

Hyperledger Composer Playground and the Perishable Goods Network



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Introduction

The **Hyperledger Composer** Playground is a web sandbox where you can deploy, edit and test business network definitions.

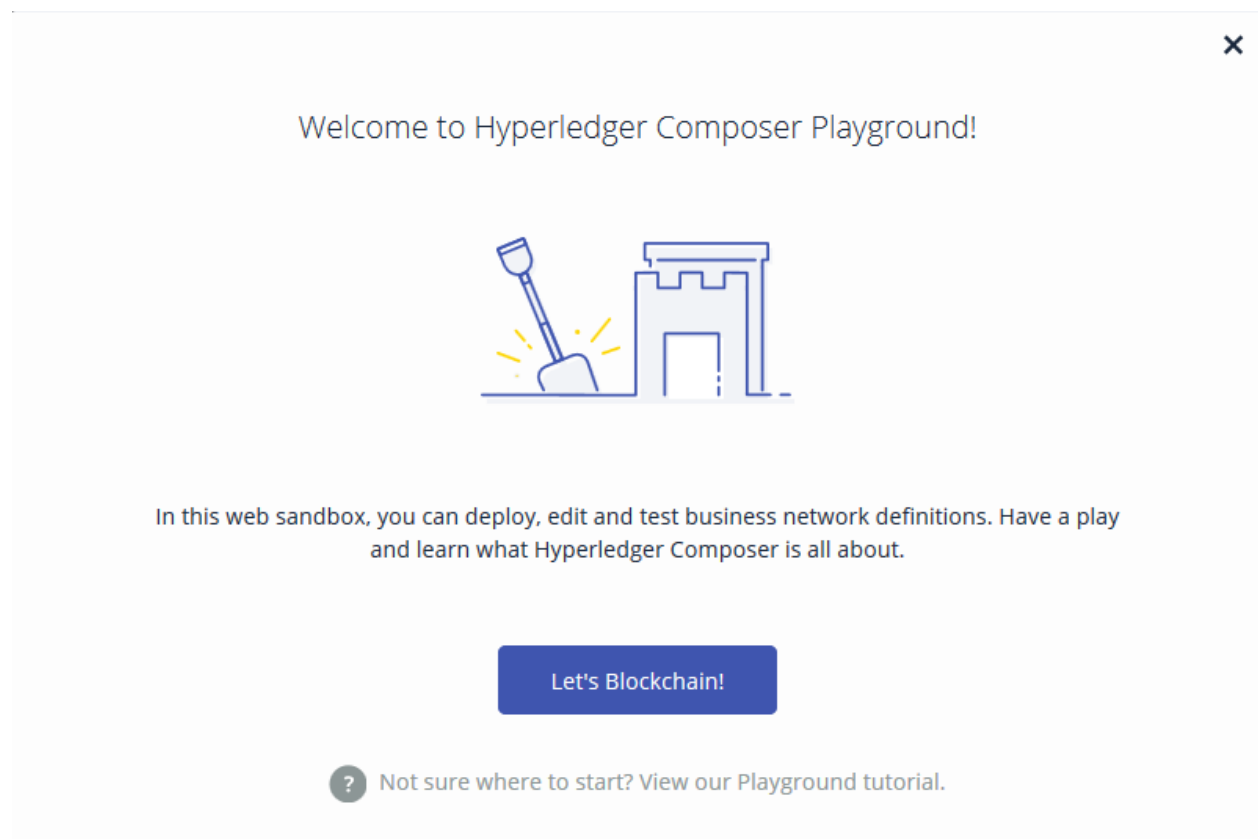
<https://hyperledger.github.io/composer/tutorials/playground-guide.html>

Step 1 Setting up the Perishable Goods Network

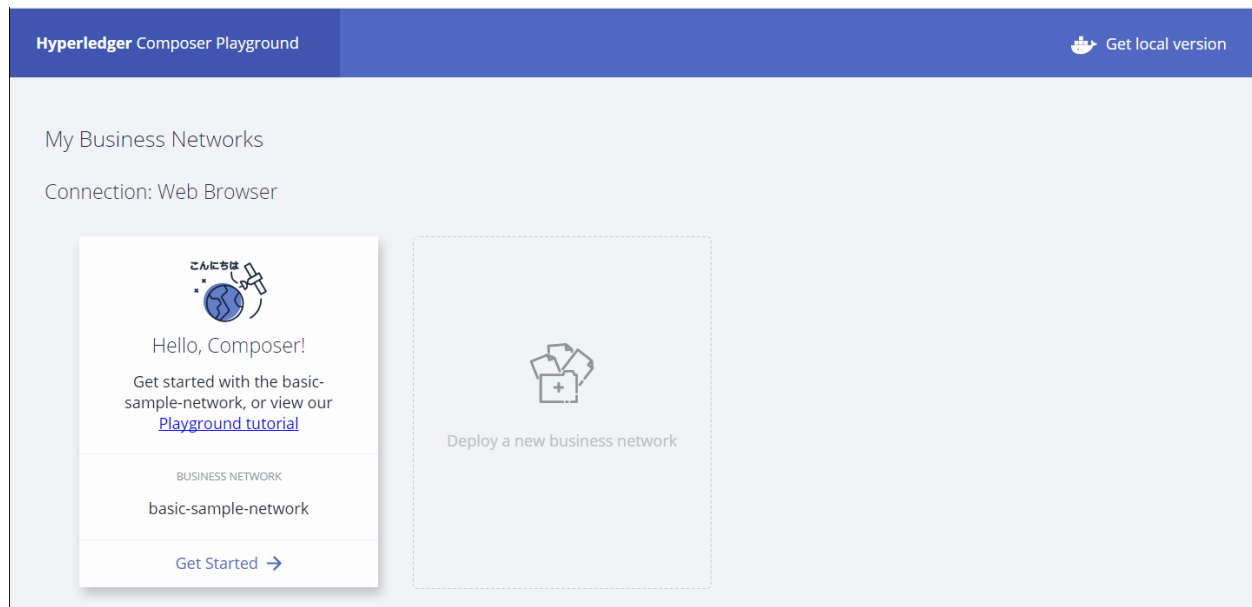
In this hands-on lab we will create a perishable Blockchain network with Hyperledger Composer.

We will then exercise the network to learn how it works.

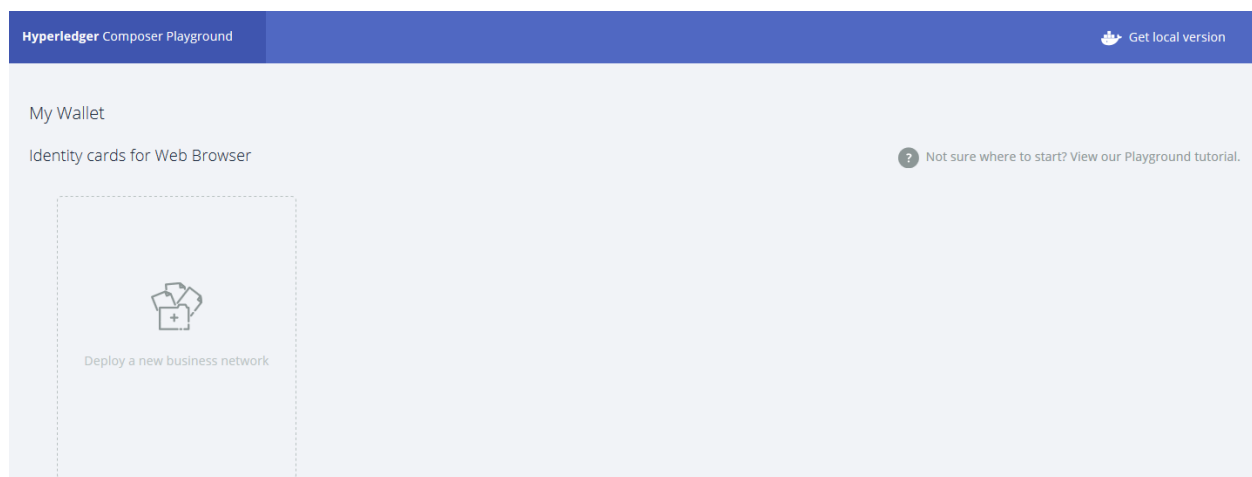
Log into the Composer Playground: <https://composer-playground.mybluemix.net/>



Click on the blue **Lets Blockchain!** Button in the Composer window.



Click on Deploy a new business network on the right grey tile to the right of the white Hello, Composer tile.



We are now in the Hyperledger Composer home screen.

We will click on the tile on the left, **Deploy a new Business Network**.

This will bring up a wizard.

Deploy New Business Network

1. BASIC INFORMATION




Give your new Business Network a name:

Describe what your Business Network will be used for:










Here we will name our app, see picture above.

Choose a Business Network Definition to start with:

Choose a sample to play with, start a new project, or import your previous work

 basic-sample-network	 empty-business-network	 Drop here to upload or browse
---	---	--

Samples on npm

 animaltracking-network	 bond-network	 carauction-network	 digitalproperty-network	 marbles-network
 perishable-network	 pii-network	 trade-network	 vehicle-lifecycle-network	

We will then select a Business Network Definition, and we choose, **perishable- network**,

Food Safety, of which the **Perishable Network** is an example, is an important Use Case for Blockchain.

<https://www.ibm.com/blogs/blockchain/category/blockchain-in-food-safety/>



perishable-network

Shipping Perishable Goods
Business Network

CONNECTION PROFILE

BASED ON
perishable-network

Shipping Perishable Goods
Business Network

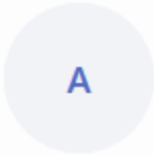
Contains: 4 Participant Types, 2
Asset Types, and 4 Transaction
Types

Deploy



We will click on Deploy.

My Business Networks

Connection: Web Browser



admin



BUSINESS NETWORK

perishable-network

[Connect now →](#)

We will then click on **Connect Now**

Web perishable
Define
Test
admin

FILES
About
README.md
Model File
models/perishable.cto
Script File
lib/logic.js
Access Control
permissions.acl
+ Add a file...
Update

v0.1.9

Perishable Goods Network

Example business network that shows growers, shippers and importers defining contracts for the price of perishable goods, based on temperature readings received for shipping containers.

The business network defines a contract between growers and importers. The contract stipulates that: On receipt of the shipment the importer pays the grower the unit price x the number of units in the shipment. Shipments that arrive late are free. Shipments that have breached the low temperature threshold have a penalty applied proportional to the magnitude of the breach x a penalty factor. Shipments that have breached the high temperature threshold have a penalty applied proportional to the magnitude of the breach x a penalty factor.

This business network defines:

Participants Grower Importer Shipper

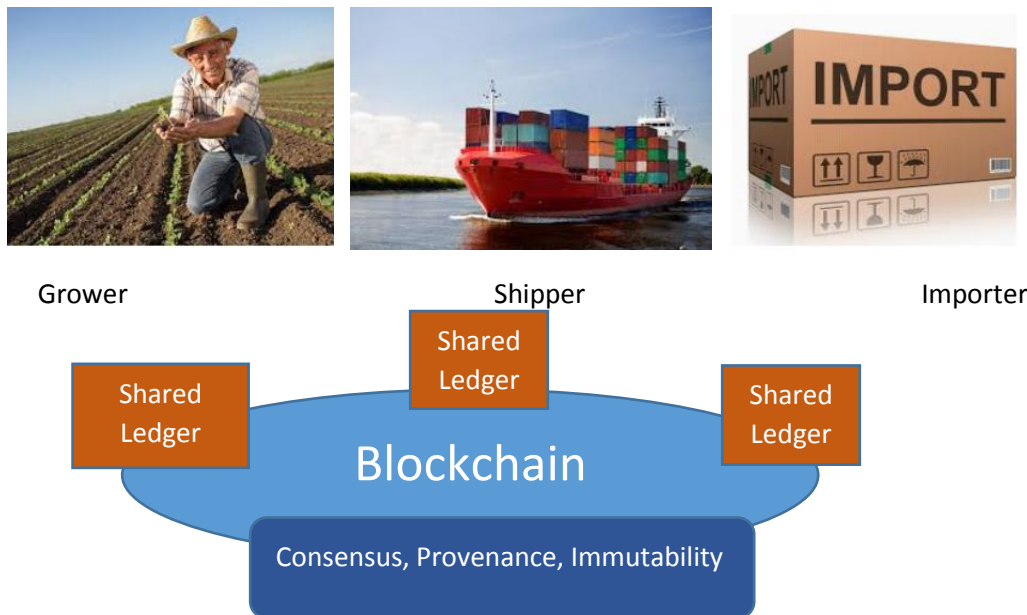
Assets Contract Shipment

Transactions TemperatureReading ShipmentReceived SetupDemo

To test this Business Network Definition in the **Test** tab:

Submit a SetupDemo transaction:

The Perishable Goods Network architecture:

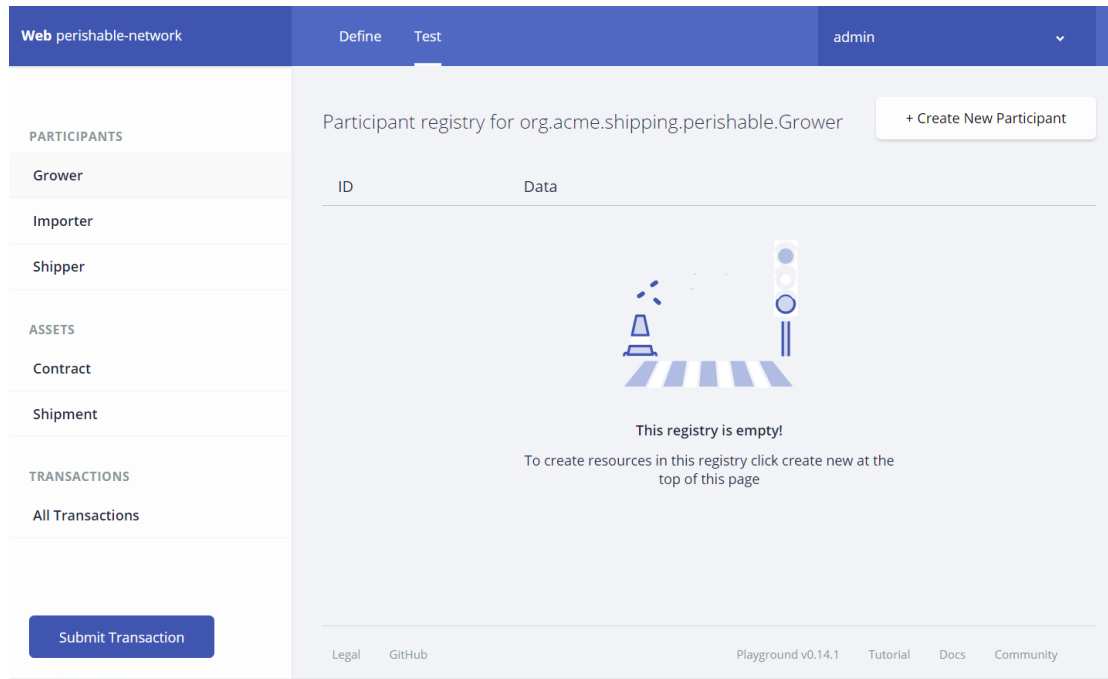


Let's look at the Perishable Goods Network

The Perishable Goods Network is written in the Hyperledger Composer Modeling Language

https://hyperledger.github.io/composer/reference/cto_language.html

We will now install the Perishable Goods Network components.



We click on the **Test tab** in the Blue action bar at the top of the window. (see above)

We then click on the **Submit Transaction** in the blue button at the lower left hand corner (see above)

Submit Transaction

Transaction Type

SetupDemo

JSON Data Preview

```
1 {
2   "$class": "org.acme.shipping.perishable.SetupDemo"
3 }
```

☐ Optional Properties

Just need quick test data? [Generate Random Data](#)

Cancel

Submit

We then click on **Submit Transaction** and select SetupDemo from the drop-down list. We then click on the **Submit** button.

If we now click on the Test tab at the top of the window we will see the participants of our network.

PARTICIPANTS

Grower

Importer

Shipper

ASSETS

Contract

Shipment

TRANSACTIONS

All Transactions

Submit Transaction

1. We have three participants that all access the Blockchain network: a **Grower**, an **Importer** and a **Shipper**. Let's look at them. The important field is accountBalance, which will change as we shortly exercise the network.

Participant registry for org.acme.shipping.perishable.Grower

farmer@email.com

```
{
  "$class": "org.acme.shipping.perishable.Grower",
  "email": "farmer@email.com",
  "address": {
    "$class": "org.acme.shipping.perishable.Address",
    "country": "USA"
  },
  "accountBalance": 0
}
```

Participant registry for org.acme.shipping.perishable.Importer

```
{
  "$class": "org.acme.shipping.perishable.Importer",
  "email": "supermarket@email.com",
  "address": {
    "$class": "org.acme.shipping.perishable.Address",
    "country": "UK"
  },
  "accountBalance": 0
}
```

Participant registry for org.acme.shipping.perishable.Shipper

```
{
  "$class": "org.acme.shipping.perishable.Shipper",
  "email": "shipper@email.com",
  "address": {
    "$class": "org.acme.shipping.perishable.Address",
    "country": "Panama"
  },
  "accountBalance": 0
}
```

What binds these three participants together is a **Smart Contract** that describes the rules that determines what the parties expect of the transactions involved in shipping fruit from the grower to the importer and which is stored in the Blockchain.

1. There are two **assets**: the **Contract** and the **Shipment**

The **Contract** defines the participants in the network and their obligations. In this case an arrival date, a unit price, a minimum and maximum temperature as well as a minimum and maximum penalty factor. Which are all encapsulated in the Smart Contract and visible to all participants in the network, which have agreed them the contract through the **consensus** mechanism.

Asset registry for org.acme.shipping.perishable.Contract

```
{
  "$class": "org.acme.shipping.perishable.Contract",
  "contractId": "CON_001",
  "grower": "resource:org.acme.shipping.perishable.Grower#farmer@email.com",
  "shipper":
"resource:org.acme.shipping.perishable.Shipper#shipper@email.com",
  "importer":
"resource:org.acme.shipping.perishable.Importer#supermarket@email.com",
  "arrivalDateTime": "2017-10-10T16:31:48.653Z",
  "unitPrice": 0.5,
  "minTemperature": 2,
  "maxTemperature": 10,
  "minPenaltyFactor": 0.2,
  "maxPenaltyFactor": 0.1
}
```

The **shipment** defines the type of goods being shipped, the unit count and the shipping status and encapsulates the temperature readings during the shipment. There is also a link to the **Smart Contract**.

Asset registry for org.acme.shipping.perishable.Shipment

```
{
  "$class": "org.acme.shipping.perishable.Shipment",
  "shipmentId": "SHIP_001",
  "type": "BANANAS",
  "status": "ARRIVED",
  "unitCount": 5000,
  "temperatureReadings": [
    {
      "$class": "org.acme.shipping.perishable.TemperatureReading",
      "centigrade": 8,
      "shipment": "resource:org.acme.shipping.perishable.Shipment#SHIP_001",
      "transactionId": "5d7e0439-ff34-46c5-8ad6-6a1a61218713",
      "timestamp": "2017-10-09T16:33:09.032Z"
    }
  ],
  "contract": "resource:org.acme.shipping.perishable.Contract#CON_001"
}
```

Let's look at the supporting files:

The Model File

```
/**
 * A business network for shipping perishable goods
 * The cargo is temperature controlled and contracts
 * can be negotiated based on the temperature
 * readings received for the cargo
 */

namespace org.acme.shipping.perishable

/**
 * The type of perishable product being shipped
 */
enum ProductType {
    o BANANAS
    o APPLES
    o PEARS
    o PEACHES
    o COFFEE
}

/**
 * The status of a shipment
 */
enum ShipmentStatus {
    o CREATED
    o IN_TRANSIT
    o ARRIVED
}

/**
 * An abstract transaction that is related to a Shipment
 */
abstract transaction ShipmentTransaction {
    --> Shipment shipment
}

/**
 * An temperature reading for a shipment. E.g. received from a
 * device within a temperature controlled shipping container
 */
transaction TemperatureReading extends ShipmentTransaction {
    o Double centigrade
}

/**
```

```

    * A notification that a shipment has been received by the
    * importer and that funds should be transferred from the importer
    * to the grower to pay for the shipment.
    */
transaction ShipmentReceived extends ShipmentTransaction {
}

/**
 * A shipment being tracked as an asset on the ledger
 */
asset Shipment identified by shipmentId {
    o String shipmentId
    o ProductType type
    o ShipmentStatus status
    o Long unitCount
    o TemperatureReading[] temperatureReadings optional
    --> Contract contract
}

/**
 * Defines a contract between a Grower and an Importer to ship using
 * a Shipper, paying a set unit price. The unit price is multiplied by
 * a penalty factor proportional to the deviation from the min and max
 * negotiated temperatures for the shipment.
 */
asset Contract identified by contractId {
    o String contractId
    --> Grower grower
    --> Shipper shipper
    --> Importer importer
    o DateTime arrivalDateTime
    o Double unitPrice
    o Double minTemperature
    o Double maxTemperature
    o Double minPenaltyFactor
    o Double maxPenaltyFactor
}

/**
 * A concept for a simple street address
 */
concept Address {
    o String city optional
    o String country
    o String street optional
    o String zip optional
}

```

```

/**
 * An abstract participant type in this business network
 */
abstract participant Business identified by email {
    o String email
    o Address address
    o Double accountBalance
}

/**
 * A Grower is a type of participant in the network
 */
participant Grower extends Business {
}

/**
 * A Shipper is a type of participant in the network
 */
participant Shipper extends Business {
}

/**
 * An Importer is a type of participant in the network
 */
participant Importer extends Business {
}

/**
 * JUST FOR INITIALIZING A DEMO
 */
transaction SetupDemo {
}

```

The Script file containing the application logic

```

/*
 * Licensed under the Apache License, Version 2.0 (the "License");
 * you may not use this file except in compliance with the License.
 * You may obtain a copy of the License at
 *
 * http://www.apache.org/licenses/LICENSE-2.0
 *
 * Unless required by applicable law or agreed to in writing, software
 * distributed under the License is distributed on an "AS IS" BASIS,
 * WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.
 * See the License for the specific language governing permissions and
 * limitations under the License.
 */

```

```

/**
 * A shipment has been received by an importer
 * @param {org.acme.shipping.perishable.ShipmentReceived} shipmentReceived - the
ShipmentReceived transaction
 * @transaction
 */
function payOut(shipmentReceived) {

    var contract = shipmentReceived.shipment.contract;
    var shipment = shipmentReceived.shipment;
    var payOut = contract.unitPrice * shipment.unitCount;

    console.log('Received at: ' + shipmentReceived.timestamp);
    console.log('Contract arrivalDateTime: ' + contract.arrivalDateTime);

    // set the status of the shipment
    shipment.status = 'ARRIVED';

    // if the shipment did not arrive on time the payout is zero
    if (shipmentReceived.timestamp > contract.arrivalDateTime) {
        payOut = 0;
        console.log('Late shipment');
    } else {
        // find the lowest temperature reading
        if (shipment.temperatureReadings) {
            // sort the temperatureReadings by centigrade
            shipment.temperatureReadings.sort(function (a, b) {
                return (a.centigrade - b.centigrade);
            });
            var lowestReading = shipment.temperatureReadings[0];
            var highestReading =
shipment.temperatureReadings[shipment.temperatureReadings.length - 1];
            var penalty = 0;
            console.log('Lowest temp reading: ' + lowestReading.centigrade);
            console.log('Highest temp reading: ' + highestReading.centigrade);

            // does the lowest temperature violate the contract?
            if (lowestReading.centigrade < contract.minTemperature) {
                penalty += (contract.minTemperature - lowestReading.centigrade) *
contract.minPenaltyFactor;
                console.log('Min temp penalty: ' + penalty);
            }

            // does the highest temperature violate the contract?
            if (highestReading.centigrade > contract.maxTemperature) {
                penalty += (highestReading.centigrade - contract.maxTemperature) *
contract.maxPenaltyFactor;

```



```

        console.log('Max temp penalty: ' + penalty);
    }

    // apply any penalties
    payOut -= (penalty * shipment.unitCount);

    if (payOut < 0) {
        payOut = 0;
    }
}

console.log('Payout: ' + payOut);
contract.grower.accountBalance += payOut;
contract.importer.accountBalance -= payOut;

console.log('Grower: ' + contract.grower.$identifier + ' new balance: ' +
contract.grower.accountBalance);
console.log('Importer: ' + contract.importer.$identifier + ' new balance: ' +
contract.importer.accountBalance);

return getParticipantRegistry('org.acme.shipping.perishable.Grower')
    .then(function (growerRegistry) {
        // update the grower's balance
        return growerRegistry.update(contract.grower);
    })
    .then(function () {
        return getParticipantRegistry('org.acme.shipping.perishable.Importer');
    })
    .then(function (importerRegistry) {
        // update the importer's balance
        return importerRegistry.update(contract.importer);
    })
    .then(function () {
        return getAssetRegistry('org.acme.shipping.perishable.Shipment');
    })
    .then(function (shipmentRegistry) {
        // update the state of the shipment
        return shipmentRegistry.update(shipment);
    });
}

/**
 * A temperature reading has been received for a shipment
 * @param {org.acme.shipping.perishable.TemperatureReading} temperatureReading - the
TemperatureReading transaction
 * @transaction
 */

```

```

function temperatureReading(temperatureReading) {

    var shipment = temperatureReading.shipment;

    console.log('Adding temperature ' + temperatureReading.centigrade + ' to shipment ' +
shipment.$identifier);

    if (shipment.temperatureReadings) {
        shipment.temperatureReadings.push(temperatureReading);
    } else {
        shipment.temperatureReadings = [temperatureReading];
    }

    return getAssetRegistry('org.acme.shipping.perishable.Shipment')
        .then(function (shipmentRegistry) {
            // add the temp reading to the shipment
            return shipmentRegistry.update(shipment);
        });
}

/**
 * Initialize some test assets and participants useful for running a demo.
 * @param {org.acme.shipping.perishable.SetupDemo} setupDemo - the SetupDemo transaction
 * @transaction
 */
function setupDemo(setupDemo) {

    var factory = getFactory();
    var NS = 'org.acme.shipping.perishable';

    // create the grower
    var grower = factory.newResource(NS, 'Grower', 'farmer@email.com');
    var growerAddress = factory.newConcept(NS, 'Address');
    growerAddress.country = 'USA';
    grower.address = growerAddress;
    grower.accountBalance = 0;

    // create the importer
    var importer = factory.newResource(NS, 'Importer', 'supermarket@email.com');
    var importerAddress = factory.newConcept(NS, 'Address');
    importerAddress.country = 'UK';
    importer.address = importerAddress;
    importer.accountBalance = 0;

    // create the shipper
    var shipper = factory.newResource(NS, 'Shipper', 'shipper@email.com');
    var shipperAddress = factory.newConcept(NS, 'Address');
    shipperAddress.country = 'Panama';

```

```

shipper.address = shipperAddress;
shipper.accountBalance = 0;

// create the contract
var contract = factory.newResource(NS, 'Contract', 'CON_001');
contract.grower = factory.newRelationship(NS, 'Grower', 'farmer@email.com');
contract.importer = factory.newRelationship(NS, 'Importer', 'supermarket@email.com');
contract.shipper = factory.newRelationship(NS, 'Shipper', 'shipper@email.com');
var tomorrow = setupDemo.timestamp;
tomorrow.setDate(tomorrow.getDate() + 1);
contract.arrivalDateTime = tomorrow; // the shipment has to arrive tomorrow
contract.unitPrice = 0.5; // pay 50 cents per unit
contract.minTemperature = 2; // min temperature for the cargo
contract.maxTemperature = 10; // max temperature for the cargo
contract.minPenaltyFactor = 0.2; // we reduce the price by 20 cents for every degree below the
min temp
contract.maxPenaltyFactor = 0.1; // we reduce the price by 10 cents for every degree above the
max temp

// create the shipment
var shipment = factory.newResource(NS, 'Shipment', 'SHIP_001');
shipment.type = 'BANANAS';
shipment.status = 'IN_TRANSIT';
shipment.unitCount = 5000;
shipment.contract = factory.newRelationship(NS, 'Contract', 'CON_001');
return getParticipantRegistry(NS + '.Grower')
    .then(function (growerRegistry) {
        // add the growers
        return growerRegistry.addAll([grower]);
    })
    .then(function() {
        return getParticipantRegistry(NS + '.Importer');
    })
    .then(function(importerRegistry) {
        // add the importers
        return importerRegistry.addAll([importer]);
    })
    .then(function() {
        return getParticipantRegistry(NS + '.Shipper');
    })
    .then(function(shipperRegistry) {
        // add the shippers
        return shipperRegistry.addAll([shipper]);
    })
    .then(function() {
        return getAssetRegistry(NS + '.Contract');
    })
    .then(function(contractRegistry) {

```

```

        // add the contracts
        return contractRegistry.addAll([contract]);
    })
    .then(function() {
        return getAssetRegistry(NS + '.Shipment');
    })
    .then(function(shipmentRegistry) {
        // add the shipments
        return shipmentRegistry.addAll([shipment]);
    });
}

```

The access control file

```

/**
 * Sample access control list.
 */
rule Default {
    description: "Allow all participants access to all resources"
    participant: "ANY"
    operation: ALL
    resource: "org.acme.shipping.perishable.*"
    action: ALLOW
}

rule SystemACL {
    description: "System ACL to permit all access"
    participant: "org.hyperledger.composer.system.Participant"
    operation: ALL
    resource: "org.hyperledger.composer.system.*"
    action: ALLOW
}

```

We now have our business network running.

Important, out of the box the Grower, Importer and Shipper all have an account balance of \$0.

Step 2. Running the Perishable Goods Network

We run the Perishable Goods Network by issuing Transactions from the **Test** tab in the blue action bar at the top of the window.

Let's begin by issuing a Temperature reading Transaction. We can modify the temperature any way we want to.

Submit Transaction

Transaction Type

TemperatureReading



JSON Data Preview

TemperatureReading

ShipmentReceived

SetupDemo

```
1 {
2   "$class": "org.acme.shipping.perishable.TemperatureReading",
3   "centigrade": 0,
4   "shipment": {
5     "resource": "org.acme.shipping.perishable.Shipment#shipmentId:0126"
6   }
7 }
```



Optional Properties

Just need quick test data? [Generate Random Data](#)

Cancel

Submit

Submit a TemperatureReading transaction

TemperatureReading is a stand-in for temperature sensors on board the plane or ship that transports the fruit. And allows us to modify the temperature so that it violates the provisions in the **Smart Contract**.

```
{
  "$class": "org.acme.shipping.perishable.TemperatureReading",
  "centigrade": 0,
```

```
"shipment": "resource:org.acme.shipping.perishable.Shipment#shipmentId:9227"
}
```

If the temperature reading falls outside the min/max range of the contract, the price received by the grower will be reduced. You may submit several readings if you wish. Each reading will be aggregated within SHIP_001 Shipment Asset Registry.

Submit a ShipmentReceived transaction

For the SHIP_001 shipment. It triggers the payout to the grower, based on the parameters of the CON_001 contract.

```
{
  "$class": "org.acme.shipping.perishable.ShipmentReceived",
  "shipment": "resource:org.acme.shipping.perishable.Shipment#shipmentId:2356"
}
```

The Grower's and Importer's account balance will change

If the date-time of the ShipmentReceived transaction is after the arrivalDateTime on CON_001 then the grower will not receive any payment for the shipment.

Congratulations!

Step 3 Installing the Composer locally

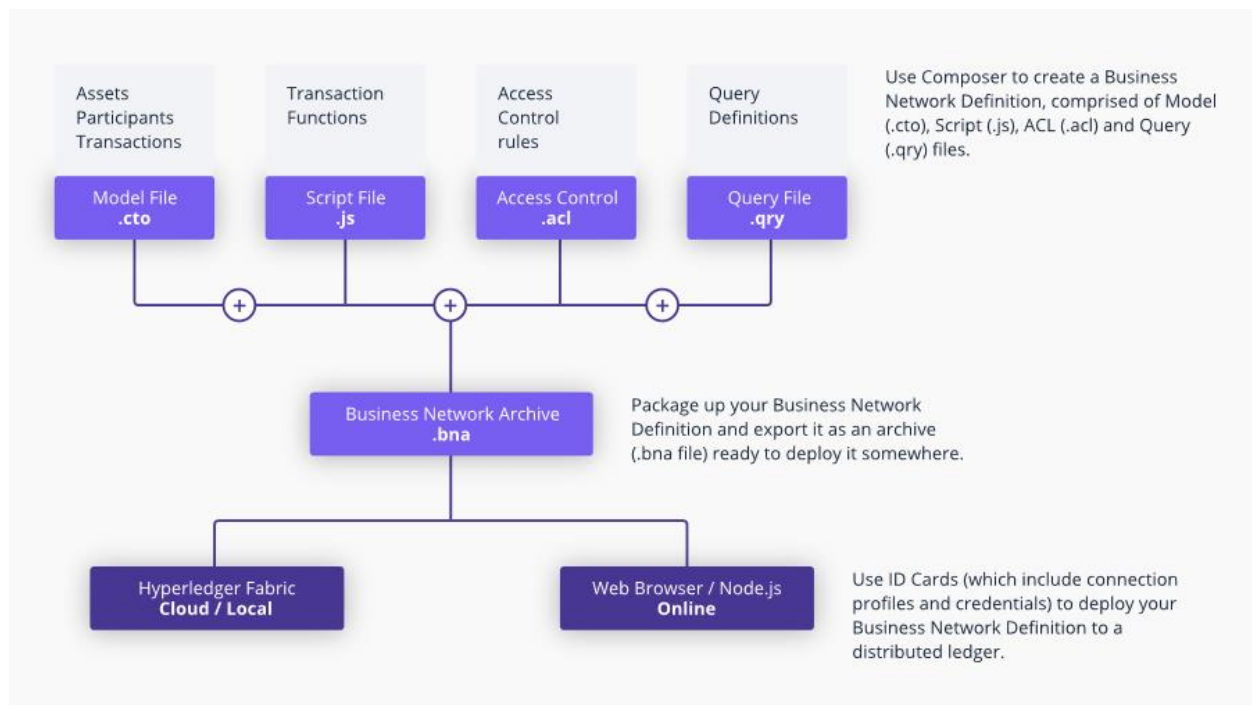
<https://hyperledger.github.io/composer/reference/composer.network.deploy.html>

Step 4 Where do we go from here?

Create your own Business Network Definitions from scratch.

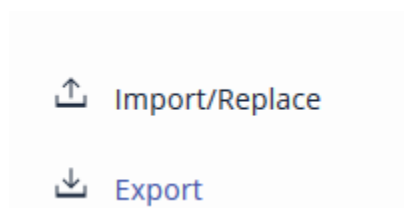
<https://hyperledger.github.io/composer/introduction/introduction.html>

The next step would be to add a User Interface that would hide the Blockchain network.



Export BNA file.

<https://hyperledger.github.io/composer/business-network/bnd-deploy.html>



Appendix

<https://hyperledger.github.io/composer/tutorials/tutorials.html>

<https://hyperledger.github.io/composer/introduction/introduction.html>