two init-containers: `init-check-certificates` to check if the signer certificates are saved on Vault and `init-certificates` to download the keys/certs from Vault, and two main containers: `signer` and `logs`.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - service.yaml: This creates the signer service endpoint.

values.yaml

- This file contains the default values for the chart.

---

zone

About

This chart deploys the Zone service of Corda CENM. The folder contents are below:

Folder Structure

```
└── zone
    ├── Chart.yaml
    ├── files
    │   └── run.sh
    ├── README.md
    ├── templates
    │   ├── configmap.yaml
    │   ├── deployment.yaml
    │   ├── _helpers.tpl
    │   ├── pvc.yaml
    │   └── service.yaml
    └── values.yaml
```

Charts description

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

files

- This folder contains the configuration files needed for zone service.
  - run.sh: The main configuration file for zone service.

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Zone implementation. This folder contains following template files:
  - configmap.yaml: This creates a configmap of all the files from the `files` folder above.
  - deployment.yaml: This creates the main Kubernetes deployment. It contains `init-certificates` to download the keys/certs from Vault, and one main containers: `main` to start the zone service.
  - _helpers.tpl: This is a helper file to add any custom labels.
  - pvc.yaml: This creates the PVC used by the zone.
  - service.yaml: This creates the zone service endpoint.

values.yaml

- This file contains the default values for the chart.

6.4.4 Hyperledger Fabric Charts

The structure below represents the Chart structure for Hyperledger fabric components in Hyperledger Bevel implementation.

```
/hyperledger-fabric
|-- charts
|    |-- ca
|    |-- catools
|    |-- create_channel
|    |-- fabric_cli
|    |-- install_chaincode
|    |-- instantiate_chaincode
|    |-- join_channel
|    |-- orderernode
|    |-- peernode
|    |-- upgrade_chaincode
|    |-- verify_chaincode
|    |-- zkkafka
```

Pre-requisites

`helm` to be installed and configured on the cluster.

CA (certification authority)

About

This folder consists CA helm charts which are used by the ansible playbooks for the deployment of the CA component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/ca
|-- templates
|    |-- _helpers.tpl
|    |-- volumes.yaml
|    |-- deployment.yaml
|    |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for CA implementation.
- This folder contains following template files for CA implementation
  - _helpers.tpl

    This file doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for CA.
  - deployment.yaml

    This file is used as a basic manifest for creating a Kubernetes deployment. For the CA node, this file creates a CA deployment. The file defines where CA container is defined with fabric image and CA client and CA server onfiguration details and the init container basically configures the vault with various vault parameters. Certificates and CA server database are defined on the volume mount paths.
  - service.yaml

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates CA service endpoint. The file basically specifies service type and kind of service ports for the CA client and CA server.
  - volume.yaml

    This yaml is used to create persistent volumes claim for the CA deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates CA pvc for, the volume claim for CA.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name etc.

values.yaml

- This file contains the default configuration values for the chart.

CA tools

About

This folder consists CA tools helm charts which are used by the ansible playbooks for the deployment of the CA tools component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/catools
|-- templates
|    |-- volumes.yaml
|    |-- deployment.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for CA tools implementation.
- This folder contains following template files for CA tools implementation
  - deployment.yaml

    This file is used as a basic manifest for creating a Kubernetes deployment for CA tools. The file basically describes the container and volume specifications of the CA tools
  - volume.yaml

    This yaml is used to create persistent volumes claim for the Orderer deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates two persistentVolumeClaims, one for CA tools pvc and the other to store crypto config in the ca-tools-crypto-pvc persistent volume.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name etc.

values.yaml

- This file contains the default configuration values for the chart.

Create channel

About

This folder consists of create_channel helm charts which are used by the ansible playbooks for the deployment of the create_channel component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/create_channel
|-- templates
|   |--_helpers.tpl
|   |-- create_channel.yaml
|   |-- configmap.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Peer implementation.
- This folder contains following template files for peer implementation
  - _helpers.tpl

    This file doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for channels.
  - configmap.yaml

    The configmap.yaml file through template engine generate configmaps. In Kubernetes, a ConfigMap is a container for storing configuration data. Things like pods can access the data in a ConfigMap. The configmap.yaml file creates two configmaps namely genesis-block-peer and peer-config. For Create_channel component, it creates two configmaps, one for the channel creation having various data fields such as channel, peer and orderer details, and another for the generation of channel artifacts containing the channel transaction (channeltx) block and other labels.
  - create_channel.yaml

    This file creates channel creation job where in the createchannel container the create channel peer commands are fired based on checking the results obtained from fetching channeltx block to see if channel has already been created or not. Additionally, the commands are fired based on the tls status whether it is enabled or not. The init container is used to setup vault configurations, and certificates are obtained from the volume mount paths.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name etc.

values.yaml

- This file contains the default configuration values for the chart.

Install Chaincode

About

This folder consists of install_chaincode helm charts which are used by the ansible playbooks for the deployment of the install_chaincode component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/install_chaincode
|-- templates
|    |--_helpers.tpl
|    |-- install_chaincode.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for install_chaincode implementation.
- This folder contains following template files for install_chaincode implementation
  - _helpers.tpl

    This fie doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. This file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for install_chaincodes.
  - install_chaincode.yaml

    This yaml file basically creates a job for the installation of chaincode. We define containers where fabrictools image is pulled and chaincode install peer commands are fired. Moreover, the chart provides the environment requirements such as docker endpoint, peer and orderer related information, volume mounts, etc for the chaincode to be installed. The init container basically configures the vault with various vault parameters.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Instantiate Chaincode

About

This folder consists instantiate_chaincode helm charts, which are used by the ansible playbooks for the deployment of the instantiate_chaincode component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/instantiate_chaincode
|-- templates
|    |--_helpers.tpl
|    |-- instantiate_chaincode.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for instantiate_chaincode implementation.
- This folder contains following template files for instantiate_chaincode implementation
  - _helpers.tpl

    This file doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. This file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for instantiate_chaincodes.
  - instantiate_chaincode.yaml

    This yaml file basically creates a job for the instantiation of chaincode. We define containers where fabrictools image is pulled and based on the endorsement policies set, chaincode instantiate peer commands are fired. Moreover, the chart provides the environment requirements such as docker endpoint, peer and orderer related information, volume mounts, etc for the chaincode to be instantiated. The init container basically configures the vault with various vault parameter.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Join channel

About

This folder consists join_channel helm charts which are used by the ansible playbooks for the deployment of the join_channel component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/join_channel
|-- templates
|    |--_helpers.tpl
|    |-- join_channel.yaml
|    |-- configmap.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which, when combined with values, will generate valid Kubernetes manifest files for Peer implementation.
- This folder contains following template files for peer implementation
  - _helpers.tpl

    This file doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for peers.
  - configmap.yaml

    The configmap.yaml file through template engine generate configmaps. In Kubernetes, a ConfigMap is a container for storing configuration data. Things like pods, can access the data in a ConfigMap. The configmap.yaml file creates two configmaps namely genesis-block-peer and peer-config. For join_channel component, it creates two configmaps, one for the channel creation having various data fields such as channel, peer and orderer details, and another for the generation of channel artifacts containing the channel transaction (channeltx) block and other labels.

- join_channel.yaml

  This file creates channel join job where in the joinchannel container the commands are fired based on the tls status whether it is enabled or not wherein first the channel config is fetched and then the peers join the created channel. The init container is used to setup vault configurations. And certificates are obatined from the volume mount paths.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Orderer Chart

About

This folder consists Orderer helm charts which are used by the ansible playbooks for the deployment of the Orderer component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/Orderernode
|-- templates
|    |--_helpers.tpl
|    |-- volumes.yaml
|    |-- deployment.yaml
|    |-- service.yaml
|    |-- configmap.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values ,will generate valid Kubernetes manifest files for Orderer implementation.
- This folder contains following template files for Orderer implementation
  - _helpers.tpl

    This fie doesnt output a Kubernetes manifest file as it begins with underscore (_) .And its a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials ,as we have defined a template to encapsulate a Kubernetes block of labels for Orderers.

- configmap.yaml

  The configmap.yaml file through template engine generate configmaps.In Kubernetes, a ConfigMap is a container for storing configuration data.Things like pods, can access the data in a ConfigMap. The configmap.yaml file creates two configmaps namely genesis-block-orderer and orderer-config.

- deployment.yaml

  This file is used as a basic manifest for creating a Kubernetes deployment.For the Orderer node, this file creates orderer deployment.

- service.yaml

  This template is used as a basic manifest for creating a service endpoint for our deployment.This service.yaml creates orderer service endpoint

- volume.yaml

  This yaml is used to create persistent volumes claim for the Orderer deployment.A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates orderer-pvc for , the volume claim for Orderer.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Peer Chart

About

This folder consists Peer helm charts which are used by the ansible playbooks for the deployment of the Peer component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/peernode
|-- templates
|   |--_helpers.tpl
|   |-- volumes.yaml
|   |-- deployment.yaml
|   |-- service.yaml
|   |-- configmap.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for Peer implementation.
- This folder contains following template files for peer implementation
  - _helpers.tpl

    This file doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for peers.
  - configmap.yaml

    The configmap.yaml file through template engine generate configmaps. In Kubernetes, a ConfigMap is a container for storing configuration data. Things like pods can access the data in a ConfigMap. The configmap.yaml file creates two configmaps namely genesis-block-peer and peer-config.
  - service.yaml

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates peer service endpoint.
  - volume.yaml

    This yaml is used to create persistent volumes claim for the peer deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates peer-pvc for the volume claim for peer.
  - deployment.yaml

    This file is used as a basic manifest for creating a Kubernetes deployment. For the peer node, this file creates three deployments namely ca, ca-tools and peer.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Upgrade Chaincode

About

This folder consists of upgrade_chaincode helm charts, which are used by the ansible playbooks for the deployment of the upgrade_chaincode component. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/upgrade_chaincode
|-- templates
|    |--_helpers.tpl
|    |-- upgrade_chaincode.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for upgrade_chaincode implementation.
- This folder contains following template files for upgrade_chaincode implementation
  - _helpers.tpl

    This file doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. This file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for upgrade_chaincodes.
  - upgrade_chaincode.yaml

    This yaml file basically creates a job for the upgradation of chaincode. We define containers where fabrictools image is pulled and based on the endorsement policies set, chaincode upgrade peer commands are fired. Moreover, the chart provides the environment requirements such as docker endpoint, peer and orderer related information, volume mounts, channel information, etc, for the chaincode to be upgraded. The init container basically configures the vault with various vault parameter.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion ,name etc.

values.yaml

- This file contains the default configuration values for the chart.

---

zkkafka

About

This folder consists zkkafka helm charts which are used by the ansible playbooks for the deployment of the zkkafka component. The folder contains a templates folder,a chart file and a value file.

Folder Structure

```
/zkkafka
|-- templates
|   |--_helpers.tpl
|   |-- volumes.yaml
|   |-- deployment.yaml
|   |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for zkkafka implementation.
- This folder contains following template files for zkkafka implementation
  - _helpers.tpl

    This file doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for zkkafkas.
  - deployment.yaml

    This file is used as a basic manifest for creating a Kubernetes deployment.For the zkkafka node, this file creates zkkafka deployment.
  - service.yaml

    This template is used as a basic manifest for creating a service endpoint for our deployment. This service.yaml creates zkkafka service endpoint
  - volume.yaml

    This yaml is used to create persistent volumes claim for the zkkafka deployment. A persistentVolumeClaim volume is used to mount a PersistentVolume into a Pod. PersistentVolumes provide a way for users to 'claim' durable storage without having the information details of the particular cloud environment. This file creates zkkafka pvc for the volume claim for zkkafka.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

6.4.5 Indy Charts

The structure below represents the Chart structure for Hyperledger Indy components in Hyperledger Bevel implementation.

```
/hyperledger-indy
|-- charts
|    |-- indy-auth-job
|    |-- indy-cli
|    |-- indy-domain-genesis
|    |-- indy-key-mgmt
|    |-- indy-ledger-txn
|    |-- indy-node
|    |-- indy-pool-genesis
```

Pre-requisites

`helm` to be installed and configured on the cluster.

Indy-Auth-Job

About

This chart is using admin auth to generate auth. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/indy-auth-job
|-- templates
|    |-- job.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which when combined with values, will generate valid Kubernetes manifest files for auth job implementation.
- This folder contains following template files for auth job implementation
  - Job.yaml

    This job uses admin auth to generate auth read only methods, policies and roles for stewards, so they have the right they need to work.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Indy-Domain-Genesis

About

This folder consists of domain genesis helm chart which is used to generate the domain genesis for indy network.

Folder Structure

```
/indy-domain-genesis
|-- templates
|    |-- configmap.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This chart is used to generate the domain genesis.
  - configmap.yaml

    The ConfigMap API resource provides mechanisms to inject containers with configuration data while keeping containers agnostic of Kubernetes. Here it is used to store Domain Genesis Data.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Indy Key Management

About

This folder consists indy-key-management helm charts which are used by the ansible playbooks for the generation of indy crypto material. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/indy-key-management
|-- templates
|    |-- job.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which, when combined with values, will generate crypto material for Indy.
- This folder contains following template files for peer implementation
  - job.yaml

    This job is used to generate crypto and save into vault.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Indy Ledger Txn

About

This folder contains helm chart which is used to run Indy Ledger Transaction Script.

Folder Structure

```
/indy-ledger-txn
|-- templates
|   |-- job.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which, when combined with values, will generate valid Kubernetes manifest files for ledger NYM transaction implementation.
- This folder contains following template files for indy-ledger NYM Transaction implementation
  - job.yaml

    This Job is used to generate a NYM transaction between an admin identity and an endorser identity.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Indy Node

About

This folder consists of indy-node helm charts, which are used by the ansible playbooks for the deployment of the indy nodes. The folder contains a templates folder, a chart file and a value file.

Folder Structure

```
/indy-node
|-- templates
|   |-- configmap.yaml
|   |-- service.yaml
|   |-- statesfulset.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which, when combined with values, will generate Indy nodes.
- This folder contains following template files for instantiate_chaincode implementation
  - configmap.yaml

    The configmap.yaml file through template engine generate configmaps. In Kubernetes, a ConfigMap is a container for storing configuration data. Things like pods can access the data in a ConfigMap. This file is used to inject Kubernetes container with indy config data.
  - service.yaml

    This creates a service for indy node and indy node client. A service in Kubernetes is a grouping of pods that are running on the cluster
  - statesfulset.yaml

    Statefulsets is used for Stateful applications, each repliCA of the pod will have its own state, and will be using its own Volume. This statefulset is used to create indy nodes.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

Indy Pool Genesis

About

This folder consists of pool genesis helm chart which is used to generate the pool genesis for indy network.

Folder Structure

```
/indy-pool-genesis
|-- templates
|   |-- configmap.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This chart is used to generate the initial pool genesis which is used to connect to indy network.
  - configmap.yaml

    The ConfigMap API resource provides mechanisms to inject containers with configuration data while keeping containers agnostic of Kubernetes. Here it is used to store Pool Genesis Data.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

6.4.6 Quorum Charts

The structure below represents the Chart structure for Quorum components in Hyperledger Bevel implementation.

```
/quorum
|-- charts
|    |-- node_constellation
|    |-- node_tessera
```

Pre-requisites

`helm` to be installed and configured on the cluster.

node_constellation

About

This chart is used to deploy Quorum nodes with constellation transaction manager.

Folder Structure

```
/node_constellation
|-- templates
|    |-- _helpers.tpl
|    |-- configmap.yaml
|    |-- ingress.yaml
|    |-- deployment.yaml
```

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```
|   |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which, when combined with values, will generate valid Kubernetes manifest files for auth job implementation.
- This folder contains following template files for node_constellation implementation
  - _helpers.tpl

    This file doesn't output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for node_constellation.
  - deployment.yaml

    This file is used as a basic manifest for creating a Kubernetes deployment. For the node_constellation, this file creates a constellation node deployment deployment. The file defines 3 containers, init container which gets all the secrets from the vault, constellation node container and a quorum container.
  - service.yaml

    This template is used as a basic manifest for creating a service endpoint for our deployment. The file basically specifies service type and kind of service ports for the constellation node.
  - configmap.yaml

    The ConfigMap API resource provides mechanisms to inject containers with configuration data while keeping containers agnostic of Kubernetes. Here it is used to store Genesis Data.
  - ingress.yaml

    Ingress exposes HTTP and HTTPS routes from outside the cluster to services within the cluster. Traffic routing is controlled by rules defined on the Ingress resource. This file containes those resources.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

---

node_tessera

About

This chart is used to deploy Quorum nodes with tessera transaction manager.

Folder Structure

```
/node_constellation
|-- templates
|   |-- _helpers.tpl
|   |-- configmap.yaml
|   |-- ingress.yaml
|   |-- deployment.yaml
|   |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which, when combined with values, will generate valid Kubernetes manifest files for tessera implementation.
- This folder contains following template files for node_constellation implementation
  - _helpers.tpl

    This file doesnt output a Kubernetes manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block of labels for node_constellation.
  - deployment.yaml

    This file is used as a basic manifest for creating a Kubernetes deployment. For the node_constellation, this file creates a constellation node deployment deployment.The file defines 4 containers, init container which gets all the secrets from the vault, mysql-init caontainer, mysql-db and a quorum container.
  - service.yaml

    This template is used as a basic manifest for creating a service endpoint for our deployment. The file basically specifies service type and kind of service ports for the tessera node.
  - configmap.yaml

    The ConfigMap API resource provides mechanisms to inject containers with configuration data while keeping containers agnostic of Kubernetes. Here it is used to store tessera config data.
  - ingress.yaml

    Ingress exposes HTTP and HTTPS routes from outside the cluster to services within the cluster. Traffic routing is controlled by rules defined on the Ingress resource. This file contains those resources.

Chart.yaml

- This file contains the information about the chart such as apiversion, appversion, name, etc.

values.yaml

- This file contains the default configuration values for the chart.

6.4.7 Hyperledger Besu Charts

The structure below represents the Chart structure for Hyperledger Besu components in Hyperledger Bevel implementation.

```
|hyperledger-besu
|-- charts
|    |-- node_orion
```

Pre-requisites

`helm` to be installed and configured on the cluster.

node_orion (besu node chart with orion transaction manager)

About

This folder consists of Hyperledger-Besu node charts which is used by the ansible playbook for the deployment of the node. This folder contains a template folder, a chart file and a value file.

Folder Structure

```
|node_orion
|-- templates
|    |-- _helpers.tpl
|    |-- configmap.yaml
|    |-- deployment.yaml
|    |-- service.yaml
|-- Chart.yaml
|-- values.yaml
```

Charts description

templates

- This folder contains template structures which, when combined with values, will generate valid Kuberetenes manifest files for Hyperledger-Besu node implementation.
- This folder contains following template files for node implementation
  - _helpers.tpl

    This file doesn't output a Kubernets manifest file as it begins with underscore (_). And it's a place to put template helpers that we can re-use throughout the chart. That file is the default location for template partials, as we have defined a template to encapsulate a Kubernetes block label for node.
  - configmap.yaml

    The configmap contains the genesis file data encoded in base64 format.

- deployment.yaml

  This file is used as a basic manifest for creating a Kubernetes deployment. For the node, this file creates a deployment. The file defines where containers are defined and the respective Hyperledger-Besu images. It also contain the initial containers where the crypto material is fetched from the vault.

- service.yaml

  This template is used as a basic manifest for creating service endpoints for our deployment. This service.yaml creates endpoints for the besu node.

6.5 Jenkins Automation

6.5.1 Jenkins Pipeline

Jenkins is a self-contained, open source automation server which can be used to automate all sorts of tasks related to building, testing, and delivering or deploying software.

Jenkins in Hyperledger Bevel

In Hyperledger Bevel, although Jenkins is not mandatory, we have a single Jenkinsfile as a sample to help you setup CI/CD Pipelines.

Pre-requisites

1. Setup Jenkins with agent configurations. Declare a agent-config called `ansible` with the Docker Image ghcr.io/hyperledger/bevel-build:jenkins.
2. A EKS Cluster (Managed on AWS) and its kubeconfig file available and accessible from the Jenkins server.
3. AWS user `jenkins` with CLI credentials with access to above EKS Cluster.
4. A Hashicorp Vault installation which is accessible from the Jenkins server.
5. A Git repo which will be added as multi-branch pipeline on Jenkins (this is a fork of this repo).
6. A separate `bevel-configuration` git repo where the templated network.yaml for different platforms are stored. Details of this repo needs to be updated in pipeline Stage `Create Configuration File`.

Branch Configuration

The Jenkinsfile is designed to ignore `develop` and `main` branches by default. So, create platform specific branches in your forked repo.

- `corda` for Opensource Corda
- `corda-ent` for Enterprise Corda
- `fabric` for Hyperledger Fabric
- `besu` for Hyperledger Besu
- `indy` for Hyperledger Indy
- `quorum` for Quorum

Your `bevel-configuration` repo should have the corresponding folders and files as demanded/configured in Stage `Create Configuration File`.

Jenkins Secrets

Following secrets must be stored in Jenkins which is configured in the environment section. This can be renamed/updated in the Jenkinsfile according to your needs.

- `sownak-innersource`: is the Git Token and password to access the Git repos.
- `aws_demo_kubeconfig`: is the Kubeconfig file for AWS EKS cluster.
- `jenkins_gitops_key`: is the Gitops private key which has Read-Write access to the Git repos.
- `nexus_user`: is the Service User and Password for access to Nexus for Cordapps (only used in Corda).
- `aws_demo_vault_key`: is the private key to enable ssh access to Hashicorp Vault Server.
- `aws_demo_vault_token`: is the Root Token for Hashicorp Vault.
- `gmaps_key`: is the Google Maps API key for frontend (only used when deploying Supplychain application).
- `aws_jenkins`: is the AWS credentials for jenkins user on AWS IAM.

Environment Changes

Following `environment` variables need to be updated in Jenkinsfile for your own environment

- VAULT_SERVER=[vault server ip address or domain name reachable from this server]
- VAULT_PORT=[vault server port]
- VAULT_BASTION=[vault bastion server address]
- VAULT_PRIVATE_IP=[vault server private ip address]

Parameters

These can be changed when running manually, the automated Jenkins pipeline always use the default option):

1. FORCE_ACTION (default: no) To force rebuild `[ci skip]` commits in case of previous failure.
2. RESET_ACTION (default: yes) To have the option to NOT reset the network when running the pipeline.
3. APIONLY_ACTION (default: no) To run only API test on existing live network in case of previous failure.
4. FABRIC_VERSION (default: 1_4_4) To select the Fabric version.
5. FABRIC_CONSENSUS (default: raft) To select the Fabric consensus.
6. CORDA_VERSION (default: 4_4) To select the Corda Opensource version.
7. QUORUM_VERSION (default: 2_5_0) To select the Quorum version (only 2_5_0 is supported for now)
8. QUORUM_CONSENSUS (default: ibft) To change the Quorum consensus.
9. QUORUM_TM (default: tessera) To change the Quorum Transaction manager.
10. INDY_VERSION (default: 1_11_0) To change the Indy version.

- Default Corda Enterprise version is 4_4. This is hardcoded in the jenkinsfile.
- Default Besu settings are: Version 1_4_4, Consensus IBFT, Transaction Manager Orion.

Setup on Jenkins

Configure Multi-branch pipeline with the forked repo as the source. In case you create the branches later, scan the pipeline to get new branches on Jenkins.

Jenkins Stages

1. `Checkout SCM`: Manually checkout the branch and check for `[ci skip]` commits as they are skipped.
2. `Prepare build environment`: Creates the build directory and sets up the necessary files for build like gitops.pem, vault.pem, kubeconfig, test jsons. Also creates the ssh-tunnel connection to Hashicorp Vault server.
3. `<branch>-settings`: Set env variables CONSENSUS, VERSION and TM based on the branch i.e. based on the DLT platform.
4. `Create Configuration File`: Downloads the config file (main network.yaml, addorg.yaml and application.yaml) depending on the BRANCH_NAME, CONSENSUS, VERSION and TM from bevel-configuration and adds the secret parameters.
5. `Reset existing network`: Resets the network based on application.yaml as that should contain all the orgs.
6. `Deploy network`: Deploys the network based on main network.yaml.
7. `Add a new node`: Adds a new organization to the above network. This is not enabled for Indy currently.
8. `Deploy Supplychain-App`: Deploys the supplychain app. Not enabled for Indy. Corda Enterprise and Besu are in the future roadmap.
9. `Deploy Identity-App`: Deploys the Identity app. Only for Indy.
10. `Run SupplyChain API tests`: Runs Supplychain API test using newman. This step has a try-catch so that the whole pipeline does not fail if only API tests fail. Re-run the tests manually if only API tests fail. Not enabled for Indy. Corda Enterprise and Besu are in the future roadmap.
11. `Run Identity API tests`: Runs Identity API test using newman. This step has a try-catch so that the whole pipeline does not fail if only API tests fail. Re-run the tests manually if only API tests fail. Only for Indy.
12. `Manual Approval for resetting the deployment`: Waits for 20 minutes before resetting the network. If you want to keep the network for demo, Abort at this stage.
13. `Reset network again`: Resets the network after the 20 minutes is over or you chose to reset. Keeps the network running if the previous step was aborted.

CHAPTER 7

Sample Usage

This section shows the sample applications that are provisioned by Hyperledger Bevel. If you haven't already, follow the *Getting Started* to setup the network for your desired DLT/Blockchain platform. We have provided sample applications to be deployed using Hyperledger Bevel.

7.1 Supplychain

One of the two reference applications for Bevel, is the Supplychain usecase. On this page, we will describe the usecase and its models, as well as pre-requisites to set it up yourself.

7.1.1 Use case description

The Supplychain reference application is an example of a common usecase for a blockchain; the supplychain. The application defines a consortium of multiple organizations. The application allows nodes to track products or goods along their chain of custody. It provides the members of the consortium all the relevant data to their product.

The application has been implemented for Hyperledger Fabric, Quorum and R3 Corda, with support for Hyperledger Besu coming soon. The platforms will slightly differ in behavior, but follow the same principles.

In the context of the supplychain, there are two types of items that can be tracked, products and containers. Below you will find a definition of the item and its properties:

Product

* `health` - The blockchain will only store `min`, `max` and `average` values. The value currently is obsolete and not used, but in place for any future updates should these enable the value.

The creator of the product will be marked as its initial custodian. As a custodian, a node is able to package and unpackage goods.

Container/ContainerState

When handling an item, you can package it. It then stores data in an object called `ContainerState`, which is structured as such:

* `health` - The blockchain will only store `min`, `max` and `average` values. The value currently is obsolete and not used, but in place for any future updates should these enable the value.

Products being packaged will have their `trackingID` added to the contents list of the container. The product will be updated when its container is updated. If a product is contained it can no longer be handled directly (i.e. transfer ownership of a single product while still in a container with others).

Any of the participants can execute methods to claim custodianship of a product or container. History can be extracted via transactions stored on the ledger/within the vault.

7.1.2 Prerequisites

- The supplychain application requires that nodes have subject names that include a location field in the x.509 name formatted as such: `L=<lat>/<long>/<city>`
- DLT network of 1 or more organizations; a complete supplychain network would have the following organizations
  - Supplychain (admin/orderer organization)
  - Carrier
  - Store
  - Warehouse
  - Manufacturer

7.1.3 Setup Guide

The setup process has been automated using Ansible scripts, GitOps, and Helm charts.

The files have all been provided to use and require the user to populate the `network.yaml` file accordingly, following these steps:

1. Create a copy of the `network.yaml` you have used to set up your network.
2. For each organization, navigate to the `gitops` section. Here, the `chart_source` field will change. The value needs to be changed to `examples/supplychain-app/charts`. This is the relative location of the Helm charts for the supplychain app.
3. Make sure that you have deployed the smart contracts for the platform of choice; along with the correct `network.yaml` for the DLT.
   - For R3 Corda, run the `platforms\r3-corda\configuration\deploy-cordapps.yaml`
   - For Hyperledger Fabric, run the `platforms/hyperledger-fabric/configuration/chaincode-ops.yaml`
   - For Quorum, no smart contracts need to be deployed beforehand.

7.1.4 Deploying the supplychain-app

When having completed the Prerequisites and setup guide, deploy the supplychain app by executing the following command:

```
ansible-playbook examples/supplychain-app/configuration/deploy-supplychain-app.
yaml -e "@/path/to/application/network.yaml"
```

7.1.5 Testing/validating the supplychain-app

For testing the application, there are API tests included. For instructions on how to set this up, follow the `README.md` here.

7.2 Indy RefApp

7.2.1 Use case description

Welcome to the Indy Ref App which allows nodes to implement the concept of digital identities using blockchain. There are 3 components

- Alice: Alice is the end user and a student.
- Faber: Faber is the university.
- Indy Webserver

In this usecase, Alice obtains a Credential from Faber College regarding the transcript. A connection is build between Faber College and Alice (onboarding process).Faber College creates and sends a Credential Offer to Alice. Alice creates a Credential Request and sends it to Faber College.Faber College creates the Credential for Alice. Alice now receives the Credential and stores it in her wallet.

7.2.2 Pre-requisites

A network with 2 organizations:

- Authority
  - 1 Trustee
- University
  - 4 Steward nodes
  - 1 Endorser A Docker repository

Find more at Indy-Ref-App

CHAPTER 8

Bevel current roadmap

OFE* : Operational feature enhancement

Legend of annotations:

Mark	Description
📌	work to do
✅	work completed
🏃	on-going work
💪	stretch goal
✋	on hold

8.1 General

- 🏃 **Improve the existing `readthedocs` documentations**
  - 🏃 Update guide for deployment on Local k8s
- 🏃 **Platforms and components upgrade:**
  - ✅ Flux version 2 upgrade
  - ✅ Test and update platforms code to run on EKS v1.2x
  - 📌 Setup AWS cloudwatch exporter
  - 📌 Grafana and Promethus integration

  - 📌 Improve logging/error messaging in playbooks

8.2 Platforms

- 🏃 Reduce/decouple ansible dependecy in DLT platforms automation
- 🏃 **Corda Enterprise operational feature enhancements**
  - 📌 HA Notary options
  - 📌 Enable PostGreSQL support for Corda Enterprise
  - 📌 Removal of node
- 🏃 **HL Fabric operational feature enhancements**
  - 🏃 Feature for user identities
  - 🏃 External chaincode for Fabric 2.2.x
  - 📌 CI/CD piplelines for chaincode deployment
- 🏃 **HL Besu operational feature enhancements**
  - 🏃 Implement private transactions
  - ✋ Enable bootnodes
- 🏃 **Quorum operational feature enhancements**
  - ✔ Vault secret engine integration with tessera
  - 📌 Implement private transactions
- 🏃 **HL Indy operational feature enhancements**
  - ✋ Removal of organizations from a running Indy Network

8.3 Application

- 🏃 Hyperledger Besu reference application

8.4 Histroic DLT/Blockchain support releases

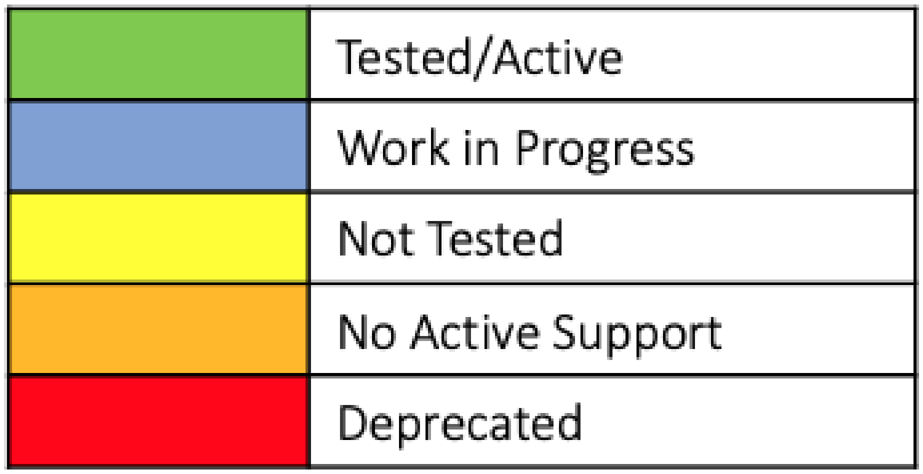
This section has been moved to the *Compability Matrix*

CHAPTER 9

Compability Matrix

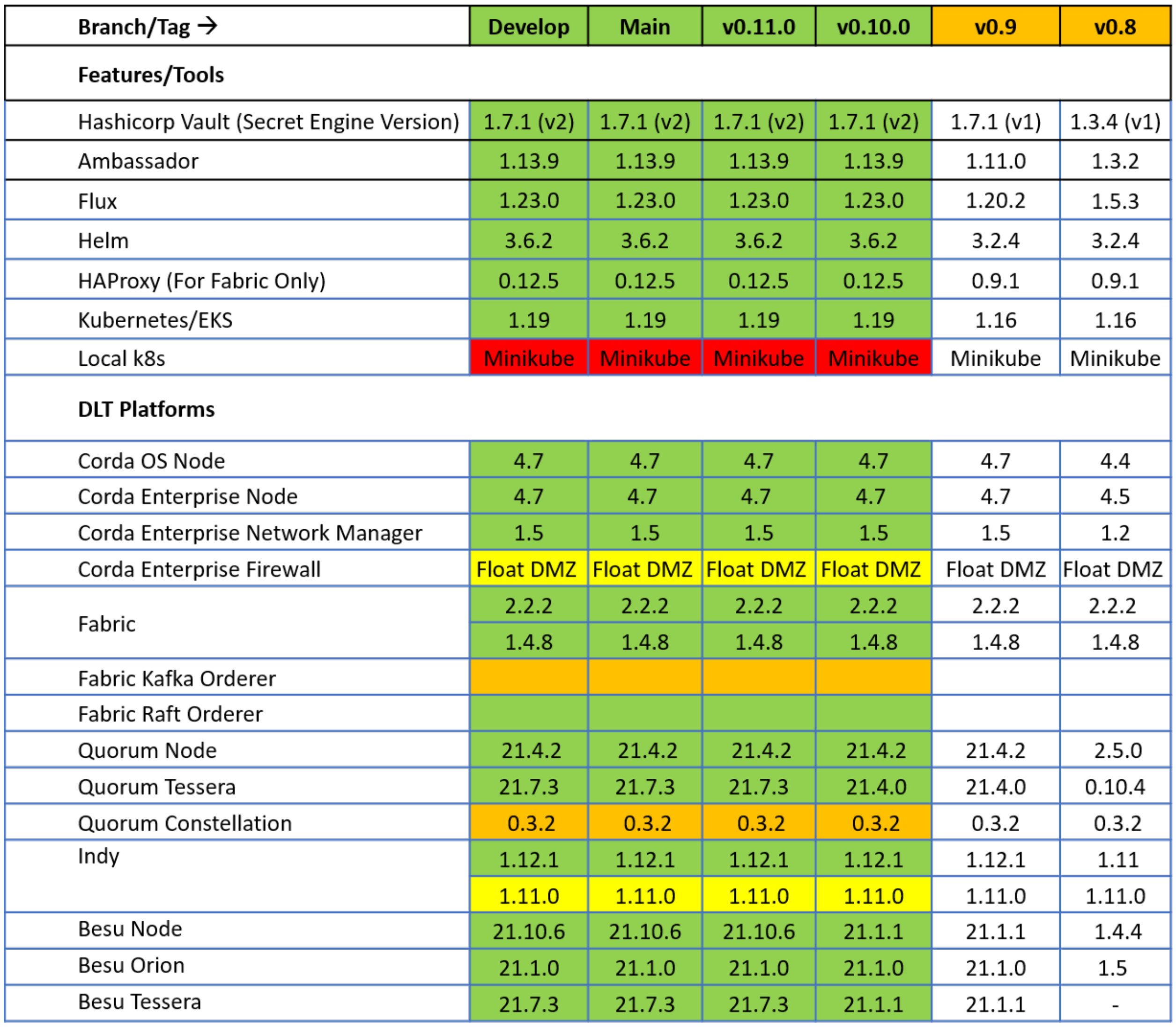
Bevel current tools/platforms support version and historic details

9.1 Colour Legends



🟩	Tested/Active
🟦	Work in Progress
🟨	Not Tested
🟧	No Active Support
🟥	Deprecated

9.2 Compatibility Table



Branch/Tag →	Develop	Main	v0.11.0	v0.10.0	v0.9	v0.8
Features/Tools						
Hashicorp Vault (Secret Engine Version)	1.7.1 (v2)	1.7.1 (v2)	1.7.1 (v2)	1.7.1 (v2)	1.7.1 (v1)	1.3.4 (v1)
Ambassador	1.13.9	1.13.9	1.13.9	1.13.9	1.11.0	1.3.2
Flux	1.23.0	1.23.0	1.23.0	1.23.0	1.20.2	1.5.3
Helm	3.6.2	3.6.2	3.6.2	3.6.2	3.2.4	3.2.4
HAProxy (For Fabric Only)	0.12.5	0.12.5	0.12.5	0.12.5	0.9.1	0.9.1
Kubernetes/EKS	1.19	1.19	1.19	1.19	1.16	1.16
Local k8s	Minikube	Minikube	Minikube	Minikube	Minikube	Minikube
DLT Platforms						
Corda OS Node	4.7	4.7	4.7	4.7	4.7	4.4
Corda Enterprise Node	4.7	4.7	4.7	4.7	4.7	4.5
Corda Enterprise Network Manager	1.5	1.5	1.5	1.5	1.5	1.2
Corda Enterprise Firewall	Float DMZ	Float DMZ	Float DMZ	Float DMZ	Float DMZ	Float DMZ
Fabric	2.2.2	2.2.2	2.2.2	2.2.2	2.2.2	2.2.2
	1.4.8	1.4.8	1.4.8	1.4.8	1.4.8	1.4.8
Fabric Kafka Orderer	🟧	🟧	🟧	🟧		
Fabric Raft Orderer	🟩	🟩	🟩	🟩		
Quorum Node	21.4.2	21.4.2	21.4.2	21.4.2	21.4.2	2.5.0
Quorum Tessera	21.7.3	21.7.3	21.7.3	21.4.0	21.4.0	0.10.4
Quorum Constellation	0.3.2	0.3.2	0.3.2	0.3.2	0.3.2	0.3.2
Indy	1.12.1	1.12.1	1.12.1	1.12.1	1.12.1	1.11
	1.11.0	1.11.0	1.11.0	1.11.0	1.11.0	1.11.0
Besu Node	21.10.6	21.10.6	21.10.6	21.1.1	21.1.1	1.4.4
Besu Orion	21.1.0	21.1.0	21.1.0	21.1.0	21.1.0	1.5
Besu Tessera	21.7.3	21.7.3	21.7.3	21.1.1	21.1.1	-

CHAPTER 10

Architecture Reference

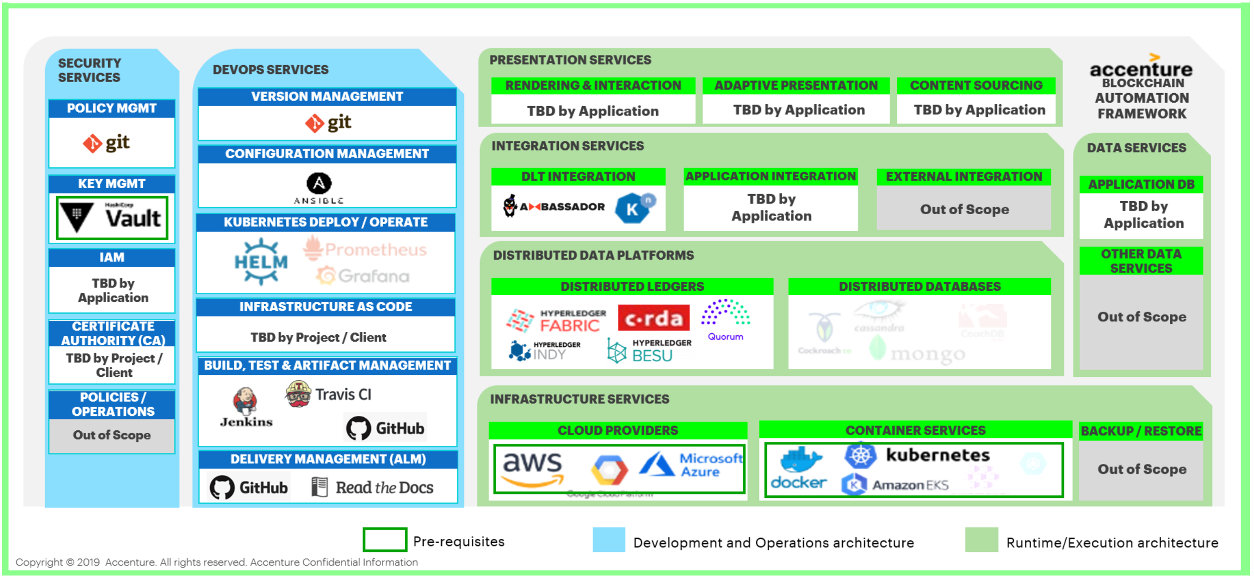


Fig. 1: Figure: Hyperledger Bevel Physical Architecture

10.1 Security Services

These are the services to enable the security of cryptographic keys, users, nodes and transactions along with the infrastructure supporting those services.

10.1.1 Policy Management

Policy management is the process of creating, communicating, and maintaining policies and procedures within an organization. Policy Management is a key feature used in development as well as operational phase of any product as it dictates who has what control in the dev/test/prod environment(s).

In Hyperledger Bevel, Policy Management is provided by the Git repository. Bevel uses *GitOps* for deployment and operations, hence all policies are defined in the Git repository. Git branches with appropriate rights to users is maintained for releases in each environment. Read/write access, admin access to git repository, access to add access keys in repository, pull request based merge in main branch are some of the key features that is used in Bevel.

10.1.2 Key Management

Key Management is the process of overseeing the generation, exchange, storage, use and destruction of cryptographic keys. Key Management is an important consideration for blockchain as all transactions in blockchain are signed using digital keys. Loss of keys can lead to financial loss as well as brand impact to the organization conducting the transaction.

Hyperledger Bevel uses Hashicorp Vault to hold secrets that are used by the DLT/Blockchain platform. A secret is anything that you want to tightly control access to (e.g. API keys, passwords, certificates). Vault provides a unified interface to any secret, while providing tight access control and recording a detailed audit log. Hashicorp Vault provides an abstraction on top of a Cloud KMS and does not create Cloud Platform lock-in. See the *Platform-Specific Reference Guides* for specific details on the structure of the Vault. Vault is a pre-requisite for Bevel and should be configured and available before the automation is triggered.

10.1.3 Identity and Access Management (IAM)

Identity and Access Management (IAM) is the process of defining and managing the access privileges of network users and determining how users are granted or denied those privileges. IAM is the front door for all blockchain applications and hence has to be designed upfront to reduce risk. Strong authentication techniques and user level permissioning will help shift left some of the security concerns.

Hyperledger Bevel does not provide IAM controls. This is to be developed and applied by the application/use-case.

10.1.4 Certificate Authority (CA)

A Certificate Authority dispenses certificates to different actors. These certificates are digitally signed by the CA and bind together the actor with the actor's public key (and optionally with a comprehensive list of properties). As a result, if one trusts the CA (and knows its public key), it can trust that the specific actor is bound to the public key included in the certificate, and owns the included attributes, by validating the CA's signature on the actor's certificate.

For test and dev environments, Hyperledger Bevel generates certificates and keys (for all Platforms) and also provides CA servers (Fabric only).

For production use, generation of certificates, keys and CA servers via Hyperledger Bevel is not recommended. The existing certificates and keys can be placed in Vault in the paths described under subsections of *Platform-Specific Reference Guides* .

10.1.5 Policies/Operations

Policies/Operations refers to the actual security policies that an organization may/should have governing their business processes, operations and management.

This part of the reference architecture is out of scope for Hyperledger Bevel.

10.2 DevOps Services

These services enable the development of on-ledger (e.g. smart contracts) or off-ledger services based on SDK's and IDE's (e.g. Web APIs) including the maintenance, monitoring and administration of the distributed ledger and its on- and off-ledger services.

10.2.1 Version Management

Version Management capabilities enable change control of smart contract and decentralized applications. This enables developers and operators to track different version of the code as well as releases.

Hyperledger Bevel utilizes Git as the version management tool.

10.2.2 Configuration Management

Configuration management involves automation of scripts and ad-hoc practices in a consistent, reliable and secure way. Configuration Management enables operators to set-up DLT/Blockchain networks idempotently by using minimum configuration changes.

Hyperledger Bevel utilizes Ansible for configuration management. Ansible features a state driven, goal oriented resource model that describes the desired state of computer systems and services, not the paths to get them to this state. No matter what state a system is in, Ansible understands how to transform it to the desired state (and also supports a "dry run" mode to preview needed changes). This allows reliable and repeatable IT infrastructure configuration, avoiding the potential failures from scripting and script-based solutions that describe explicit and often irreversible actions rather than the end goal.

10.2.3 Kubernetes Deploy/Operate

Kubernetes Deploy/Operate consists of the services that are used to deploy desired state of various services on Kubernetes clusters. It is also used for maintenance and operations of these services.

Hyperledger Bevel uses Helm to achieve this. Helm uses a packaging format called charts. A chart is a collection of files that describe a related set of Kubernetes resources. A single chart might be used to deploy something simple, like a memcached pod, or something complex, like a full web app stack with HTTP servers, databases, caches, and so on, which in our case, is the desired blockchain platform. While using helm, we can deploy a set of services and deployments together as a release.

10.2.4 Infrastructure as Code

Infrastructure as Code (IaC) is the process of managing and provisioning cloud hardware through machine-readable definition files, rather than physical hardware configuration or interactive configuration tools. IaC can be versioned and hence, maintained easily and can be used to deploy cloud environments idempotently.

This part of the reference architecture is out of scope for Hyperledger Bevel.

10.2.5 Build, Test, and Artifact Management

Build, Test, and Artifact Management capabilities enable continuous delivery management by ensuring automation of the build and deployment of artefacts.

Hyperledger Bevel uses TravisCI for running static tests, building and storing of Docker images. Jenkins Pipelines (as code) are also available for continuous deployment/reset of DLT network. Artefact management is not implemented yet, but GitHub Releases can be used for this.

10.2.6 Delivery Management

Delivery Management is the process where all software, artifacts and data from disparate tools used to move a product or feature from initial idea to max adoption are integrated into a unified common data layer, with the key information connected and easily accessible, giving each individual and team an unprecedented level of insight into bottlenecks and inefficiencies dramatically improving the speed at which better software gets to users safely.

As it is opensource and a Hyperledger Foundation project, Hyperledger Bevel integrates with GitHub for reporting and tracking new features, bugs/issues and releases. Bevel uses ReadTheDocs for sharing documentation. In specific implementations, Hyperledger Bevel can be integrated with tools like Jira and Confluence.

10.3 Presentation Services

The presentation services specify how the application will be provided to the end-user. It also defines the on-ledger and off-ledger services and capabilities via different channels.

This part of the reference architecture is out of scope for Hyperledger Bevel and will be determined by the application using Bevel.

10.4 Integration Services

These are combination of the services to interact with on- and off-ledger services via APIs or ledger protocols including runtime and operations services.

10.4.1 DLT Integration

DLT integration refers to how the presentation services will talk to the DLT Platform. This will depend on the presentation service as such.

Hyperledger Bevel provides a sample application *Supplychain*, which uses Express Nodejs API as the integration layer to talk to the underlying DLT platform. Each DLT/Blockchain platform also enables this by providing SDKs or APIs themselves.

10.4.2 Application Integration

Application Integration refers to how the application will talk to different components of the same application.

This part of the reference architecture is out of scope for Hyperledger Bevel and will be determined by the application using Bevel.

10.4.3 External Integration

External integration is required when the blockchain application interfaces with systems outside of the application or DLT platform.

This part of the reference architecture is out of scope for Hyperledger Bevel and will be determined by the application using Bevel.

10.5 Distributed Data Platforms

Distributed Data Platforms form the core of any distributed architecture solution. Hyperledger Bevel aims to support both Distributed Ledgers and Distributed Databases. Bevel currently supports DLT/Blockchain Platforms: Corda, Hyperledger Fabric, Hyperledger Indy, Hyperledger Besu, and Quorum.

10.6 Infrastructure Services

Infrastructure services refer to the various services needed to run or deploy the different services of a distributed ledger architecture.

10.6.1 Cloud Providers

A Cloud Provider is a company that delivers cloud computing based services with features like scalibility and easy maintainance.

Hyperledger Bevel is built on Kubernetes, so will run on any Cloud provider providing Kubernetes as a service; this includes private and hybrid clouds.

10.6.2 Container Services

Container services allows users to deploy and manage containers using container based virtualization. Containers allow a developer to package up an application with all of the parts it needs, such as libraries and other dependencies, and ship it all out as one package.

Hyperledger Bevel uses 2 containerization technologies: Docker and Kubernetes. Kubernetes (K8s) is an open-source system for automating deployment, scaling, and management of containerized applications. Docker is a tool designed to make it easier to create, deploy, and run applications by using containers.

10.6.3 Backup/Restore

Disaster recovery involves a set of policies, tools and procedures to enable the recovery of vital technology infrastructure and systems following a natural or human-induced disaster. Even though blockchain applications are self replicating, complete auto recovery is not always possible. Therefore it is important to have guidelines around backing up the data in a distributed store and restoring it using a conventional restoring mechanism. Backup is the process of copying and archiving data. Restore is the process of returning data that has been lost, stolen or damaged from secondary storage.

This part of the reference architecture is out of scope for Hyperledger Bevel.

10.7 Other Data Services

Data services are related to on-ledger storage and data processing.

This part of the reference architecture is out of scope for Hyperledger Bevel.

10.8 Platform-Specific Reference Guides

10.8.1 Corda Enterprise Architecture Reference

Kubernetes

Peer Nodes

The following diagram shows how Corda peer nodes will be deployed on your Kubernetes instance.

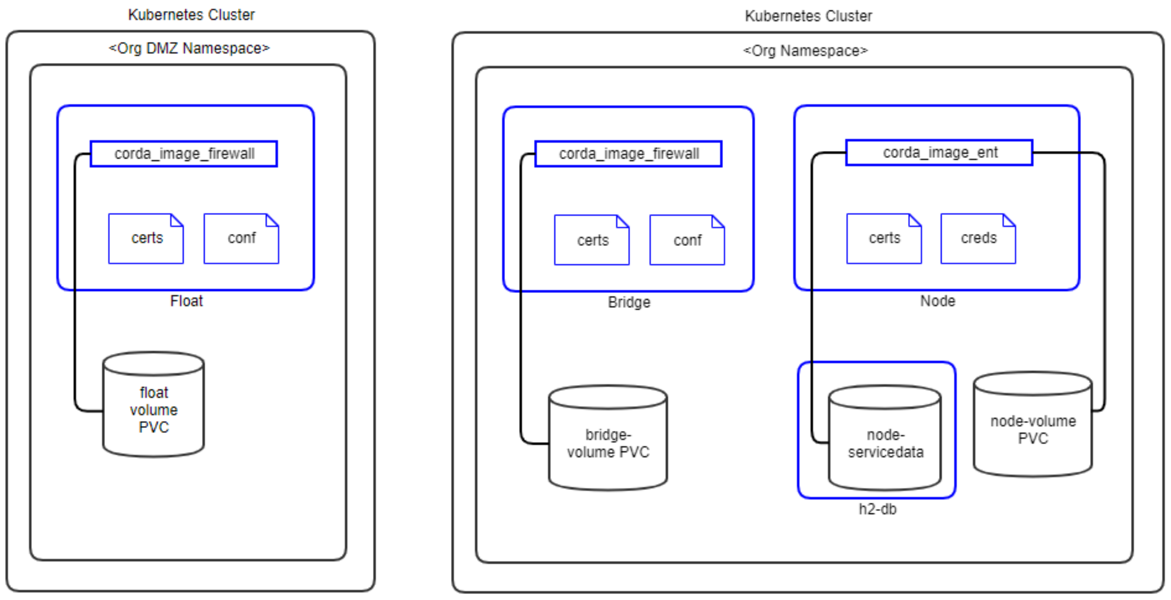


Figure: R3 Corda Enterprise Kubernetes Deployment - Peers

Notes:

1. Pods are shown in blue in the diagram.
2. Certificates are mounted as in-memory volumes from the *Vault*.
3. The h2 database is a separate pod running in the same namespace. In future release, PostgreSQL will be implemented as well.
4. All storage uses a Kubernetes Persistent Volume.
5. Release 0.6.0.0 does not implement Corda firewall components. These will be implemented in later releases based on demand.

Support Services

The following diagram shows how the Corda Enterprise Network Map Services (**Identity Manager**, **Networkmap**, **Signer** and **Notary**) will be deployed on your Kubernetes instance(s).

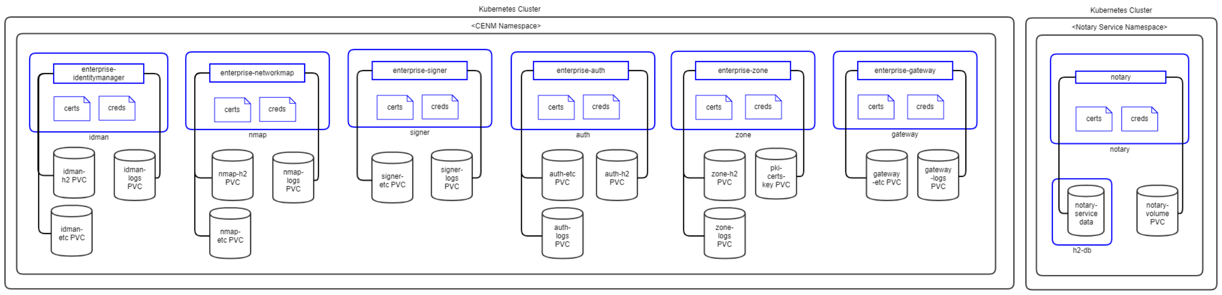


Figure: R3 Corda Kubernetes Deployment - CENM Services

Notes:

1. Pods are shown in blue in the diagram.
2. Certificates are mounted as in-memory volumes from the *Vault*.
3. All CENM pods (except Notary) have separate H2 volume for data storage. In future release, PostgreSQL will be implemented as well.
4. Notary service has a separate H2 pod for data storage. In future release, PostgreSQL will be implemented as well.
5. All storage uses a Kubernetes Persistent Volume.
6. Release 0.6.0.0 implements Notary in the same namespace as other CENM services. They will be separated when HA Notary is implemented in later releases.

Components

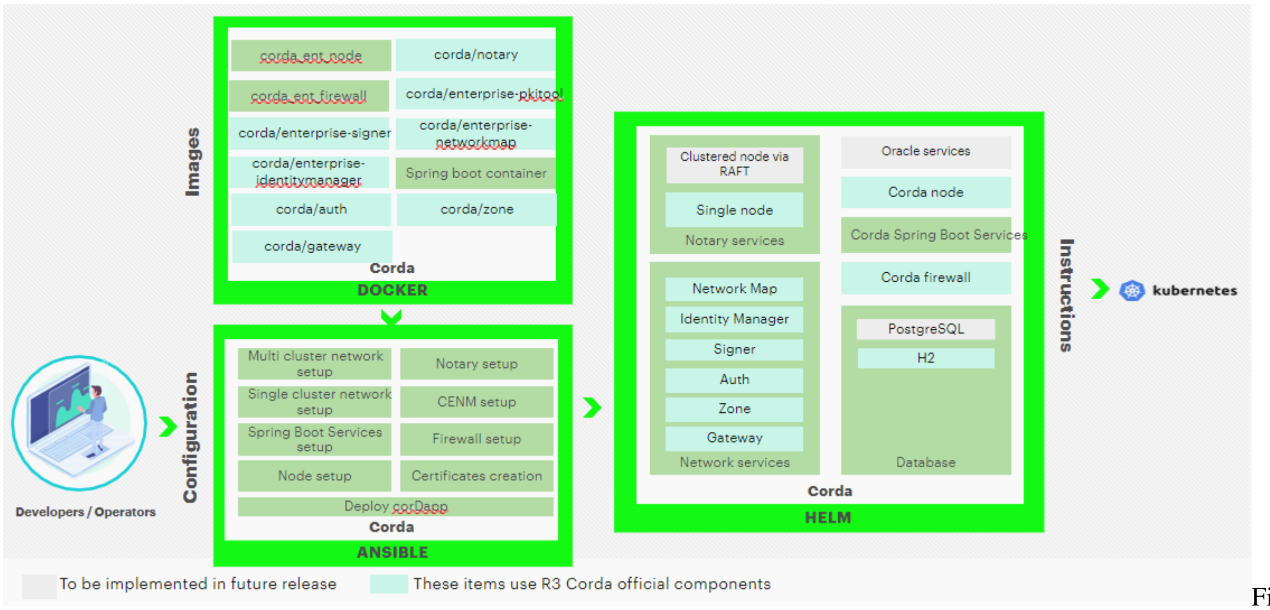


Figure: Corda Enterprise Components

Docker Images

For Corda Enterprise, the *corda_ent_node* and *corda_ent_firewall* docker images should be built and put in a private docker registry. Please follow these instructions to build docker images for Corda Enterprise.

The official Corda images are available on Docker Hub. These are evaluation only, for production implementation, please aquire licensed images from R3, upload them into your private docker registry and update the tags accordingly.

Following Corda Docker Images are used and needed by Hyperledger Bevel.

- Corda Network Map Service (Built as per these instructions)
- Corda Identity Manager Service
- Corda Signer
- Corda PKITool (Built as per these instructions)
- Corda Notary (Built as per these instructions)
- Corda Node (Built as per these instructions)
- Corda Firewall (Built as per these instructions)

Ansible Playbooks

Detailed information on ansible playbooks can be referred *here* and the execution process can be referred *here*.

Helm Charts

Detailed information on helm charts can be referred *here*.

Vault Configuration WIP

Hyperledger Bevel stores their `crypto` and `credentials` immediately within the secret secrets engine. Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

- `secrets/notary/credentials/database` - Contains password for notary database for admin and user:

```
sa="newh2pass" notaryUser1="xyz1234" notaryUser2="xyz1236"
```

- `secrets/notary/credentials/keystore` - Contains password for notary keystore:

```
keyStorePassword="newpass" trustStorePassword="newpass" defaultTrustStorePassword
↪"=trustpass" defaultKeyStorePassword="cordacadevpass" sslkeyStorePassword="sslpass"␣
↪ssltrustStorePassword="sslpass"
```

- `secrets/notary/credentials/networkmappassword` - Contains password for networkmap:

```
sa="admin"
```

- `secrets/notary/credentials/rpcusers` - Contains password for rpc users:

```
notaryoperations="usera" notaryoperations1="usera" notaryoperations2="usera"␣
↪notaryadmin="usera"
```

- `secrets/notary/credentials/vaultroottoken` - Contains password for vault root token in the format:

```
rootToken="<vault.root_token>"
```

- `secrets/<org-name>/credentials/database` - Contains password for notary database for admin and user:

```
sa="newh2pass" <org-name>User1="xyz1234" <org-name>User2="xyz1236"
```

- `secrets/<org-name>/credentials/keystore` - Contains password for notary keystore:

```
keyStorePassword="newpass" trustStorePassword="newpass" defaultTrustStorePassword
↪"=trustpass" defaultKeyStorePassword="cordacadevpass" sslkeyStorePassword="sslpass"␣
↪ssltrustStorePassword="sslpass"
```

- `secrets/<org-name>/credentials/networkmappassword` - Contains password for networkmap:

```
sa="admin"
```

- `secrets/<org-name>/credentials/rpcusers` - Contains password for rpc users:

```
<org-name>operations="usera" <org-name>operations1="usera" <org-name>operations2=
↪"usera" <org-name>admin="usera"
```

- `secrets/<org-name>/credentials/vaultroottoken` - Contains password for vault root token in the format:

```
rootToken="<vault.root_token>"
```

The complete Corda Enterprise Certificate and key paths in the vault can be referred here.

10.8.2 Certificate Paths on Vault for Corda Enterprise

- All values must be Base64 encoded files as Bevel decodes them.
- Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

For CENM

For Node/Peer Organization

10.8.3 Corda Opensource Architecture Reference

Kubernetes

Peer Nodes

The following diagram shows how Corda peer nodes will be deployed on your Kubernetes instance.

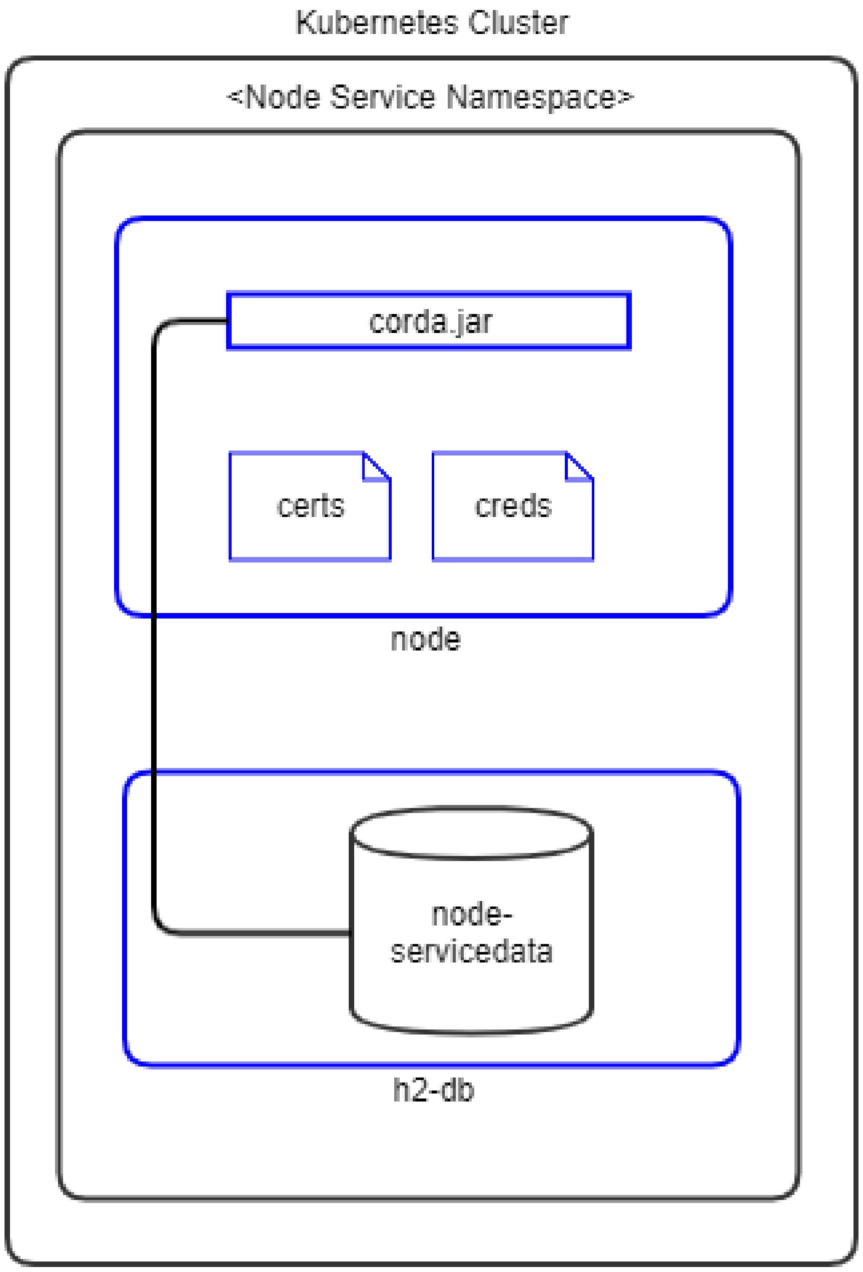


Figure: R3 Corda Kubernetes Deployment - Peers

Notes:

1. Pods are shown in blue in the diagram.
2. Certificates are mounted as in-memory volumes from the *vault*.
3. The node-pod runs corda.jar.
4. The h2 database is a separate pod running in the same namespace
5. All storage uses a Kubernetes Persistent Volume.

Support Services

The following diagram shows how the Corda Support Services (**Doorman**, **Networkmap** and **Notary**) will be deployed on your Kubernetes instance.

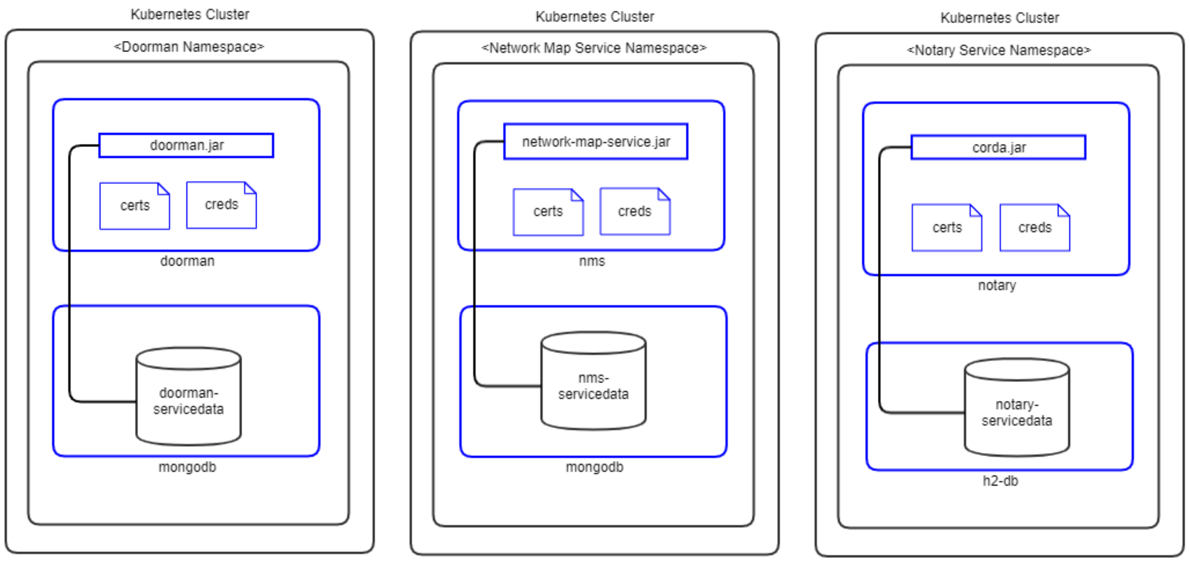


Figure: R3 Corda Kubernetes Deployment - Support Services

Notes:

1. Pods are shown in blue in the diagram.
2. Certificates are mounted as in-memory volumes from the *vault*.
3. Doorman and Networkmap services have a separate MongoDB pod for data storage.
4. Notary service has a separate H2 pod for data storage.
5. All storage uses a Kubernetes Persistent Volume.

Components

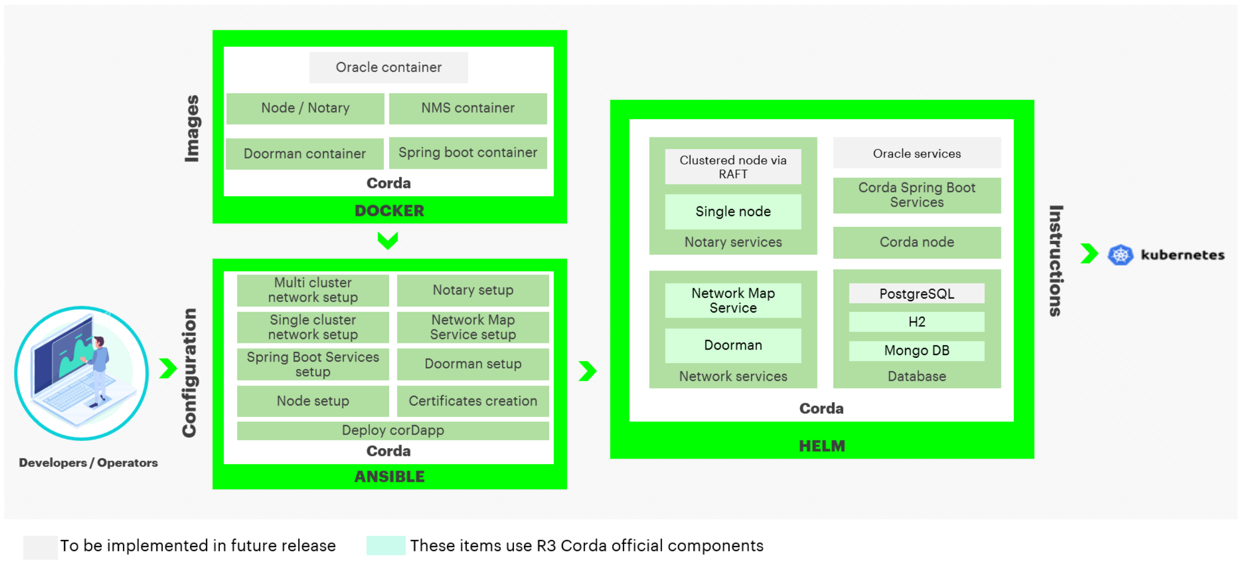


Figure: Corda Components

Docker Images

Hyperledger Bevel creates/provides a set of Corda Docker images that can be found in the GitHub Repo or can be built as per *configuring prerequisites*. The following Corda Docker Images are used and needed by Hyperledger Bevel.

- Corda Network Map Service
- Corda Doorman Service
- Corda Node

Ansible Playbooks

Detailed information on ansible playbooks can be referred *here* and the execution process can be referred *here*

Helm Charts

Detailed information on helm charts can be referred *here*

Vault Configuration

Hyperledger Bevel stores their `crypto` and `credentials` immediately within the secret secrets engine. Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

- `secrets/doorman/credentials/mongodb` - Contains password for doorman mongodb database.

```
mongodbPassword="admin"
```

- `secrets/doorman/credentials/userpassword` - Contains password for doorman mongodb database user:

```
sa="newdbnm"
```

- `secrets/networkmap/credentials/mongodb` - Contains password for networkmap mongodb database:

```
mongodbPassword="newdbnm"
```

- `secrets/networkmap/credentials/userpassword` - Contains password for networkmap mongodb database user:

```
sa="admin"
```

- `secrets/notary/credentials/database` - Contains password for notary database for admin and user:

```
sa="newh2pass" notaryUser1="xyz1234" notaryUser2="xyz1236"
```

- `secrets/notary/credentials/keystore` - Contains password for notary keystore:

```
keyStorePassword="newpass" trustStorePassword="newpass" defaultTrustStorePassword
↪"=trustpass" defaultKeyStorePassword="cordacadevpass" sslkeyStorePassword="sslpass"␣
↪ssltrustStorePassword="sslpass"
```

- `secrets/notary/credentials/networkmappassword` - Contains password for networkmap:

```
sa="admin"
```

- `secrets/notary/credentials/rpcusers` - Contains password for rpc users:

```
notaryoperations="usera" notaryoperations1="usera" notaryoperations2="usera"␣
↪notaryadmin="usera"
```

- `secrets/notary/credentials/vaultroottoken` - Contains password for vault root token in the format:

```
rootToken="<vault.root_token>"
```

- `secrets/<org-name>/credentials/database` - Contains password for notary database for admin and user:

```
sa="newh2pass" <org-name>User1="xyz1234" <org-name>User2="xyz1236"
```

- `secrets/<org-name>/credentials/keystore` - Contains password for notary keystore:

```
keyStorePassword="newpass" trustStorePassword="newpass" defaultTrustStorePassword
↪"=trustpass" defaultKeyStorePassword="cordacadevpass" sslkeyStorePassword="sslpass"␣
↪ssltrustStorePassword="sslpass"
```

- `secrets/<org-name>/credentials/networkmappassword` - Contains password for networkmap:

```
sa="admin"
```

- `secrets/<org-name>/credentials/rpcusers` - Contains password for rpc users:

```
<org-name>operations="usera" <org-name>operations1="usera" <org-name>operations2=
↪"usera" <org-name>admin="usera"
```

- `secrets/<org-name>/credentials/vaultroottoken` - Contains password for vault root token in the format:

```
rootToken="<vault.root_token>"
```

The complete Certificate and key paths in the vault can be referred here

10.8.4 Certificate Paths on Vault for Corda Network

- Secrets engine kv path for each organization services (networkmap, doorman, notary, nodes) are enabled via the automation.

For Networkmap

For Doorman

For Notary organization

For Node/Peer Organization

10.8.5 Hyperledger Fabric Architecture Reference

Kubernetes

Peer Nodes

The following diagram shows how Hyperledger Fabric peer nodes will be deployed on your Kubernetes instance.

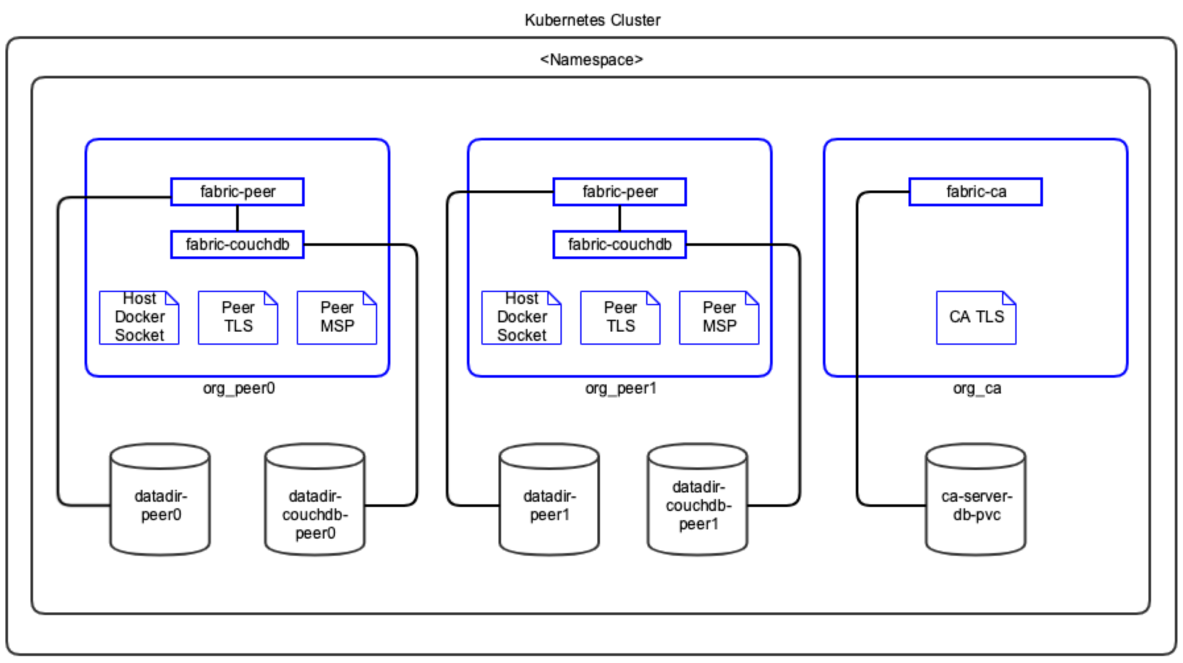


Figure: Hyperledger Fabric Kubernetes Deployment - Peers

Notes:

1. Pods are shown in blue in the diagram.
2. Each peer pod will have both `fabric-peer` and `fabric-couchdb` containers running. Since they are in the same pod, Kubernetes always schedules them on the same VM and they can communicate to each other through localhost. This guarantees minimal latency between them.
3. Host VM's Docker socket is attached to peer pod so it can create chaincode containers. Kubernetes is not aware of these containers.
4. TLS and MSP certificates are mounted as in-memory volumes from the *Vault*.
5. The storage uses a Kubernetes Persistent Volume.

Orderer Nodes

The following diagram shows how Hyperledger Fabric orderer will be deployed on your Kubernetes instance.

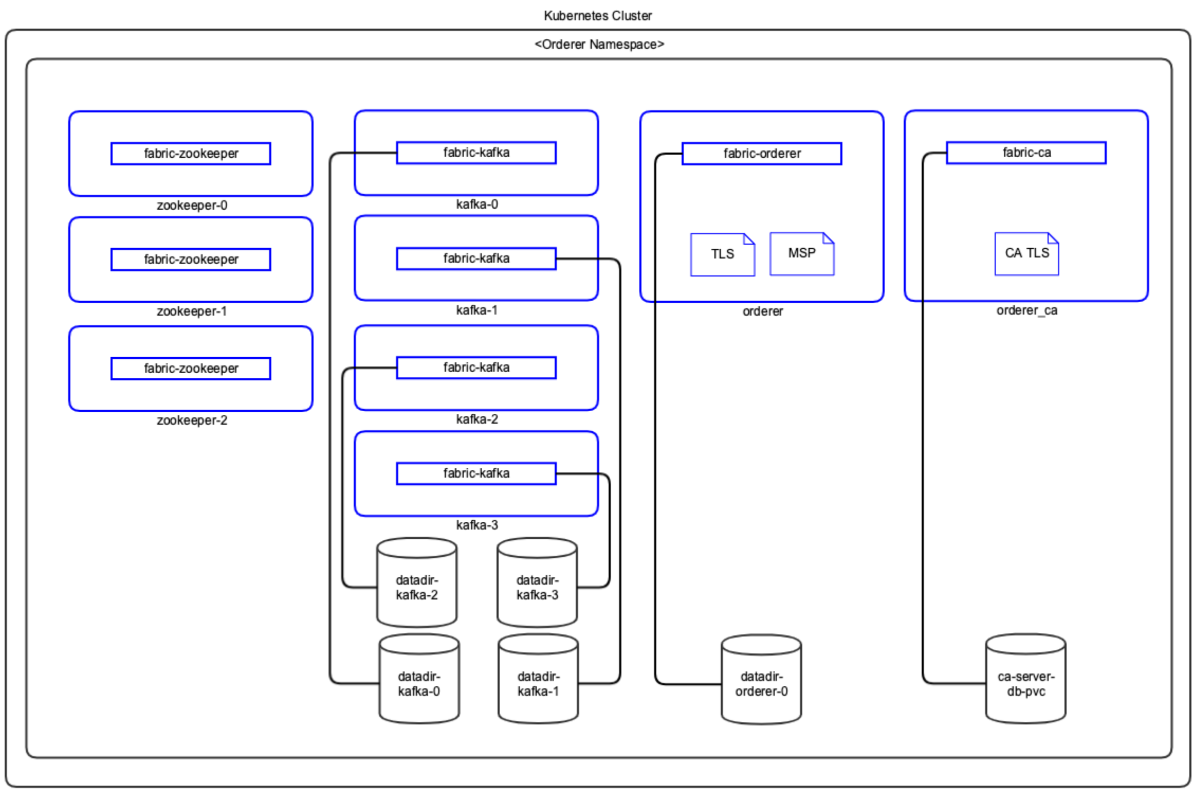


Figure: Hyperledger Fabric Kubernetes Deployment - Orderer

Notes:

1. Pods are shown in blue in the diagram.
2. TLS and MSP certificates are mounted as in-memory volumes from the *Vault*.
3. The storage uses a Kubernetes Persistent Volume.

Components

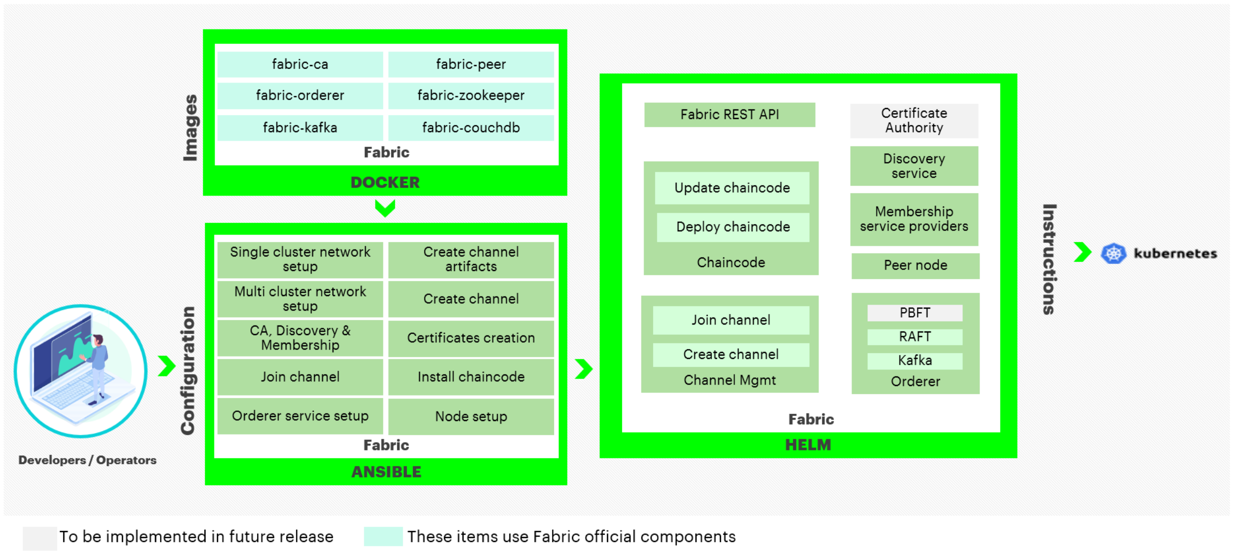


Figure: Hyperledger Fabric Components

Docker Images

Hyperledger Bevel uses the officially published Hyperledger Fabric Docker images from hub.docker.com. The following Hyperledger Fabric Docker Images are used by Hyperledger Bevel.

- fabric-ca - Hyperledger Fabric Certificate Authority
- fabric-couchdb - CouchDB for Hyperledger Fabric Peer
- fabric-kafka - Kafka for Hyperledger Fabric Orderer
- fabric-orderer - Hyperledger Fabric Orderer
- fabric-peer - Hyperledger Fabric Peer
- fabric-zookeeper - Zookeeper for Hyperledger Fabric Orderer

Ansible Playbooks

Detailed information on ansible playbooks can be referred *here* and the execution process can be referred *here*

Helm Charts

Detailed information on helm charts can be referred *here*

Vault Configuration

Hyperledger Bevel stores their `crypto` and `credentials` immediately within the secret secrets engine. Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

- `secretsv2/credentials/ordererOrganizations/<orderer-org>/ca` - Contains password for the Orderer CA Bootstrap user in the format:

```
user="${ORDERER_NAMESPACE}-adminpw
```

- `secretsv2/credentials/peerOrganizations/<org1>/ca` - Contains password for the Org Peers CA Bootstrap user in the format:

```
user="${NAMESPACE}-adminpw
```

- `secretsv2/credentials/peerOrganizations/<org1>/<peern>couchdb` - Contains the password for the Peer's CouchDB user in the format:

```
pass="${NAMESPACE}-peer-${n}-adminpw
```

The complete Certificate and key paths in the vault can be referred here.

10.8.6 Certificate Paths on Vault for Fabric Network

- Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

For each channel

For each orderer organization

For each peer organization

10.8.7 Hyperledger Indy Architecture Reference

Kubernetes

Peer Nodes

The following diagram shows how Hyperledger Indy peer nodes will be deployed on your Kubernetes instance.

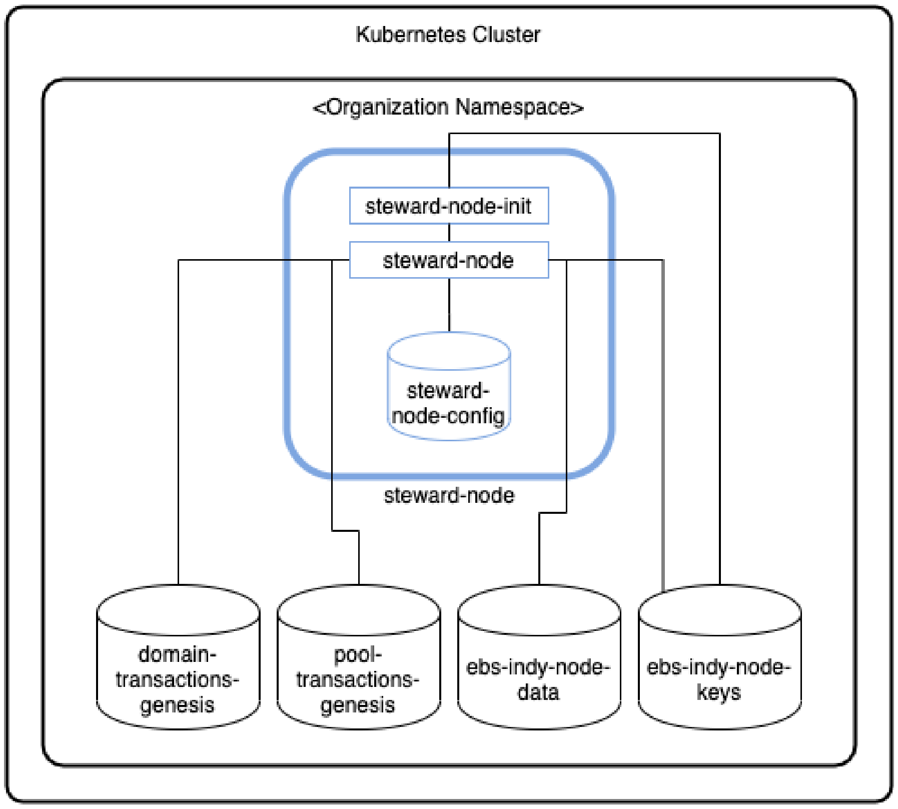


Figure: Hyperledger Indy Kubernetes Deployment - Peers

Notes:

1. Pods are shown in blue in the diagram.
2. Each StatefulSet will have `steward-node-init` for initialization (read crypto from Vault) and `steward-node` containers running. Since they are in the same pod, Kubernetes always schedules them on the same VM and they can communicate to each other through localhost. This guarantees minimal latency between them.
3. The storage uses a Kubernetes Persistent Volume.

Components

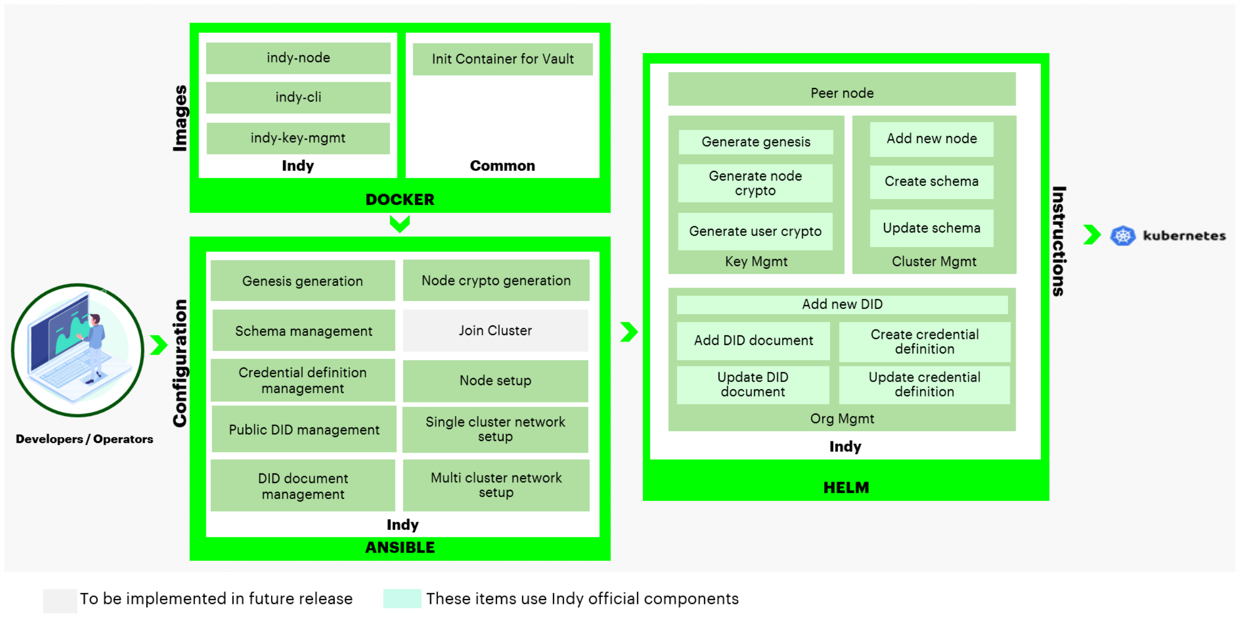


Figure: Hyperledger Indy Components

Docker Images

Hyperledger Bevel creates/provides own Docker images, which are based on Ubuntu and consist with official Hyperledger Indy libraries (indy-plenum and indy-node).

- indy-cli - Docker image contains Indy CLI, which is used to issue transactions again an Indy pool.
- indy-key-mgmt - Docker image for indy key management, which generates identity crypto and stores it into Vault or displays it onto the terminal in json format.
- indy-node - Docker image of an Indy node (runs using a Steward identity).

Ansible Playbooks

Detailed information on ansible playbooks can be referred *here* and the execution process can be referred *here*.

Helm Charts

Detailed information on helm charts can be referred *here*.

Vault Configuration

Hyperledger Bevel stores their `crypto` immediately within the secret secrets engine. The `crypto` is stored by each organization under `/org_name_lowercase` - it contains provate/public keys, dids and seeds.

The complete key paths in the vault can be referred here.

10.8.8 Certificate Paths on Vault for Indy Network

For each organization

10.8.9 Quorum Architecture Reference

Kubernetes

Nodes with Tessera

The following diagram shows how Quorum peer nodes with Tessera TM will be deployed on your Kubernetes instance.

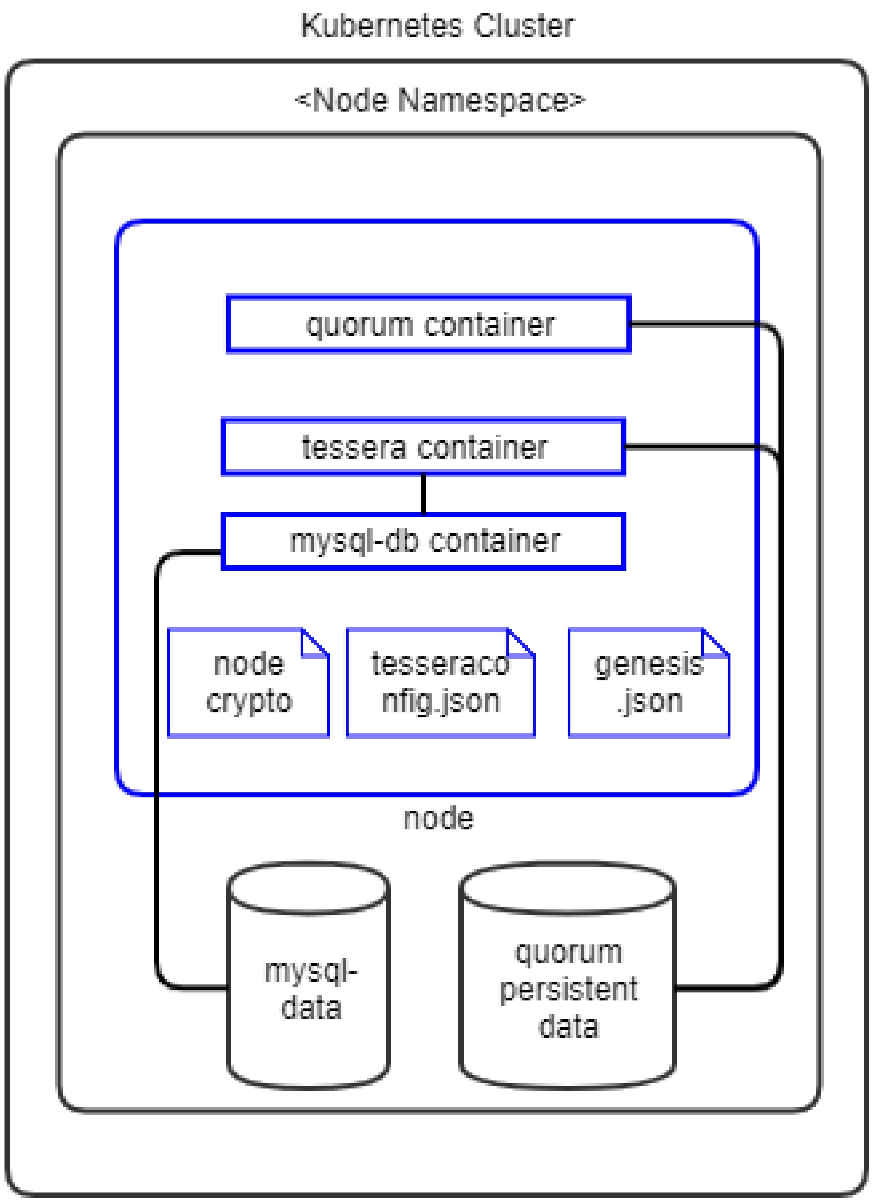


Figure: Quorum Kubernetes Deployment - Tessera Peers

Notes:

1. Pods are shown in blue in the diagram.
2. Each peer pod will have three init-containers: `certificates-init` to read crypto from Vault, `mysql-init` to initialize MySQL DB and `quorum-genesis-init-container` to generate genesis block.
3. Each peer pod will then have three containers: `mysql-db`, `tessera` and `quorum` containers running. Since they are in the same pod, Kubernetes always schedules them on the same VM and they can communicate to each other through localhost. This guarantees minimal latency between them.
4. The storage uses a Kubernetes Persistent Volume.

Nodes with Constellation

The following diagram shows how Quorum peer nodes with Constellation TM will be deployed on your Kubernetes instance.

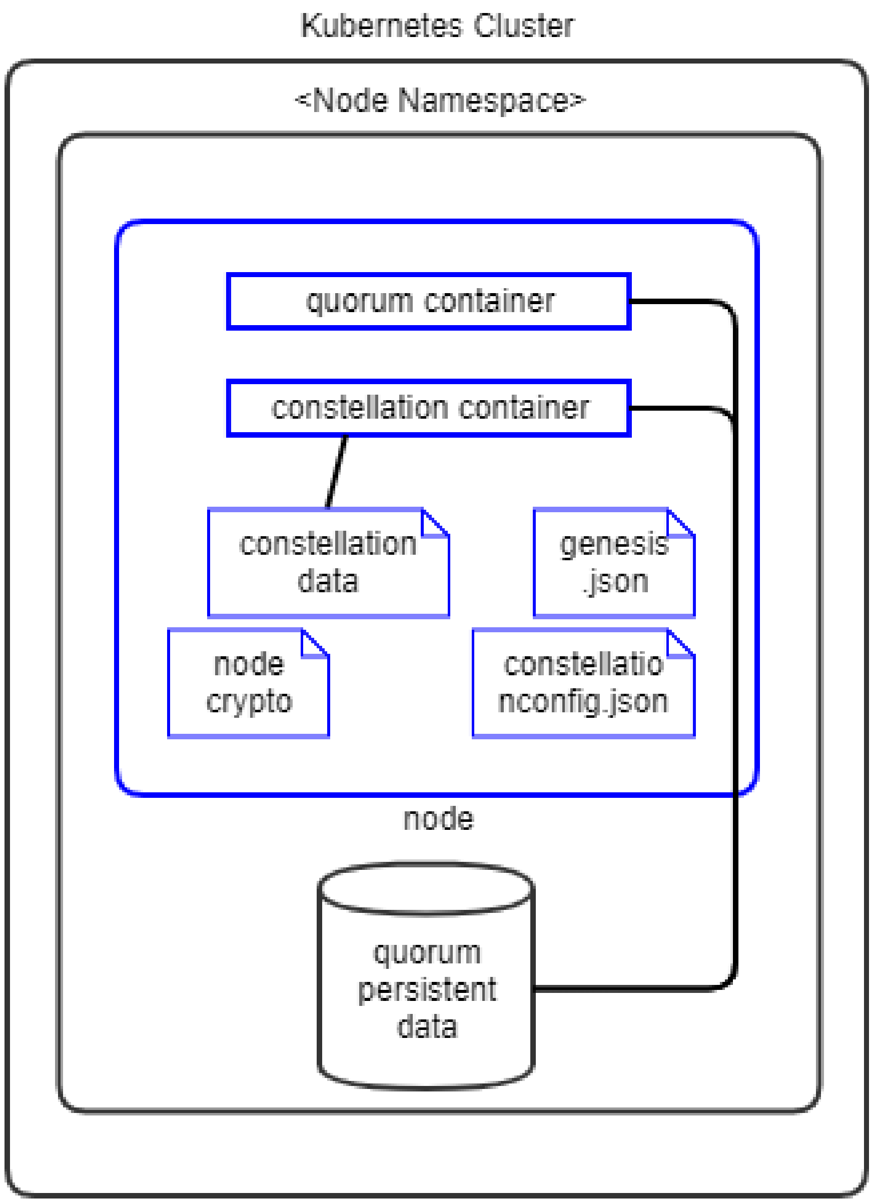


Figure: Quorum Kubernetes Deployment - Constellation Peers

Notes:

1. Pods are shown in blue in the diagram.
2. Each peer pod will have two init-containers: `certificates-init` to read crypto from Vault and `quorum-genesis-init-container` to generate genesis block.
3. Each peer pod will then have two containers: `constellation` and `quorum` containers running. Since they are in the same pod, Kubernetes always schedules them on the same VM and they can communicate to each other through localhost. This guarantees minimal latency between them.
4. The storage uses a Kubernetes Persistent Volume.

Components

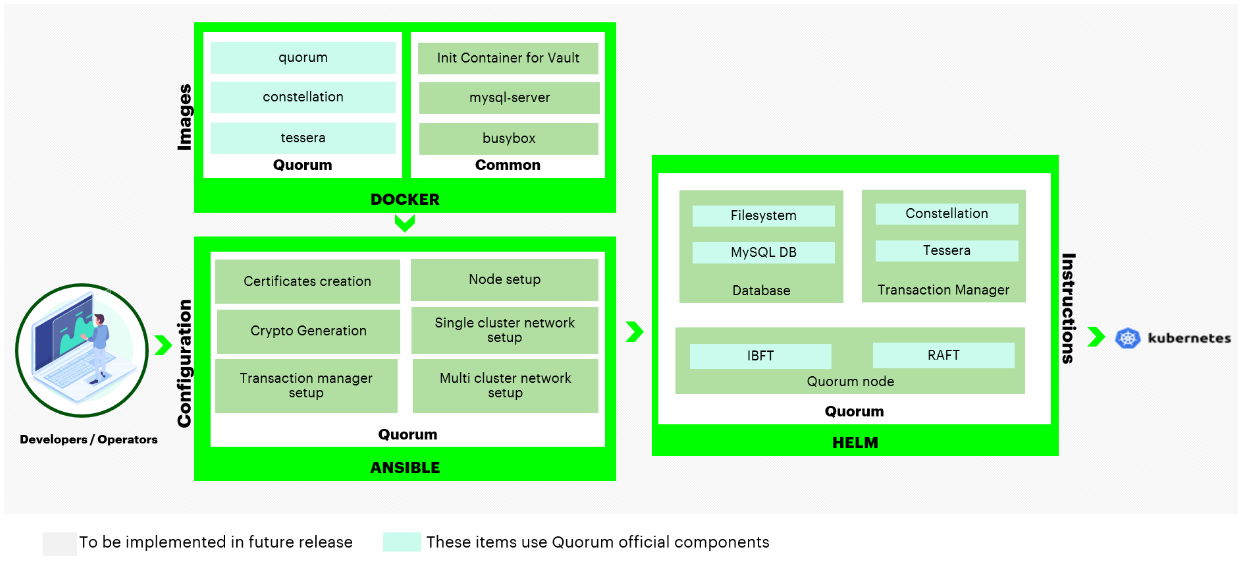


Figure: Quorum Components

Docker Images

Hyperledger Bevel uses the officially published Quorum Docker images from hub.docker.com. The following Quorum Images are used by Hyperledger Bevel.

- quorum - Quorum Peer Node
- tessera - Tessera Transaction Manager
- constellation - Constellation Transaction Manager

Additionnally, following common images are also used:

- busybox - Used for DB initialtization
- mysql-server - Used as the DB for Tessera Transaction Manager
- alpine-utils - Used as a utility to get crypto from Hashicorp Vault server

Ansible Playbooks

Detailed information on ansible playbooks can be referred *here* and the execution process can be referred *here*.

Helm Charts

Detailed information on helm charts can be referred *here*.

Vault Configuration

Hyperledger Bevel stores their `crypto` immediately in the Hashicorp Vault secrets engine. The crypto is stored by each organization under path `secretsv2/org_namespace` - it contains node keys, keystore, passwords, TM keys, and CA certificates for proxy connections. Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

The complete key paths in the Vault can be referred here.

10.8.10 Certificate Paths on Vault for Quorum Network

- Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

For IBFT/ RAFT

For Tessera/Constellation

For Root Certificates

Details of Variables

10.8.11 Hyperledger Besu Architecture Reference

Kubernetes

Nodes with Orion Transaction Manager

The following diagram shows how Besu peer nodes with Orion TM will be deployed on your Kubernetes instance.

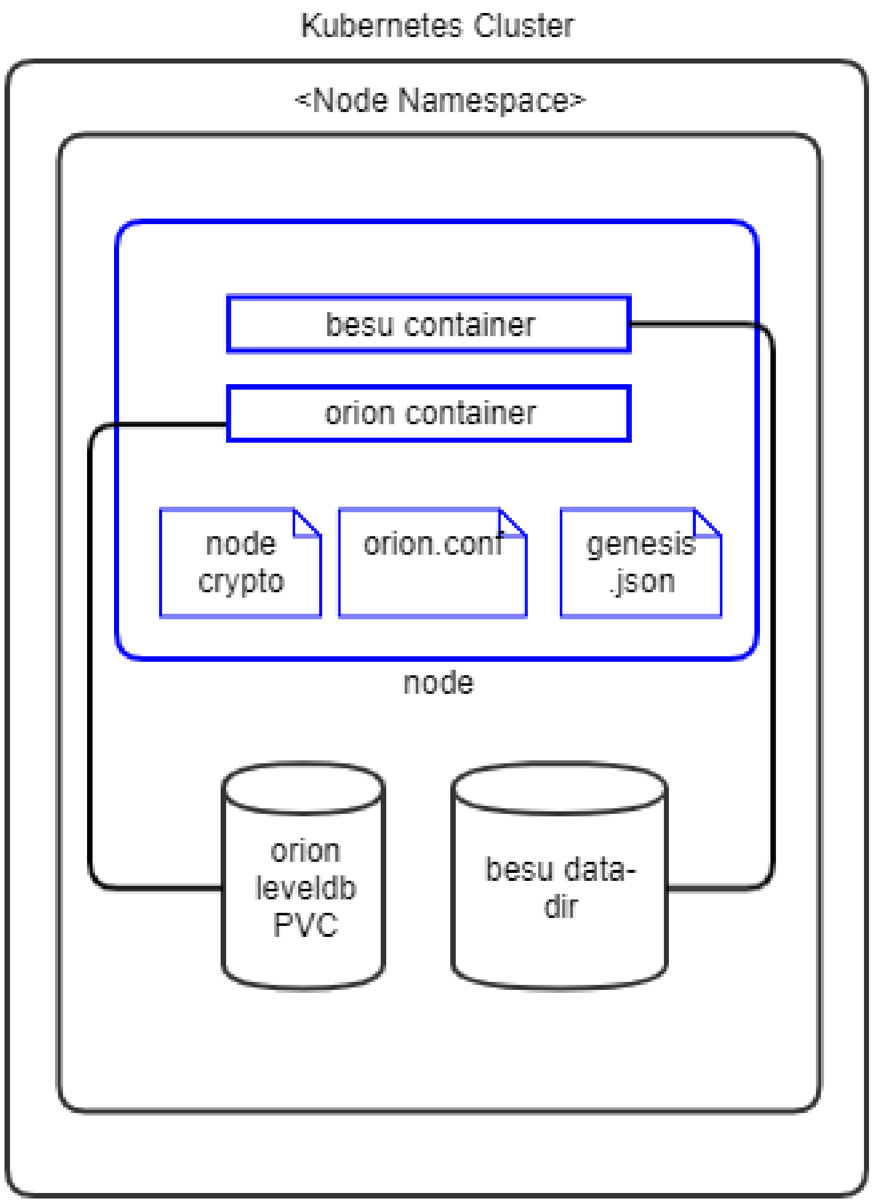


Figure: Hyperledger Besu Kubernetes Deployment - Orion Peers

Notes:

1. Pods are shown in blue in the diagram.
2. Each peer pod will have two init-containers: `certificates-init` to read crypto from Vault and `liveness-check` to check that if the bootnode endpoint is available, only when bootnode is used.
3. Each peer pod will then have two containers: `orion` and `besu` running. Since they are in the same pod, Kubernetes always schedules them on the same VM and they can communicate to each other through localhost. This guarantees minimal latency between them.
4. The storage uses a Kubernetes Persistent Volume.
5. In future releases, the levelDB PVC will be replaced by a containerised database.

Validator Nodes

The following diagram shows how Besu Validator nodes will be deployed on your Kubernetes instance.

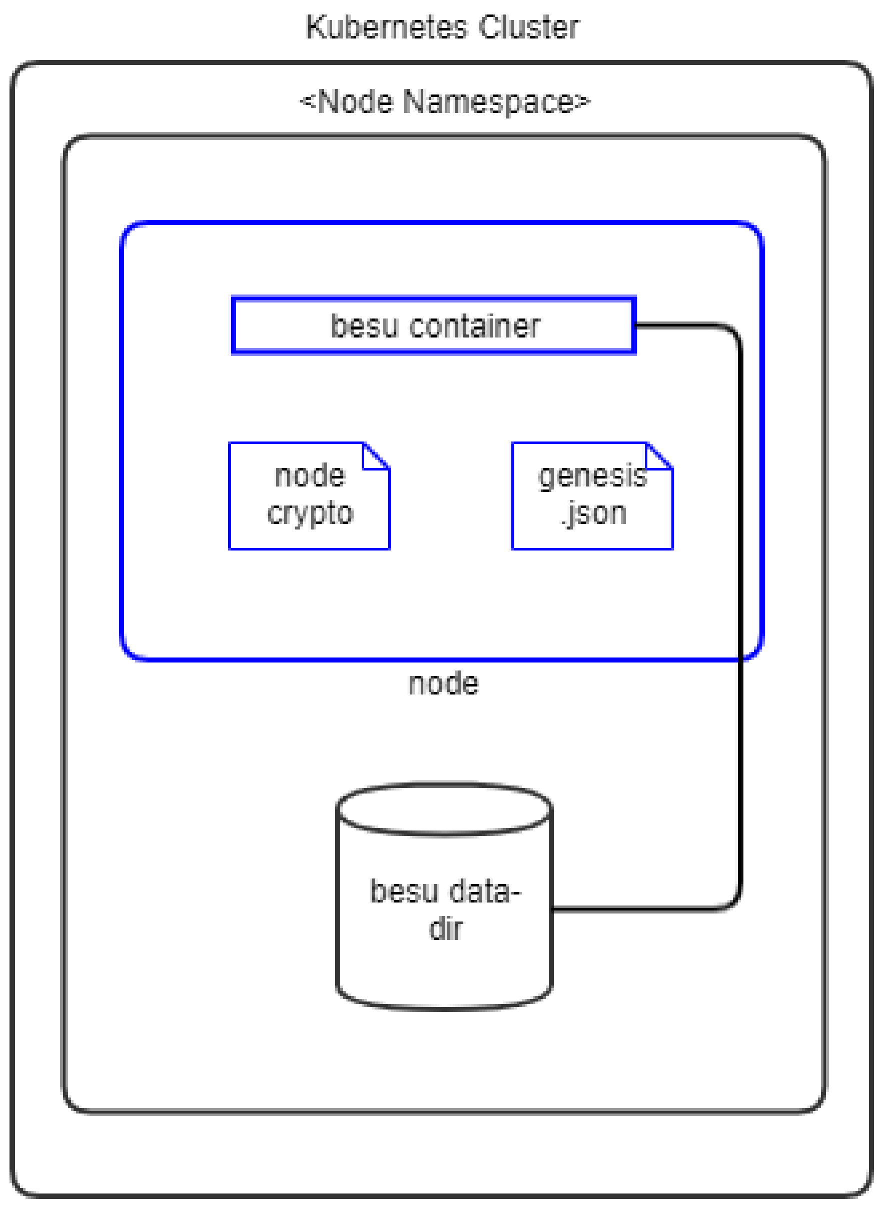


Figure: Hyperledger Besu Kubernetes Deployment - Validators

Notes:

1. Pods are shown in blue in the diagram.
2. Each peer pod will have one init-containers: `certificates-init` to read crypto from Vault.
3. Each peer pod will then have one container `besu` running.
4. The storage uses a Kubernetes Persistent Volume for storing the besu data-dir.

Components

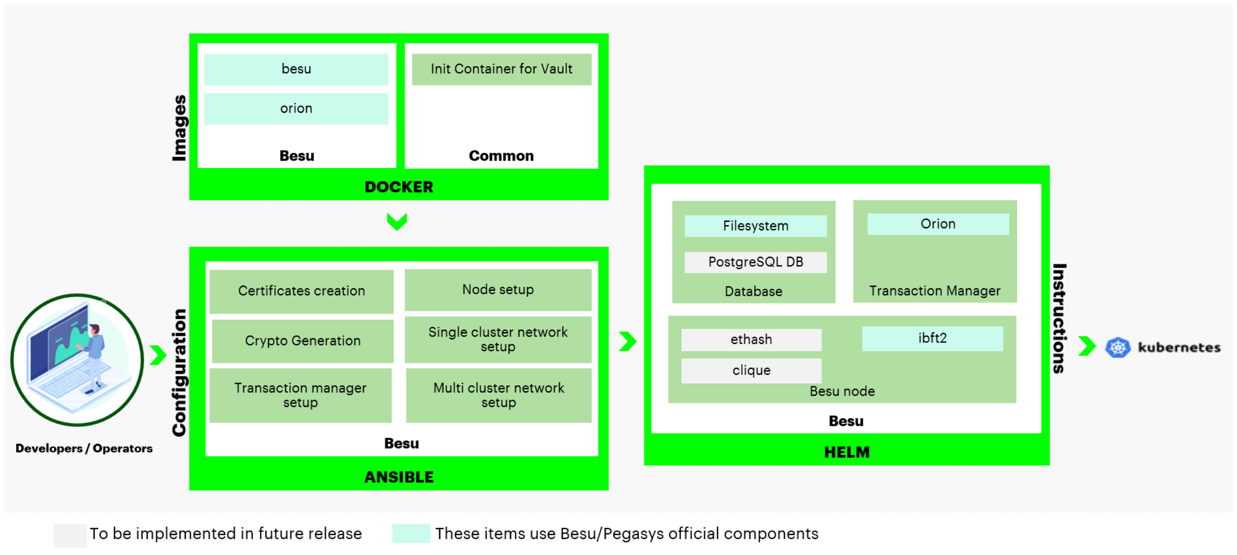


Figure: Hyperledger Besu Components

Docker Images

Hyperledger Bevel uses the officially published Besu Docker images from hub.docker.com. The following Besu Images are used by Hyperledger Bevel.

- besu - Besu Peer and Validator Node
- orion - Orion Transaction Manager

Additionally, following common images are also used:

- alpine-utils - Used as a utility to get crypto from Hashicorp Vault server

Ansible Playbooks

Detailed information on ansible playbooks can be referred *here* and the execution process can be referred *here*.

Helm Charts

Detailed information on helm charts can be referred *here*.

Vault Configuration

Hyperledger Bevel stores their `crypto` immediately in the Hashicorp Vault secrets engine. The crypto is stored by each organization under path `secretsv2/org_namespace` - it contains node keys, keystore, passwords, TM keys, and CA certificates for proxy connections. Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

The complete key paths in the Vault can be referred here.

10.8.12 Certificate Paths on Vault for Hyperledger Besu Network

- Optionally, `secret_path` can be set on the network.yaml to change the secret engine from the default `secretsv2/`.

For IBFT2 WIP

For Orion

For Root Certificates

Details of Variables

CHAPTER 11

Commands Reference

Below are various debugging commands that can be used

11.1 Kubectl related debugging

- To setup KUBECONFIG environment variable

```
export KUBECONFIG=PATH_TO_CLUSTER_KUBECONFIG_FILE
Ex. export KUBECONFIG=~/.kube/config
/root/.kube/config is the default KUBECONFIG path
```

- To check the cluster config file being used

```
kubectl config view
```

- To check the current context

```
kubectl config current-context
```

- To get all pods in a namespace

```
kubectl get pods -n NAMESPACE
Ex. kubectl get pods -n supplychain-net
```

- To get all pods in a cluster

```
kubectl get pods --all-namespaces
```

- To check description of resource type (pod/service/pvc/HelmRelease)

```
kubectl describe RESOURCE_TYPE RESOURCE_NAME -n NAMESPACE
Ex. kubectl describe pvc ca-server-db-svc -n carrier-net
Ex. kubectl describe sa vault-reviewer -n carrier-net
```

- To check logs of pod

```
kubectl logs POD_NAME -n NAMESPACE
Ex. kubectl logs flux-dev-123r45 -n default
```

- To check logs of container within a pod

```
kubectl logs POD_NAME -c CONTAINER_NAME -n NAMESPACE
Ex. kubectl logs ca-123r45 -c ca-certs-init -n carrier-net
```

- To execute a command in a running pod

```
kubectl exec POD_NAME -n NAMESPACE -- COMMAND_TO_EXECUTE
Ex. kubectl exec ca-tools-12345 -n carrier-net -- ls -a
```

- To execute a command in a container of a pod

```
kubectl exec POD_NAME -c CONTAINER_NAME -n NAMESPACE -- COMMAND_TO_EXECUTE
Ex. kubectl exec ca-tools-12345 -c ca-tools -n carrier-net -- ls -a
```

11.2 Vault related debugging

- To access vault

```
export VAULT_ADDR=
export VAULT_TOKEN=
vault read PATH_IN_VAULT
Ex. vault read secretsv2/crypto/ordererOrganizations/carrier-net/ca/carrier-net-
↪CA.key
```

- To list all enabled secrets engines with detailed output

```
vault secrets list -detailed
```

- To enable an auth method at a given path

```
vault auth enable -path PATH
Ex. vault auth enable -path authpath
```

- To delete data on a given path in the key/value secrets engine

```
vault kv delete PATH
Ex. vault kv delete secretsv2/creds
```

11.3 Helm related debugging

- To list down all helm releases

```
helm ls
```

- To delete an existing helm installation

```
helm uninstall HELM_RELEASE_NAME -n NAMESPACE
Ex. helm uninstall carrier-ca -n carrier-ns
```

11.4 Docker related debugging

- To login to docker registry

```
docker login --username USERNAME --password PASSWORD URL
Ex. docker login --username abcd --password abcd ghcr.io/hyperledger
```

- To pull images from docker registry

```
docker pull IMAGE_NAME:TAG
Ex. docker pull alpineutils:1.0
```

- To push images to docker registry

```
docker push IMAGE_NAME:TAG
Ex. docker push alpineutilstest:1.0
```

- To build an image from Dockerfile

```
cd FOLDER_TO_DOCKERFILE
docker build -t IMAGE_NAME:TAG -f DOCKERFILE_PATH PATH_TO_BUILD_CONTEXT
Ex. docker build -t alpineutilstest:1.0 -f Dockerfile .
```

11.5 Quorum related debugging

To login to a quorum node

```
kubectl exec -it POD_NAME -n POD_NAMESPACE -c quorum -- geth attach "http://
↪localhost:RPC_PORT"
Ex. kubectl exec -it carrier-0 -n carrier-ns -c quorum -- geth attach "http://
↪localhost:8546"
```

Get all the paritipants present in the network after logging into the node (for raft consensus based cluster)

```
raft.cluster
```

Get node information (after logging into the node)

```
admin.nodeInfo
```

Get the peers attached to the current node (after loggin into the node)

```
admin.peers
```

Get the account details (after logging into the node)

```
eth.accounts
```

Get retrieves the list of authorized validators at the specified block (for ibft consensus based cluster)

```
istanbul.getValidators(blockHashOrBlockNumber)
```

11.6 Indy related debugging

To access indy cli, in any terminal

```
 indy-cli
```

To create a pool

```
 pool create local-pool gen_txn_file=<path of the genesis file>
```

To connect the pool

```
pool connect <pool name>
```

To create a wallet

```
wallet create <wallet name> <key>
```

To open a wallet

```
wallet open <wallet name> <key>
```

To list the wallets

```
wallet list
```

To delete a wallet

```
wallet delete <wallet name>
```

To create a new did

```
did import <did file>
```

```
did new
```

To create a pool

```
pool create <pool name> gen_txn_file=<pool_genesis_path>
```

To open a pool

```
pool connect <pool name>
```

To list the pool

```
pool list
```

To execute a transaction on ledger

```
ledger nym did=<did name> verkey=<key detail> role=<role name>
```

To get the transaction details

```
ledger get-nym did=<did name>
```

CHAPTER 12

Frequently Asked Questions

12.1 1.FAQs for Getting Started

12.1.1 Who are the target users?

In this project, it is assumed that a user would fall into either a category of *Operators* or *Developers*. However, this is not saying that technicians such as Solution/Tech Archs who have more expertise in wider areas are not eligible users, e.g. Blockchain or Distributed Ledger Technology (DLT). On the contrary, a user who has proper technical knowledge on those areas will find the usage of Hyperledger Bevel repository mentioned in the tutorial on this website to be more straightforward. For people new to these areas, they might find a deep learning curve before using or even contributing back to this repository. If a user is from a non-tech background, but would still like to find out how Bevel could accelerate set-up of a new production-scale DLT network, the *Introduction* section is the right start point.

(1) **Operators**: An operator is a System Operator that would work as a Deployment Manager, who has strong technical knowledge on cloud architecture and DevOps but basic DLT. An operator might be a decision maker in a new DLT/Blockchain project, and would be responsible for the ongoing stability of the organization's resources and services as well as set-up and maintenance of one or more applications for the organization.

A **common scenario** that an operator would like to leverage Hyperledger Bevel repository might be that s/he has been asked to use a DLT/Blockchain technology for a business case, but s/he does not know where/how to start. S/he might have limited budget, and might not have all the technical skills in the team and was overwhelmed by the time it would take for the solution to be created.

Unique values in scenarios like this provisioned by Hyperledger Bevel repository are: (a) efficiency and rapid deployment (b) consistent quality (c) open-source (d) cloud infrastructure independence (e) optimization via scalability, modularity and security and (f) accelerated go-to-market.

Essentially, an operator would be able to set up a large-size DLT/Blockchain network in a production environment by using this repository as per the tutorials in this website along with the instructions in the readme files in the repository. The network requirements such as which DLT/Blockchain platform (e.g. Fabric/Corda) and which cloud platform (e.g. AWS/GCP/Azure/DigitalOcean etc) would be used should have been pre-determined already before using this repository. The operator would ensure that Hyperledger Bevel repo is set up and deployed properly. Eventually, Bevel would speed up the whole DLT/Blockchain network set-up process and would require less DLT/Blockchain developers enabling the operator to retain the budgets and man-power for other activities.

(2) **Developers**: A developer can be a DevOps or Full Stack Developer who would have knowledge on multiple programming languages, basic knowledge of DLT/Blockchain networks and smart contracts, Ansible and DevOps. Daily work might include developing applications and using DevOps tools.

A **common scenario** that a developer would like to use this repo might be that s/he would like to gain knowledge on production-scale DLT/Blockchain development, but might not have enough technical skills and experiences yet. Learing knowledge from the existing poorly-designed architecture would be time-consuming and fruitless.

Hyperledger Bevel provisions its **unique values** to the developer that s/he now has an opportunity to learn how different sets of cutting-edge technologies leveraged in this repository are combined in use such as reusable architecture patterns, reusable assets including APIs or microservices design. The architecture design in this repository has been fully tested and demonstrated as a high-quality one known for a fact that it has been being improved continously through the technical experts' rich experiences. The developer could try to use this repository to set up a small-size DLT/Blockchain network to see how it works and gradually pick up new skills across Blockchain, DevOps, etc.

Furthermore, the developer could even show the maturity of skills to contribute back to this project. Contributions can include but not limited to (1) suggest or add new functionalities (2) fix various bugs and (3) organize hackthon or developer events for Hyperledger Bevel in the future.

12.1.2 What is Hyperledger Bevel and how could it help me?

In simple words, Hyperledger Bevel works as an accelerator to help organizations set up a production-scale DLT network (currently supports Corda, Fabric, Indy, Besu and Quorum) with a single network.yaml file used for *Fabric* or *Corda* or *Quorum* to be configured in this project. It can work in managed Kubernetes Clusters which has been fully tested in AWS Elastic Kubernetes Services (EKS), and should also work in a non-managed Kubernetes Cluster in theory. For detailed information, please see the *Welcome page*.

12.1.3 How do I find more about Hyperledger Bevel?

Normally, when a user sees information in this section, it means that s/he has already known the existence of Hyperledger Bevel project, at least this readthedocs website. Basically, this website provisions a high-level background information of how to use Hyperledger Bevel GitHub repository. For detailed step-by-step instructions, one should go to Hyperledger Bevel's GitHub repository and find the readme files for a further reading. Upon finishing reading the tutorials in this website, one should be able to analyse whether Hyperledger Bevel would be the right solution in your case and reach a decision to use it or not.

12.1.4 How much would Hyperledger Bevel cost? How much would it cost to run Hyperledger Bevel on a cloud platform?

As an open source repository, there will be no cost at all to use Hyperledger Bevel. However, by running Hyperledger Bevel repository on a cloud platform, there might be cost by using a cloud platform and it will depend on which cloud services you are going to use.

12.1.5 Who can support me during this process and answer my questions?

One could raise questions in the Github repository and Hyperledger Bevel maintainers will give their best supports at early stages. Later on, when the open community matures, one would expect to get support from people in the community as well.

12.1.6 Is there any training provided? If so, what kind of training will be included?

Unfortunately, there are no existing training for using Hyperledger Bevel yet, because we are not sure about the potential size of the community and what types of training people would look forward to. However, we do aware that trainings could happen, if there would be a large number of same or similar questions or issues raised by new users, and if we would have a large amount of requests like this in the future.

12.1.7 Can I add/remove one or more organisations as DLT nodes in a running DLT/Blockchain network by using Hyperledger Bevel?

Yes, you can add additional nodes to a running DLT/Blockchain network using Hyperledger Bevel . Unfortunately, Bevel does not support removing nodes in a running DLT/Blockchain network, but this significant feature is in our future roadmap, and we will add this feature in a future release.

12.1.8 Does Hyperledger Bevel support multiple versions of Fabric and Corda? What are the minimum versions for Fabric and Corda supported in Hyperledger Bevel?

Hyperledger Bevel currently only supports version 1.4.8 & 2.2.2 for Fabric and version 4.1 and 4.4 for Corda as minimum versions, and will only support future higher versions for Fabric and Corda. Corda Enterprise 4.7 is available as per latest release. Please check the latest releases for version upgrades and deprecations.

12.2 2.FAQs for Operators Guide

12.2.1 What is the minimal infrastructure set-up required to run Hyperledger Bevel?

To run Hyperledger Bevel repository, you need to have a managed/non-managed Kubernetes clusters ready as well as an unsealed Hashicorp Vault service available.

12.2.2 What would be the recommended/required cloud service?

We recommand to use Cloud Services such as Aamzon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP) and DigitalOcean (DO) as their managed Kubernetes clusters services are being or will be tested for this repository. We have fully tested this repository in AWS, and testing it on Azure, GCP, DO is in our future roadmap.

12.2.3 Do I have to use AWS?

No, AWS is not mandatory, but is recommended because it is the first cloud platform we have tested on. Theoretically, Hyperledger Bevel repository should work in any cloud platforms as long as a Kubernetes Cluster service is provisioned, but there is no 100% guarantee it will work, since there might be unseen/unknown features in these managed Kubernetes clusters environments we are not aware of.

12.2.4 Are there any pre-requisites to run Hyperledger Bevel?

Yes, you can find them on this *page*.

12.2.5 How to configure HashiCorp Vault and Kubernetes?

Please see this *page* for details.

12.2.6 I'm using Windows machine, can I run Hyperledger Bevel on it?

Hyperledger Bevel repository relies a lot on using Ansible, which might not work in Windows machines. Please check Ansible website for more information.

12.2.7 How do I configure a DLT/Blockchain network?

The network.yaml file is the main file to be configured to set up a DLT/Blockchain network. *This page* gives the links for a user to pick up knowledge of how to configure this file for Fabric and Corda first (see the two "Configuration file specification" sections for each DLT/Blockchain platform). Having this knowledge will then enable a user to understand how to use this file in the "Setting up DLT network" section.

12.2.8 How can I test whether my DLT/Blockchain network are configured and deployed correctly?

Please see this *page* for detials.

12.2.9 How/Where can I request for new features, bugs and get feedback?

One could request a new feature on the Github repository for now. In the future, people might use Jira or Slack to do the same as well.

12.2.10 Are CI/CD pipeline tools a mandatory to use Hyperledger Bevel?

No, CI/CD pipeline tools like Jenkins are not mandatory, but it could help a user automate the set-up or testing of a new DLT/Blockchain network in different environments, once a user has a good understanding of using it. We have the main Jenkinsfile in `automation` folder which can be taken as a template.

12.2.11 Is it required to run Ansible in a particular machine like AWS EC2?

No, a user should be able to run the Ansible command on any machine as long as Ansible command CLI is installed.

12.2.12 Is there an example ansible_hosts file?

Yes, you can find an example ansible_hosts file here. The configuration in this file means that all Ansible commands will be run in the same machine that works as both an Ansible client and server machine.

12.2.13 Can I specify the tools versions such as kubectl, helm in this project?

Yes, you can specify tools versions like kubectl, helm, HashiCorp Vault, AWS-authenticator in the playbook environment-setup.yaml.

12.2.14 How would system react if we plan to update tools versions (e.g. kubectl, helm)?

Honestly speaking, we don't know. The latest version Hyperledger Bevel has been tested on specific client versions of these tools, see below: (1) Kubectl: v1.14.2 for Kubernetes 1.14, v1.16.13 for Kubernetes 1.16, v1.19.8 for Kubernetes 1.19 (2) Helm: v3.6.2 (3) HashiCorp Vault: v1.7.1 (4) AWS-Authenticator: v1.10.3

It is assumed that newer versions of these tools would be backward compatible, which is beyond our control. One can raise a new ticket to Hyperledger Bevel GitHub repository, if any major updates would break the system down.

12.2.15 Why does the Flux K8s pod get a permission denied for this Hyperledger Bevel GitHub repository?

This usually means that the private key that you have used in your network.yaml for gitops does not have access to the GitHub repository. The corresponding public key must be added to your GitHub Account (or other git repository that you are using). Details can be found here.

12.2.16 Why does the flux-helm-operator keep on reporting "Failed to list *v1beta1.HelmRelease: the server could not find the requested resource (get helmreleases.flux.weave.works)"?

The HelmRelease CustomResourceDefinition (CRD) was missing from the cluster, according to https://github.com/fluxcd/flux, the following command has to be used to deploy it:

```
kubectl apply -f https://raw.githubusercontent.com/fluxcd/flux/helm-0.10.1/deploy-
↪helm/flux-helm-release-crd.yaml
```

12.3 3.FAQs for Developer Guide

12.3.1 How do I contribute to this project?

- Guide on Bevel *contribution*
- Details on creating pull request on github can be found in this link.

12.3.2 Where can I find Hyperledger Bevel's coding standards?

TBD

12.3.3 How can I engage in Hyperledger Bevel community for any events?

Connect us on Bevel Discord Channel Discord Chat

CHAPTER 13

Glossary

13.1 General

This sections lists the general terms that are used in Hyperledger Bevel.

13.1.1 Ansible

Ansible is an open-source software provisioning, configuration management, and application-deployment tool. It runs on many Unix-like systems, and can configure both Unix-like systems as well as Microsoft Windows. It includes its own declarative language to describe system configuration. For more details, refer: Ansible

13.1.2 AWS

Amazon Web Services is a subsidiary of Amazon that provides on-demand cloud computing platforms to individuals, companies, and governments, on a metered pay-as-you-go basis. For more details, refer: AWS

13.1.3 AWS EKS

Amazon Elastic Container Service for Kubernetes (Amazon EKS) is a managed service that makes it easy for users to run Kubernetes on AWS without needing to stand up or maintain your own Kubernetes control plane. Since Amazon EKS is a managed service it handles tasks such as provisioning, upgrades, and patching. For more details, refer: EKS

13.1.4 Blockchain as a Service (BaaS)

Blockchain-as-a-Service platform is a full-service cloud-based solution that enables developers, entrepreneurs, and enterprises to develop, test, and deploy blockchain applications and smart contracts that will be hosted on the BaaS platform.

13.1.5 Charts

Helm uses a packaging format called charts. A chart is a collection of files that describe a related set of Kubernetes resources. A single chart might be used to deploy something simple, like a memcached pod, or something complex, like a full web app stack with HTTP servers, databases, caches, and so on. For more details, refer: Helm Charts

13.1.6 CI/CD

CI and CD are two acronyms that are often mentioned when people talk about modern development practices. CI is straightforward and stands for continuous integration, a practice that focuses on making preparing a release easier. But CD can either mean continuous delivery or continuous deployment, and while those two practices have a lot in common, they also have a significant difference that can have critical consequences for a business.

13.1.7 CLI

A command-line interface (CLI) is a means of interacting with a computer program where the user (or client) issues commands to the program in the form of successive lines of text (command lines).

13.1.8 Cluster

In Kubernetes, a cluster consists of at least one cluster Main node and multiple worker machines called nodes. For more details, refer: Cluster

13.1.9 Deployment

Software deployment is all of the activities that make a software system available for use. The general deployment process consists of several interrelated activities with possible transitions between them. These activities can occur at the producer side or at the consumer side or both.

13.1.10 DLT

Distributed Ledger Technology (DLT) is a digital system for recording the transaction of assets in which the transactions and their details are recorded in multiple places at the same time. Unlike traditional databases, distributed ledgers have no central data store or administration functionality. For more details, refer: DLT

13.1.11 Docker

Docker is a set of platform-as-a-service products that use OS-level virtualization to deliver software in packages called containers. Containers are isolated from one another and bundle their own software, libraries and configuration files; they can communicate with each other through well-defined channels. For more details, refer: Docker

13.1.12 Flux

Flux is the operator that makes GitOps happen in a cluster. It ensures that the cluster config matches the one in git and automates your deployments. Flux enables continuous delivery of container images, using version control for each step to ensure deployment is reproducible, auditable and revertible. Deploy code as fast as your team creates it, confident that you can easily revert if required. For more details, refer: Flux

13.1.13 Git

Git is a distributed version-control system for tracking changes in source code during software development. It is designed for coordinating work among programmers, but it can be used to track changes in any set of files. Its goals include speed, data integrity, and support for distributed, non-linear workflows For more details, refer: GIT

13.1.14 Gitops

GitOps is a method used for Continuous Delivery. It uses Git as a single source of truth for infrastructures like declarative infrastructure and the applications. For more details, refer: Gitops

13.1.15 HashiCorp Vault

HashiCorp Vault is a tool for securely accessing secrets. A secret is anything that you want to tightly control access to, such as API keys, passwords, or certificates. Vault provides a unified interface to any secret, while providing tight access control and recording a detailed audit log. For more details, refer: Vault

13.1.16 HashiCorp Vault Client

A Vault client is any stand-alone application or integrated add-in that connects to the vault server to access files and perform vault operations.

13.1.17 Helm

Helm is the first application package manager running atop Kubernetes. It allows describing the application structure through convenient helm-charts and managing it with simple commands. For more details, refer: Helm

13.1.18 Hosts

A Host is either a physical or virtual machine.

13.1.19 IAM user

An AWS Identity and Access Management (IAM) user is an entity that you create in AWS to represent the person or application that uses it to interact with AWS. A user in AWS consists of a name and credentials. For more details, refer: IAM Users

13.1.20 IOT

The Internet of Things is simply “A network of Internet connected objects able to collect and exchange data.” It is commonly abbreviated as IoT. In a simple way to put it, You have “things” that sense and collect data and send it to the internet. For more details, refer: IOT

13.1.21 Instance

A “cloud instance” refers to a virtual server instance from a public or private cloud network. In cloud instance computing, single hardware is implemented into software and run on top of multiple computers.

13.1.22 Jenkins

Jenkins is a free and open source automation server written in Java. Jenkins helps to automate the non-human part of the software development process, with continuous integration and facilitating technical aspects of continuous delivery. For more details, refer: Jenkins

13.1.23 Jenkins Stages

A stage block in Jenkins defines a conceptually distinct subset of tasks performed through the entire Pipeline (e.g. "Build", "Test" and "Deploy" stages), which is used by many plugins to visualize or present Jenkins Pipeline status/progress.

13.1.24 Kubeconfig File

A kubeconfig file is a file used to configure access to Kubernetes when used in conjunction with the kubectl command line tool (or other clients). This is usually referred to an environment variable called KUBECONFIG.

13.1.25 Kubernetes

Kubernetes (K8s) is an open-source container-orchestration system for automating application deployment, scaling, and management. It was originally designed by Google, and is now maintained by the Cloud Native Computing Foundation. For more details, refer: Kubernetes

13.1.26 Kubernetes Node

A node is a worker machine in Kubernetes, previously known as a minion. A node may be a VM or physical machine, depending on the cluster. Each node contains the services necessary to run pods and is managed by the main components. The services on a node include the container runtime, kubelet and kube-proxy. For more details, refer: Kubernetes Node

13.1.27 Kubernetes Storage Class

A StorageClass in Kubernetes provides a way for administrators to describe the "classes" of storage they offer. Different classes might map to quality-of-service levels, or to backup policies, or to arbitrary policies determined by the cluster administrators. For more details, refer: Storage class

13.1.28 Kubernetes PersistentVolume (PV)

A PersistentVolume (PV) is a piece of storage in the cluster that has been provisioned by an administrator or dynamically provisioned using Storage Classes. It is a resource in the cluster just like a node is a cluster resource. PVs are volume plugins like Volumes, but have a lifecycle independent of any individual pod that uses the PV. For more details, refer: PVC

13.1.29 Kubernetes Persistent Volume Claim (PVC)

A PVC, binds a persistent volume to a pod that requested it. When a pod wants access to a persistent disk, it will request access to the claim which will specify the size , access mode and/or storage classes that it will need from a Persistent Volume. For more details, refer: PVC

13.1.30 PGP signature

Pretty Good Privacy (PGP) is an encryption program that provides cryptographic privacy and authentication for data communication. PGP is used for signing, encrypting, and decrypting texts, e-mails, files, directories, and whole disk partitions. For more details, refer: PGP

13.1.31 Playbook

An Ansible playbook is an organized unit of scripts that defines work for a server configuration managed by the automation tool Ansible. For more details, refer: Playbooks

13.1.32 Pipeline

Jenkins Pipeline (or simply "Pipeline") is a suite of plugins which supports implementing and integrating continuous delivery pipelines into Jenkins. A continuous delivery pipeline is an automated expression of your process for getting software from version control right through to your users and customers. For more details, refer: Pipeline

13.1.33 Roles

Roles provide a framework for fully independent, or interdependent collections of variables, tasks, files, templates, and modules. In Ansible, the role is the primary mechanism for breaking a playbook into multiple files. This simplifies writing complex playbooks, and it makes them easier to reuse. For more details, refer: Roles

13.1.34 SCM

Supply Chain Management (SCM) is the broad range of activities required to plan, control and execute a product's flow, from acquiring raw materials and production through distribution to the final customer, in the most streamlined and cost-effective way possible.

13.1.35 SHA256

SHA-256 stands for Secure Hash Algorithm – 256 bit and is a type of hash function commonly used in Blockchain. A hash function is a type of mathematical function which turns data into a fingerprint of that data called a hash. It's like a formula or algorithm which takes the input data and turns it into an output of a fixed length, which represents the fingerprint of the data. For more details, refer: SHA256

13.1.36 Sphinx

Sphinx is a tool that makes it easy to create intelligent and beautiful documentation, written by Georg Brandl and licensed under the BSD license. It was originally created for the Python documentation, and it has excellent facilities for the documentation of software projects in a range of languages. For more details, refer: Sphinx

13.1.37 SSH

SSH, also known as Secure Shell or Secure Socket Shell, is a network protocol that gives users, particularly system administrators, a secure way to access a computer over an unsecured network. SSH also refers to the suite of utilities that implement the SSH protocol. For more details, refer: SSH

13.1.38 Template

- Ansible: A template in Ansible is a file which contains all your configuration parameters, but the dynamic values are given as variables. During the playbook execution, depending on the conditions like which cluster you are using, the variables will be replaced with the relevant values. For more details, refer: Ansible Template
- Helm Charts: In Helm Charts, Templates generate manifest files, which are YAML-formatted resource descriptions that Kubernetes can understand. For more details, refer: Helm Charts Template

13.1.39 TLS

Transport Layer Security, and its now-deprecated predecessor, Secure Sockets Layer, are cryptographic protocols designed to provide communications security over a computer network. For more details, refer: TLS

13.1.40 YAML

YAML (”YAML Ain’t Markup Language”) is a human-readable data-serialization language. It is commonly used for configuration files and in applications where data is being stored or transmitted. YAML targets many of the same communications applications as Extensible Markup Language but has a minimal syntax which intentionally differs from SGML. For more details, refer: YAML

13.2 Hyperledger-Fabric

This section lists specific terms used in Hyperledger Fabric

13.2.1 CA

The Hyperledger Fabric CA is a Certificate Authority (CA) for Hyperledger Fabric. It provides features such as: registration of identities, or connects to LDAP as the user registry. For more details, refer: CA

13.2.2 CA Server

Fabric CA server is used to host one or more Certification Authorities (Fabric CA) for your Fabric Network (based on the MSPs)

13.2.3 Chaincode

Chaincode is a piece of code that is written in one of the supported languages such as Go or Java. It is installed and instantiated through an SDK or CLI onto a network of Hyperledger Fabric peer nodes, enabling interaction with that network’s shared ledger. For more details, refer: Chaincode

13.2.4 Channel

A Hyperledger Fabric channel is a private “subnet” of communication between two or more specific network members, for the purpose of conducting private and confidential transactions. A channel is defined by members (organizations), anchor peers per member, the shared ledger, chaincode application(s) and the ordering service node(s). For more details, refer: Channel

13.2.5 Channel Artifacts

Artifacts in Hyperledger are channel configuration files which are required for the Hyperledger Fabric network. They are generated at the time of network creation. For more details, refer: Channel Artifacts

13.2.6 Instantiate

Instantiating a chaincode means to initialize it with initial values. For more details, refer: Instantiating Chaincode

13.2.7 MSP

Hyperledger Fabric includes a Membership Service Provider (MSP) component to offer an abstraction of all cryptographic mechanisms and protocols behind issuing and validating certificates, and user authentication. For more details, refer: MSP

13.2.8 Orderer

Orderer peer is considered as the central communication channel for the Hyperledger Fabric network. Orderer peer/node is responsible for consistent Ledger state across the network. Orderer peer creates the block and delivers that to all the peers For more details, refer: Orderer

13.2.9 Peer

Hyperledger Fabric is a permissioned blockchain network that gets set by the organizations that intend to set up a consortium. The organizations that take part in building the Hyperledger Fabric network are called the "members". Each member organization in the blockchain network is responsible to set up their peers for participating in the network. All of these peers need are configured with appropriate cryptographic materials like Certificate Authority and other information. For more details, refer: Peer

13.2.10 Zkkafka

Kafka is primarily a distributed, horizontally-scalable, fault-tolerant, commit log. A commit log is basically a data structure that only appends. No modification or deletion is possible, which leads to no read/write locks, and the worst case complexity O(1). There can be multiple Kafka nodes in the blockchain network, with their corresponding Zookeeper ensemble. For more details, refer: zkkafka

13.2.11 RAFT

RAFT is distributed crash Fault tolerance consensus algorithm which makes sure that in the event of failure, the system should be able to take a decision and process clients request. In technical term Raft is a consensus algorithm for managing a replicated log. Replicated log is a part of Replicated state machine. For more details, refer: raft

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13.3 R3 Corda

This section lists specific terms used in R3 Corda.

13.3.1 Compatibility Zone

Every Corda node is part of a "zone" (also sometimes called a Corda network) that is permissioned. Production deployments require a secure certificate authority. We use the term "zone" to refer to a set of technically compatible nodes reachable over a TCP/IP network like the internet. The word "network" is used in Corda but can be ambiguous with the concept of a "business network", which is usually more like a membership list or subset of nodes in a zone that have agreed to trade with each other. For more details, refer Compatibility Zone.

13.3.2 CorDapp

CorDapps (Corda Distributed Applications) are distributed applications that run on the Corda platform. The goal of a CorDapp is to allow nodes to reach agreement on updates to the ledger. They achieve this goal by defining flows that Corda node owners can invoke over RPC. For more details, refer: CorDapp

13.3.3 Corda Node

A Corda node is a JVM run-time environment with a unique identity on the network that hosts Corda services and CorDapps.For more details, refer Corda Node.

13.3.4 Corda Web Server

A simple web server is provided that embeds the Jetty servlet container. The Corda web server is not meant to be used for real, production-quality web apps. Instead it shows one example way of using Corda RPC in web apps to provide a REST API on top of the Corda native RPC mechanism.

13.3.5 Doorman

The Doorman CA is a Certificate Authority R3 Corda. It is used for day-to-day key signing to reduce the risk of the root network CA's private key being compromised. This is equivalent to an intermediate certificate in the web PKI. For more details, refer Doorman.

13.3.6 NetworkMap

The Network Map Service accepts digitally signed documents describing network routing and identifying information from nodes, based on the participation certificates signed by the Identity Service, and makes this information available to all Corda Network nodes. For more details, refer Networkmap.

13.3.7 Notary

The Corda design separates correctness consensus from uniqueness consensus, and the latter is provided by one or more Notary Services. The Notary will digitally sign a transaction presented to it, provided no transaction referring to any of the same inputs has been previously signed by the Notary, and the transaction timestamp is within bounds.Business network operators and network participants may choose to enter into legal agreements which rely on the presence of such digital signatures when determining whether a transaction to which they are party, or upon the details of which they otherwise rely, is to be treated as 'confirmed' in accordance with the terms of the underlying agreement. For more details, refer Corda Notaries.

13.4 Hyperledger-Indy

This section lists specific terms used in Hyperledger-Indy.

13.4.1 Admin DID

A decentralized identifier for Admin as defined by the DID Data Model and Generic Syntax specification.

13.4.2 Admin Seed

Seed can be any randomly chosen 32 byte value. There is no predefined format for the seed and it used to initializing keys. The seed used for Admin key is called an admin seed.

13.4.3 Agency

A service provider that hosts Cloud Agents and may provision Edge Agents on behalf of a Ledger's Entities.

13.4.4 Agent

A software program or process used by or acting on behalf of a Ledger's Entity to interact with other Agents or, via a Ledger's Client component, directly with the Ledger. Agents are of two types: Edge Agents run at the edge of the network on a local device, while Cloud Agents run remotely on a server or cloud hosting service. Agents typically have access to a Wallet in order to perform cryptographic operations on behalf of the Ledger's Entity they represent.

13.4.5 Dependent

An Individual who needs to depend on a Guardian to administer the Individual's Ledger Identities. Under a Trust Framework, all Dependents may have the right to become Independents. Mutually exclusive with Independent.

13.4.6 Developer

An Identity Owner that has legal accountability (in a scenario where there is a Trust Framework) for the functionality of an Agent, or for software that interacts with an Agent or the Ledger, to provide services to a Ledger Entity.

13.4.7 DID

A decentralized identifier as defined by the DID Data Model and Generic Syntax specification. DIDs enable interoperable decentralized self-sovereign identity management. An Identity Record is associated with exactly one DID. A DID is associated with exactly one DDO.

13.4.8 Domain Genesis

Domain genesis is a genesis file used to initialise the network and may populate network with some domain data.

13.4.9 Endorser

Endorser has the required rights to write on a ledger. Endorser submits a transaction on behalf of the original author.

13.4.10 Genesis Record

The first Identity Record written to the Ledger that describes a new Ledger Entity. For a Steward, the Genesis Record must be written by a Trustee. For an Independent Identity Owner, the Genesis Record must be written by a Trust Anchor. For a Dependent Identity Owner, the Genesis Record must be written by a Guardian.

13.4.11 Identity

A set of Identity Records, Claims, and Proofs that describes a Ledger Entity. To protect privacy: a) an Identity Owner may have more than one Ledger Identity, and b) only the Identity Owner and the Relying Party(s) with whom an Identity is shared knows the specific set of Identity Records, Claims, and Proofs that comprise that particular Identity.

13.4.12 Identity Owner

A Ledger Entity who can be held legally accountable. An Identity Owner must be either an Individual or an Organization. Identity owners can also be distinguised as Independent Identity Owner and Dependent Identity Owner based on the writer of the Genesis record, for an Independent Identity Owner the Genesis Record must be written by a Trust Anchor and in case of a Dependent Identity Owner the the Genesis Record must be written by a Guardian.

13.4.13 Identity Record

A transaction on the Ledger that describes a Ledger Entity. Every Identity Record is associated with exactly one DID. The registration of a DID is itself an Identity Record. Identity Records may include Public Keys, Service Endpoints, Claim Definitions, Public Claims, and Proofs. Identity Records are Public Data.

13.4.14 Identity Role

Each identity has a specific role in Indy described by one of four roles in Indy. These roles are Trustee, Steward, Endorser and Netork Monitor.

13.4.15 Issuer Key

The special type of cryptographic key necessary for an Issuer to issue a Claim that supports Zero Knowledge Proofs.

13.4.16 Ledger

The ledger in Indy is Indy-plenum based. Provides a simple, python-based, immutable, ordered log of transactions backed by a merkle tree. For more details, refer Indy-plenum

13.4.17 NYM Transaction

NYM record is created for a specific user, Trust Anchor, Sovrin Stewards or trustee. The transaction can be used for creation of new DIDs, setting and Key Rotation of verification key, setting and changing of roles.

13.4.18 Pairwise-Unique Identifier

A Pseudonym used in the context of only one digital relationship (Connection). See also Pseudonym and Verinym.

13.4.19 Pool Genesis

Pool genesis is a genesis file used to initialise the network and may populate network with some pool data.

13.4.20 Private Claim

A Claim that is sent by the Issuer to the Holder's Agent to hold (and present to Relying Parties) as Private Data but which can be verified using Public Claims and Public Data. A Private Claim will typically use a Zero Knowledge Proof, however it may also use a Transparent Proof.

13.4.21 Private Data

Data over which an Entity exerts access control. Private Data should not be stored on a Ledger even when encrypted. Mutually exclusive with Public Data.

13.4.22 Private Key

The half of a cryptographic key pair designed to be kept as the Private Data of an Identity Owner. In elliptic curve cryptography, a Private Key is called a signing key.

13.4.23 Prover

The Entity that issues a Zero Knowledge Proof from a Claim. The Prover is also the Holder of the Claim.

13.4.24 Pseudonym

A Blinded Identifier used to maintain privacy in the context on an ongoing digital relationship (Connection).

13.4.25 Steward

An Organization, within a Trust Framework, that operate a Node. A Steward must meet the Steward Qualifications and agree to the Steward Obligations defined in the a Trust Framework. All Stewards are automatically Trust Anchors.

13.4.26 Trust Anchor

An Identity Owner who may serve as a starting point in a Web of Trust. A Trust Anchor has two unique privileges: 1) to add new Identity Owners to a Network, and 2) to issue Trust Anchor Invitations. A Trust Anchor must meet the Trust Anchor Qualifications and agree to the Trust Anchor Obligations defined in a Trust Framework. All Trustees and Stewards are automatically Trust Anchors.

13.4.27 Verinym

A DID authorized to be written to an Indy-powered Ledger by a Trust Anchor so that it is directly or indirectly associated with the Legal Identity of the Identity Owner. Mutually exclusive with Anonym.

13.4.28 Wallet

A software module, and optionally an associated hardware module, for securely storing and accessing Private Keys, Master Secrets, and other sensitive cryptographic key material and optionally other Private Data used by an Entity on Indy. A Wallet may be either an Edge Wallet or a Cloud Wallet. In Indy infrastructure, a Wallet implements the emerging DKMS standards for interoperable decentralized cryptographic key management.

13.4.29 Zero Knowledge Proof

A Proof that uses special cryptography and a Master Secret to permit selective disclosure of information in a set of Claims. A Zero Knowledge Proof proves that some or all of the data in a set of Claims is true without revealing any additional information, including the identity of the Prover. Mutually exclusive with Transparent Proof.

13.5 Quorum

This section lists specific terms used in Quorum.

13.5.1 Constellation

Haskell implementation of a general-purpose system for submitting information in a secure way. it is comparable to a network of MTA (Message Transfer Agents) where messages are encrypted with PGP. Contains Node (Private transaction manager) and the Enclave.

13.5.2 Enode

Enode is a url which identifies a node, it is generated using the node keys.

13.5.3 Istanbul Tool

Istanbul tool is istanbul binary compiled from the code repository. The tool is used to generate the configuration files required for setting up the Quorum network with IBFT consensus.

13.5.4 Node Keys

Node keys consist of node private and node public keys. Those keys are required by the binaries provided by Quorum to boot the node and the network.

13.5.5 Private Transactions

Private Transactions are those Transactions whose payload is only visible to the network participants whose public keys are specified in the privateFor parameter of the Transaction . privateFor can take multiple addresses in a comma separated list.

13.5.6 Public Transactions

Public Transactions are those Transactions whose payload is visible to all participants of the same Quorum network. These are created as standard Ethereum Transactions in the usual way.

13.5.7 Quorum Node

Quorum Node is designed to be a lightweight fork of geth in order that it can continue to take advantage of the R&D that is taking place within the ever growing Ethereum community. Quorum Node is running geth, a Go-Etherium client with rpc endpoints. It supports raft and IBFT pluggable consensus and private and permissioned transactions.

13.5.8 State

Quorum supports dual state, Public State(accessible by all nodes within the network) and Private State(only accessible by nodes with the correct permissions). The difference is made through the use of transactions with encrypted (private) and non-encrypted payloads (public). Nodes can determine if a transaction is private by looking at the v value of the signature. Public transactions have a v value of 27 or 28, private transactions have a value of 37 or 38.

13.5.9 Static nodes

Static nodes are nodes we keep reference to even if the node is not alive. So that when the nodes comes alive, then we can connect to it. Hostnames are permitted here, and are resolved once at startup. If a static peer goes offline and its IP address changes, then it is expected that that peer would re-establish the connection in a fully static network, or have discovery enabled.

13.5.10 Tessera

Java implementation of a general-purpose system for submitting information in a secure way. it is comparable to a network of MTA (Message Transfer Agents) where messages are encrypted with PGP. Contains Node (Private transaction manager) and The Enclave.

13.5.11 The Enclave

Distributed Ledger protocols typically leverage cryptographic techniques for transaction authenticity, participant authentication, and historical data preservation (i.e. through a chain of cryptographically hashed data.) In order to achieve a separation of concerns, as well as to provide performance improvements through parallelization of certain crypto-operations, much of the cryptographic work including symmetric key generation and data encryption/decryption is delegated to the Enclave.

13.5.12 Transaction Manager

Quorum's Transaction Manager is responsible for Transaction privacy. It stores and allows access to encrypted transaction data, exchanges encrypted payloads with other participant's Transaction Managers but does not have access to any sensitive private keys. It utilizes the Enclave for cryptographic functionality (although the Enclave can optionally be hosted by the Transaction Manager itself.)

CHAPTER 14

Contributing

Thank you for your interest to contribute to Bevel!

We welcome contributions to Hyperledger Bevel Project in many forms, and there's always plenty to do!

First things first, please review the Hyperledger Code of Conduct before participating and please follow it in all your interactions with the project.

You can contibute to Bevel, as a user or/and as a developer.

14.1 As a user:

Making Feature/Enhancement ProposalsReporting bugs

14.2 As a developer:

Consider picking up a "help-wanted" or "good-first-issue" task

If you can commit to full-time/part-time development, then please contact us on our Rocketchat channel to work through logistics!

Please visit the *Developer Guide* in the docs to learn how to make contributions to this exciting project.

14.3 Pull Request Process :

For source code integrity , Hyperledger Bevel GitHub pull requests are accepted from forked repositories only. There are also quality standards identified and documented here that will be enhanced over time.

1. Fork Bevel via Github UI
2. Clone the fork to your local machine

3. Complete the desired changes and where possible test locally (more detail to come here)
4. Commit your changesi) Make sure you sign your commit using git commit -s for more information see hereii) Make sure your commit message follows Conventional Commits syntax; this aids in release notes generation
5. Push your changes to your feature branch
6. Initiate a pull request from your fork to the base repository (develop branch , unless it is a critical bug, in that case initiate to the main branch)
7. Await DCO & linting quality checks (CI to come soon), as well as any feedback from reviewers.
8. Work on the feedbacks to revise the PR if there are any comments
9. If not, the PR gets approved , delete feature branch post the merge

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NOTE: If you are a regular contributor , please make sure to take the latest pull from the develop branch everytime before making any pull request , main branch in case of a critical defect / bug .

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