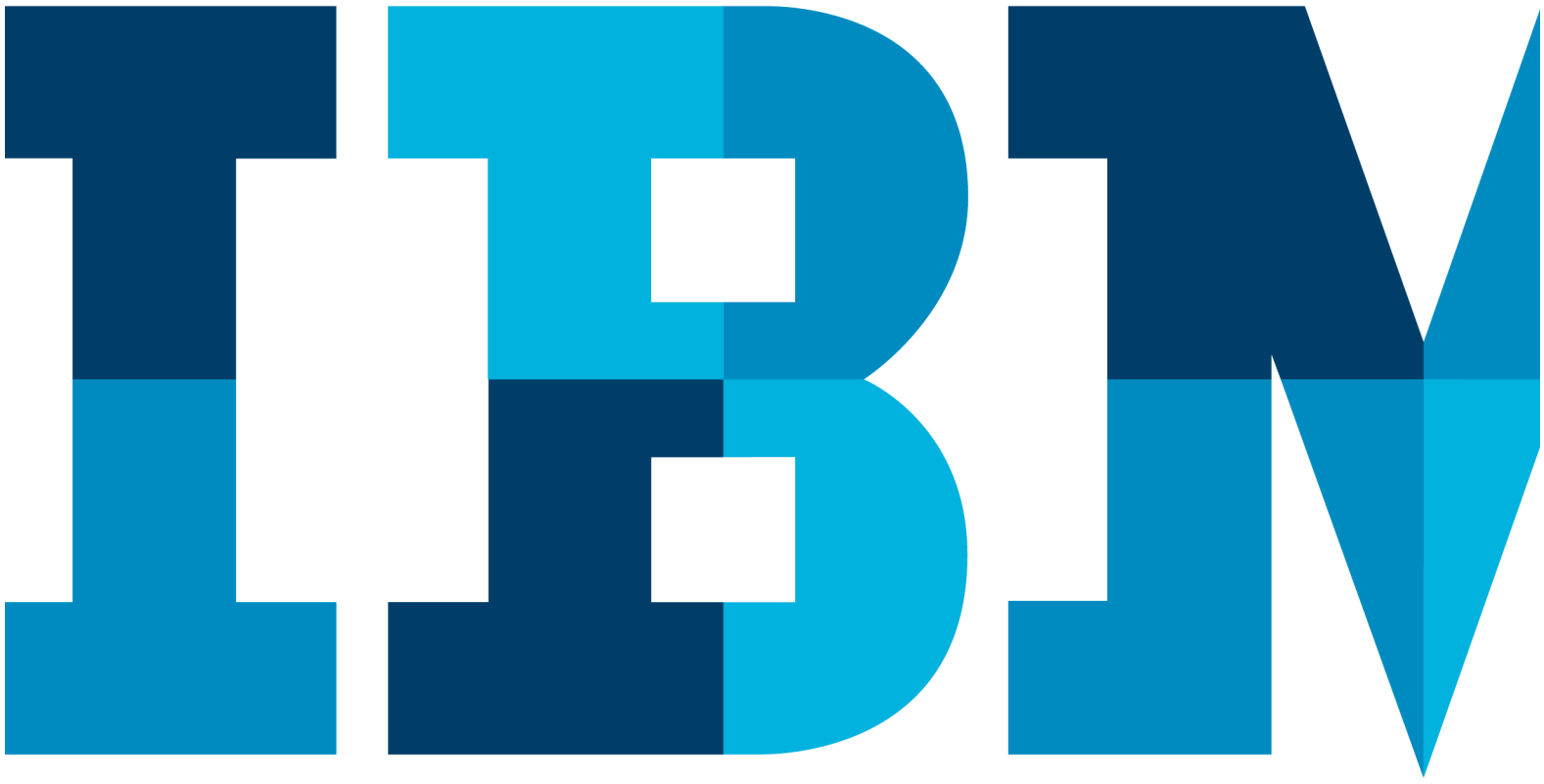
IBM Blockchain Hands-On
Hyperledger Composer Playground

Lab – Exercises



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Introduction to this section of the lab

Skill requirements:

- There are no skill prerequisites to completing this section although some background knowledge of object-oriented concepts and/or JavaScript is desirable.

Technical pre-requisites:

- Internet Connection
- Any Modern Browser (IE9+)

This section of the lab takes place entirely in the web browser using *Composer Playground*. A GitHub logic is required to import the sample into the Composer Playground.

Playground simulates the entire blockchain network within the browser by providing a sandpit environment to define, test and explore business networks defined using Composer. It is possible to connect to a live blockchain Hyperledger Fabric instance, or install the Composer Playground on a local machine for more developer friendly tools.

Hyperledger Composer Playground is one method to use Hyperledger Composer, other methods are also available at www.fabric-composer.org.

Section 1. Using Hyperledger Composer

Hyperledger Composer (https://hyperledger.github.io/composer) is an open-source set of tools designed to make building blockchain applications easier.

It allows users to model the business networks, assets and transactions that are required for blockchain applications, and to implement those transactions using simple JavaScript functions. The blockchain applications run on instances of Linux Foundation Hyperledger Fabric (www.hyperledger.org).

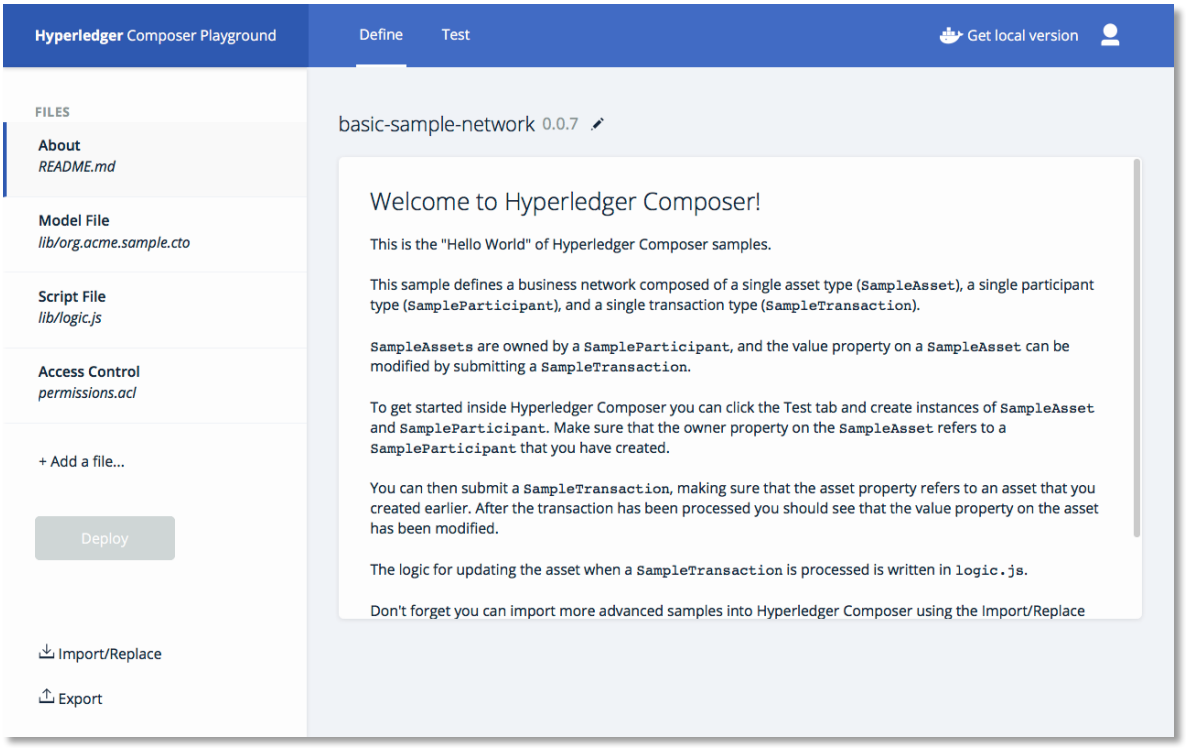
The purpose of this lab is to introduce you to the concepts of a blockchain by showing you how a blockchain transfers assets between participants in a business network. We will use the implementation of a simple blind car auction as the scenario for the demo.

The car auction business network has a set of known participants (buyers and sellers), assets (cars and car listings) and transactions (placing bids and closing auctions). We will model these using Hyperledger Composer and test the business logic that makes the auction work.

Crucially, a blockchain could be used to bring together the buyers and sellers of these assets without needing any trusted third party. However, an auctioneer could be used to provide visibility and governance of the network if required.

Open the Playground

__1. Open a web browser and go to http://composer-playground.mybluemix.net

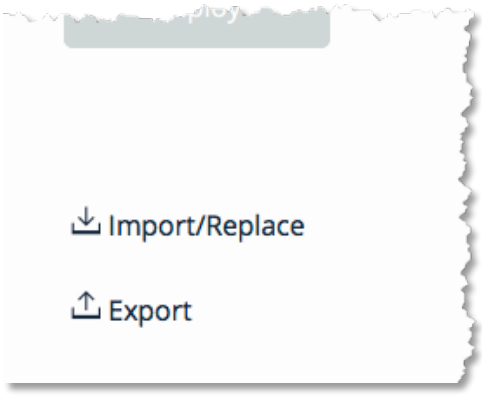


__2. By default, files are saved to local browser storage. If you have previously run this lab or edited files within this web page, then in order to run through this lab you might need to delete any web browser cookies from the *mybluemix.net* domain.

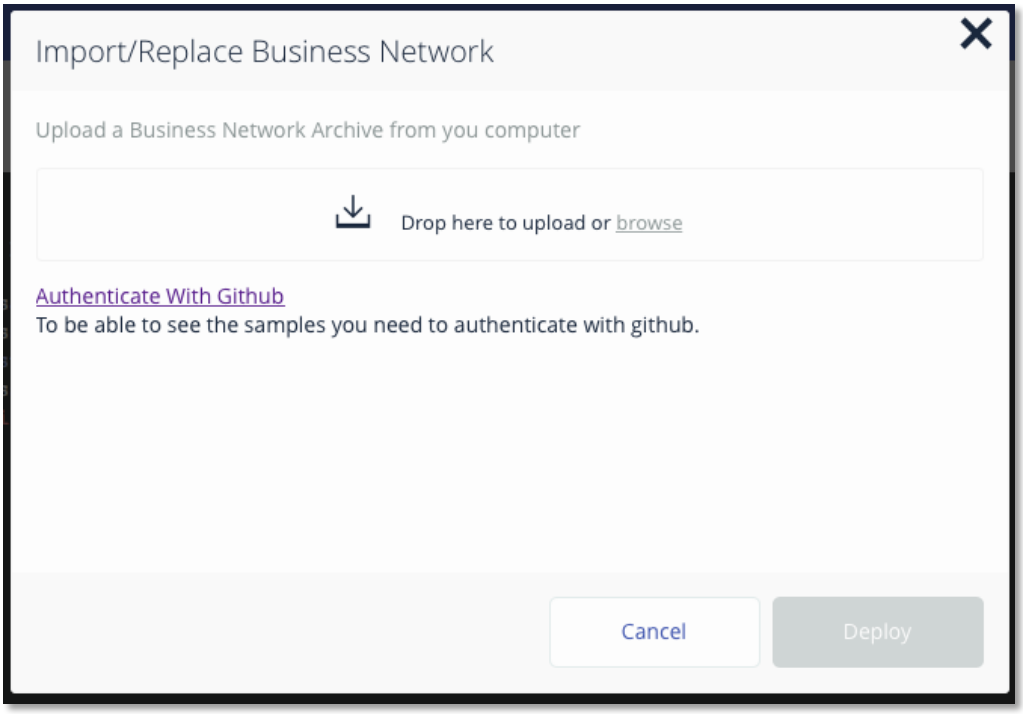
This will ensure that the asset, participant and transaction registries are empty, and that any changes made to the files are discarded.

Import the Car Auction Sample

__3. Click the Import/Replace button.



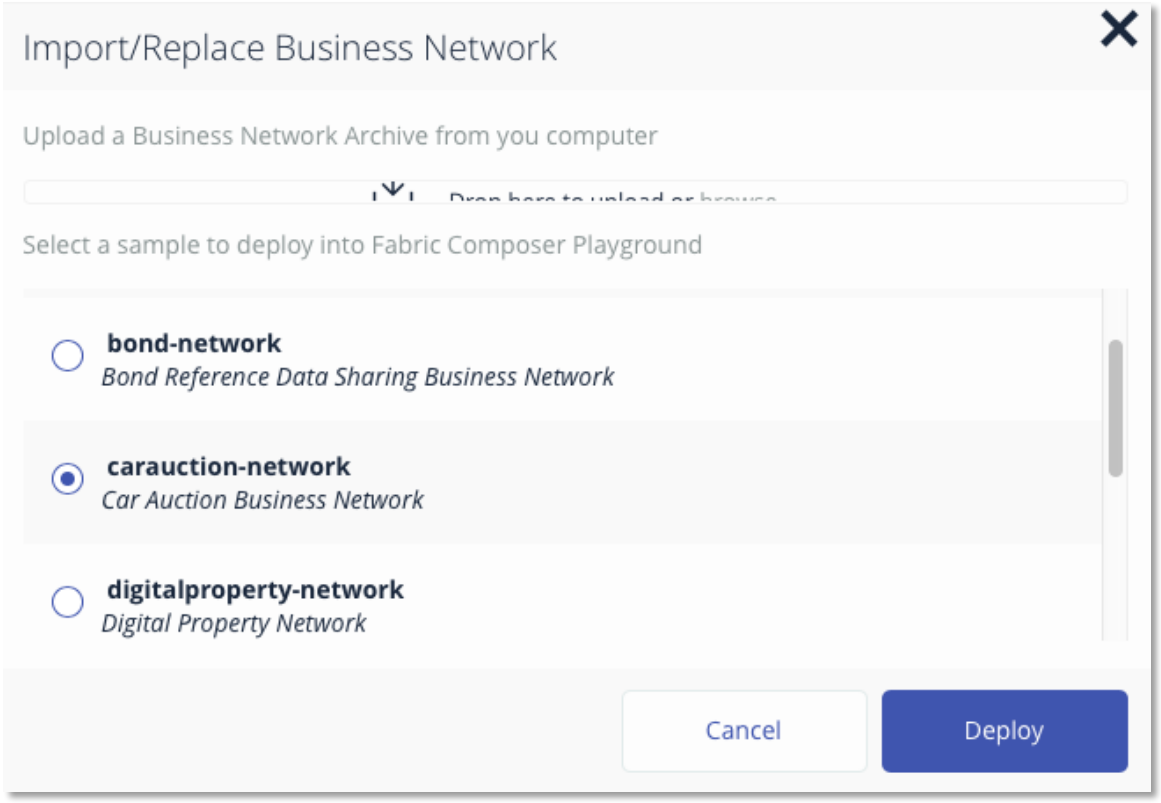
Press the “Authenticate with GitHub” link if present:



If you do not have a Gihub ID, they are free and easy to obtain.

Simply click through to authenticate and select “Create an account” link.

__4. Select the carauction-network sample and press the Deploy button:



Explore the Editor Views

1.3.1. Model File

__5. Click the Model File (lib/org.acme.vehicle.auction.cto) to open it, if it is not already open.

This .cto file models the assets, participants and transactions for this blockchain application.

__6. Look at the Vehicle asset:

```
6   asset Vehicle identified by vin {
7     o String vin
8     --> Member owner
9   }
10
```

This uses the Hyperledger Composer Modeling Language which will be looked at more later. An *asset* is anything of worth that will be transferred around the blockchain. Here we can see the asset class is called '*Vehicle*' and will have an associated *vin* and a reference (indicated by "-->") to a '*Member*' participant that we will call '*owner*'.

__7. Type and add some characters in an appropriate point to show the live validation of the model.

```
17  asset VehicleListing identifiedxxx by listingId {
18    o String listingId
19    o Double reservePrice
20    o String description
21    o ListingState state
22    o Offer[] offers optional
23    --> Vehicle vehicle
24  }
```

Error found!

Error: Syntax error in file undefined. Expected "extends", "identified by", "{", comment, end of line or whitespace but "i" found. Line 17 column 22

__8. Scroll down and look at the abstract '*User*' participant.

The participant will be the people or companies within the business network. Each *User* participant will be defined as having a *email*, *firstName* and *lastName*. As the class is **abstract** instances of it cannot be created; instances are instead implemented by the *Member* and *Auctioneer* classes.

```
26  abstract participant User identified by email {
27    o String email
28    o String firstName
29    o String lastName
30  }
31
32  participant Member extends User {
33    o Double balance
34  }
35
36  participant Auctioneer extends User {
37  }
38
```

Here the user can become a *Member* requiring a *balance*, or an *Auctioneer* that does not.

__9. Look at the *Offer* and *CloseBidding* transaction definitions:

```
39  transaction Offer identified by transactionId {
40    o String transactionId
41    o Double bidPrice
42    --> VehicleListing listing
43    --> Member member
44  }
45
46  transaction CloseBidding identified by transactionId {
47    o String transactionId
48    --> VehicleListing listing
49  }
50
```

The *transaction* definitions give a description of the transactions that can be performed on the blockchain. They are implemented in a Transaction Processor file using the Javascript language.

1.3.2. Transaction Processors

__10. Click on the lib/logic.js file:

__11. Scroll to **the bottom of the file** to review the logic used to make an offer on a car being auctioned:

```
84
85  /**
86   * Make an Offer for a VehicleListing
87   * @param {org.acme.vehicle.auction.Offer} offer - the offer
88   * @transaction
89   */
90  function makeOffer(offer) {
91      var listing = offer.listing;
92      if (listing.state !== 'FOR_SALE') {
93          throw new Error('Listing is not FOR SALE');
94      }
95      if (listing.offers == null) {
96          listing.offers = [];
97      }
98      listing.offers.push(offer);
99      return getAssetRegistry('org.acme.vehicle.auction.VehicleListing')
100         .then(function(vehicleListingRegistry) {
101             // save the vehicle listing
102             return vehicleListingRegistry.update(listing);
103         });
104 }
105
```

This implements the *makeOffer* function, which is executed when the *Offer* transaction is invoked on the blockchain. (It is the **@param** comment above the function that links the full transaction name as defined by the model to the Javascript method that implements it.)

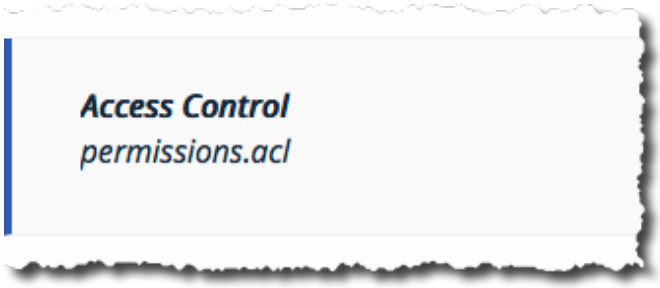
Other Interesting areas of the function implementation include:

a) The logic that the vehicle must be for sale to submit an offer on it
b) The retrieval and update of the asset registry a few lines later
c) Saving the updated asset back to the registry

1.3.3. Access Control List

The final file that defines the blockchain application is the Access Control List, which describes the rules which govern which participants in the business network can work with which parts of the blockchain.

__12. Click the permissions.acl file:



__13. Look at the ACL rules defined:

```
/**
 * Access Control List for the auction network.
 */
rule Auctioneer {
    description: "Allow the auctioneer full access"
    participant: "org.acme.vehicle.auction.Auctioneer"
    operation: ALL
    resource: "org.acme.vehicle.auction"
    action: ALLOW
}

rule Member {
    description: "Allow the member read access"
    participant: "org.acme.vehicle.auction.Member"
    operation: READ
    resource: "org.acme.vehicle.auction"
    action: ALLOW
}

rule VehicleOwner {
    description: "Allow the owner of a vehicle total access"
    participant(m): "org.acme.vehicle.auction.Member"
    operation: ALL
    resource(v): "org.acme.vehicle.auction.Vehicle"
    condition: (v.owner.getIdentifier() == m.getIdentifier())
    action: ALLOW
}

rule VehicleListingOwner {
    description: "Allow the owner of a vehicle total access to their vehicle listing"
    participant(m): "org.acme.vehicle.auction.Member"
    operation: ALL
    resource(v): "org.acme.vehicle.auction.VehicleListing"
    condition: (v.vehicle.owner.getIdentifier() == m.getIdentifier())
    action: ALLOW
}
```

The rule allows or denies users to access aspects of the blockchain.

Add Three Participants

In the next section we will now work with this blockchain application as currently deployed. (It is also possible to make changes to these files and click the 'Deploy' button to make them live, although it might be first necessary to Reset the blockchain – see later.)

We will first instantiate three *Member* participants of the car auction business network:

- Alice Smith (alice@foo.com), who will make a bid on a car,
- Bob Jones (bob@foo.com), who will also make a bid on a car, and
- Charlie Brown (charlie@foo.com), who currently owns a car.

We will not instantiate an Auctioneer in this demo; this could be used in order to provide oversight of the network, although is not necessary.

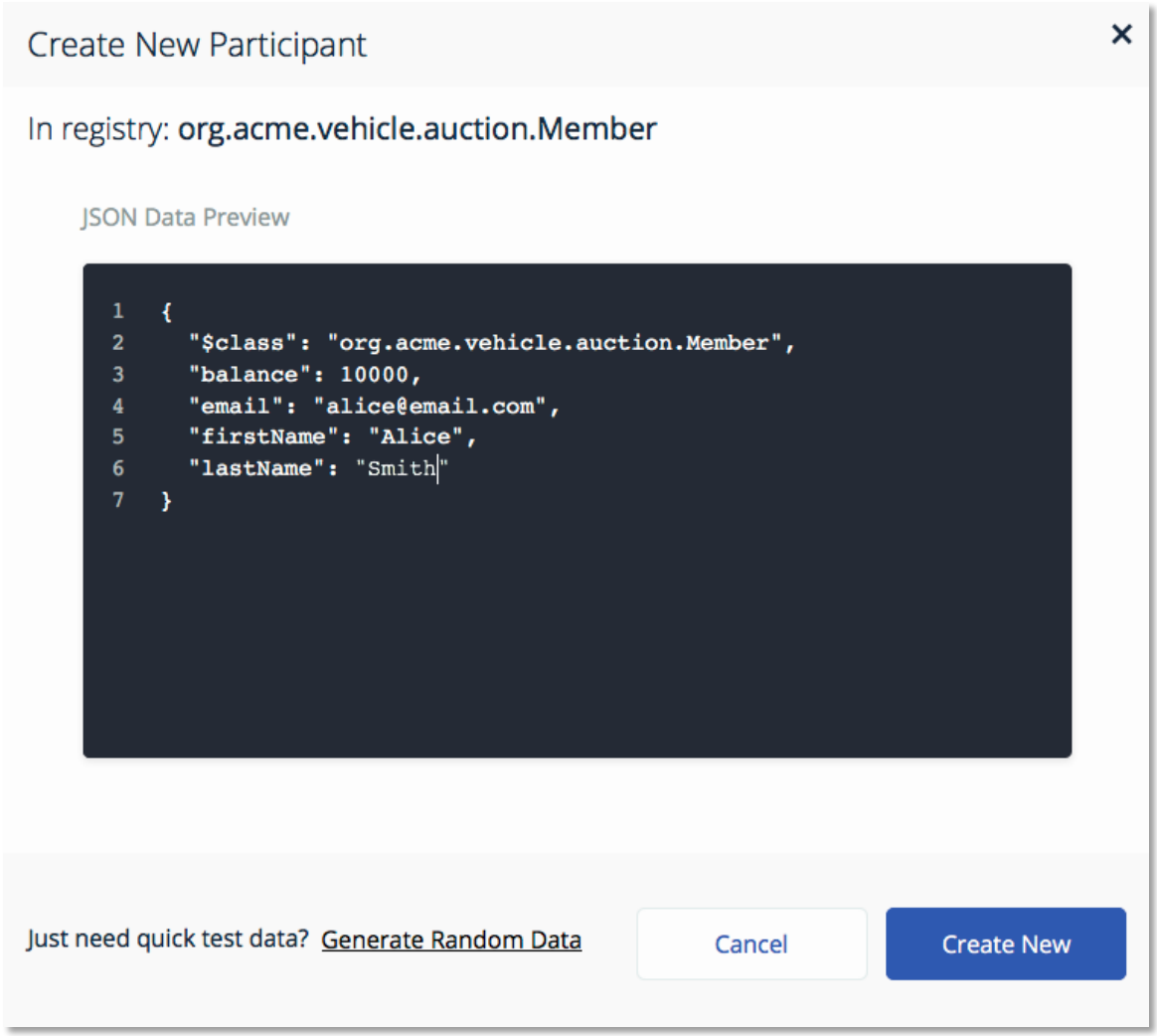
__14. Click the **Test** tab and then click on the *Member* participant registry:

The registry is empty as no members have currently been defined.

__15. Click on **Member** to view there are no current members in the environement

__16. Click **Create New Participant** to add a new Member.

__17. Type the correct values into the JSON data structure to add Alice to the business network. Let's give her a starting balance of 10000.



__18. Click **Create New** to add Alice to the registry.

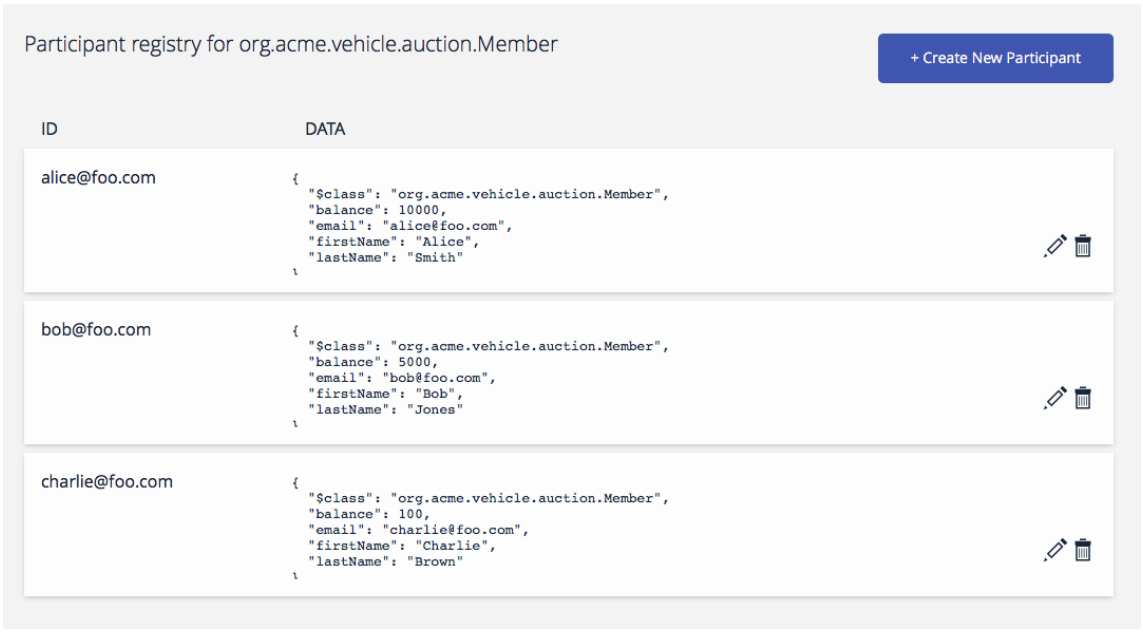
__19. Do the same for Bob. Let's give him a starting balance of 5000.

```
{
  "$class": "org.acme.vehicle.auction.Member",
  "balance": 5000,
  "email": "bob@email.com",
  "firstName": "Bob",
  "lastName": "Jones"
}
```

__20. Finally do the same for Charlie. He hasn't got so much money (he's selling his car, after all) so let's give him a starting balance of 100.

```
{
  "$class": "org.acme.vehicle.auction.Member",
  "balance": 100,
  "email": "charlie@email.com",
  "firstName": "Charlie",
  "lastName": "Brown"
}
```

__21. Verify that all participants in the business network have been correctly defined. Use the appropriate Edit button ( ) to make any changes.



Add an Asset

We will now add Charlie's car to the Vehicle Asset registry.

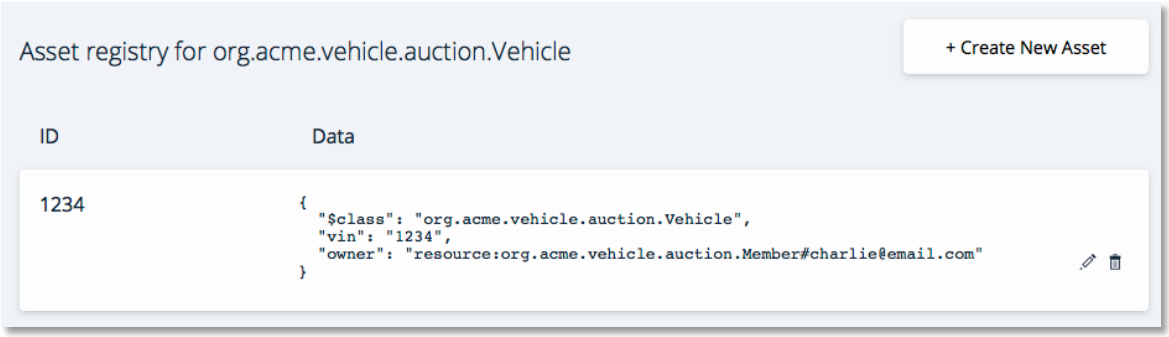
__22. Click the ***Vehicle*** asset registry.

__23. This registry contains no assets currently. Click the **Create New Asset** button to add a new asset.

__24. Instantiate the car by adding a vehicle identification number (VIN) of 1234 and assign it to Charlie by filling in the JSON object as follows. (We use his email address to identify him; this was specified as the key field in the User definition using the 'identified by' statement.)

```
{
  "$class": "org.acme.vehicle.auction.Vehicle",
  "vin": "1234",
  "owner": "resource:org.acme.vehicle.auction.Member#charlie@email.com"
}
```

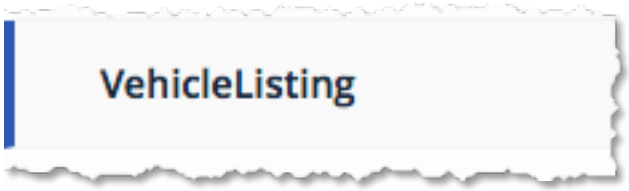
__25. View your newly added asset in the registry.



Add a Vehicle Listing

In this section we will put the car up for sale by creating a *VehicleListing* instance.

__26. Click the ***VehicleListing*** asset registry. Once more, the VehicleListing registry should be empty.



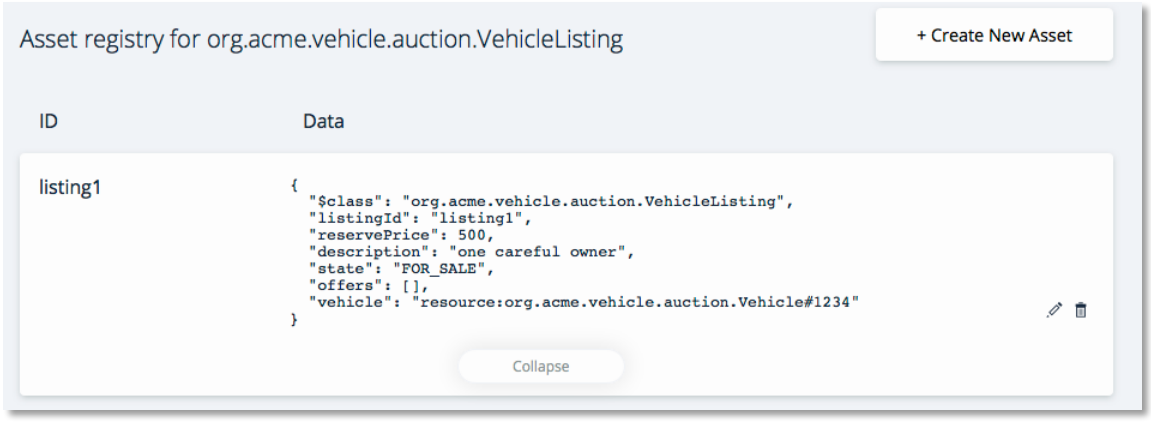
__27. Click the **Create New Asset** button to add the asset.

__28. Press the "**Generate Random Data**" button to populate the asset with random data.

__29. Update the fields and remove the random offers to show the below. Syntactic validation of the object occurs at this point, so correct any errors if necessary.

```
{
  "$class": "org.acme.vehicle.auction.VehicleListing",
  "listingId": "listing1",
  "reservePrice": 500,
  "description": "one careful owner",
  "state": "FOR_SALE",
  "offers": [],
  "vehicle": "resource:org.acme.vehicle.auction.Vehicle#1234"
}
```

__30. View the listing in the registry.

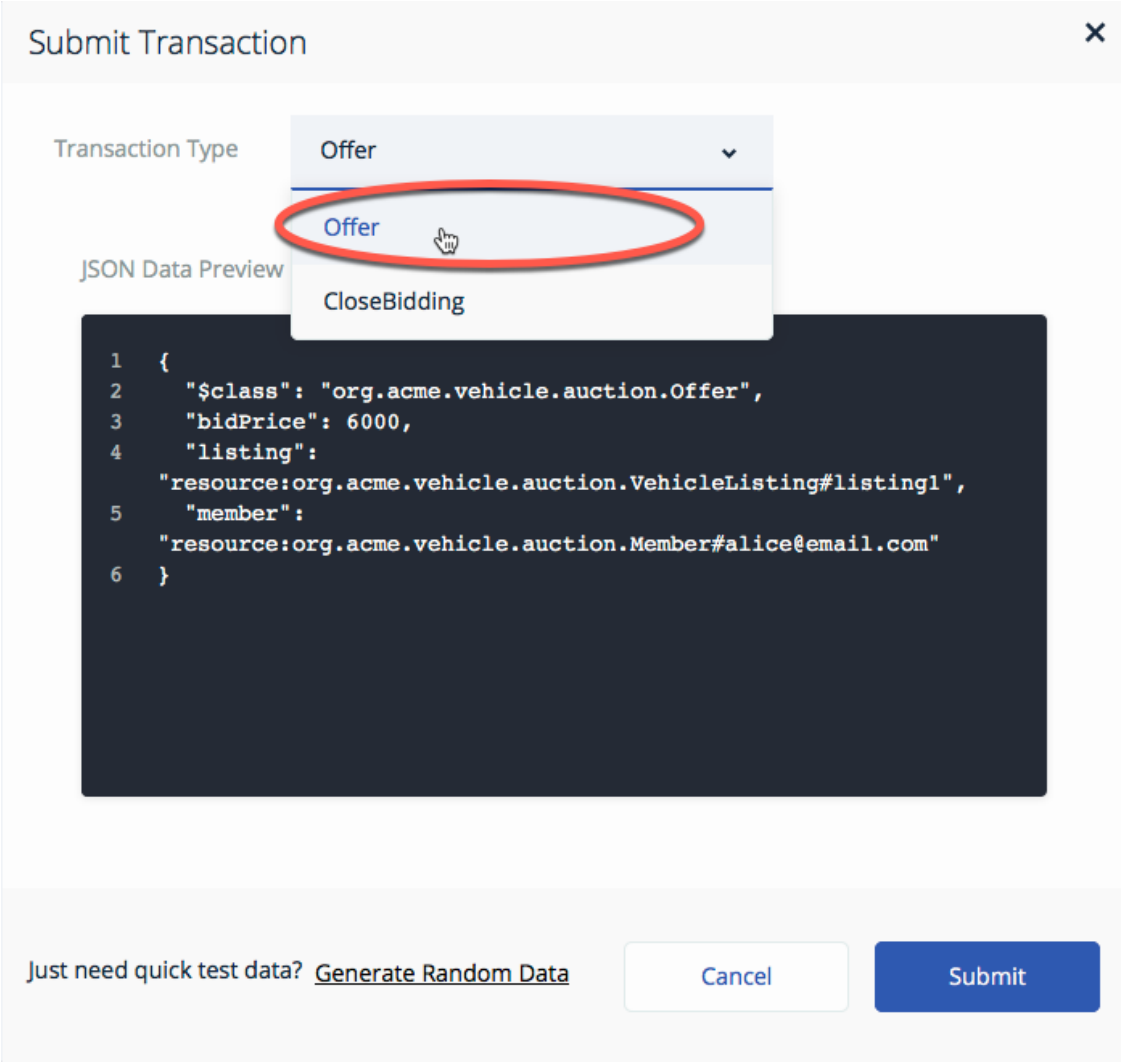


Submit offers on the vehicle

We will now let Alice and Bob bid on the vehicle.

__31. Click on the Submit Transaction button

__32. Let Alice put in a bid of 6000.

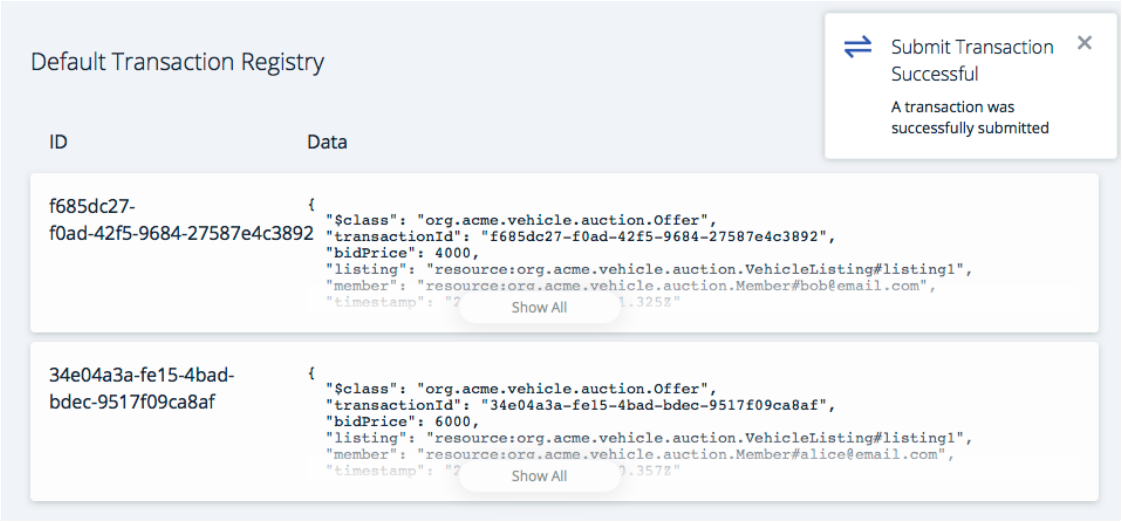


__33. See the transaction successful

__34. Let Bob put in a bid of 4000.

```
{
  "$class": "org.acme.vehicle.auction.Offer",
  "bidPrice": 4000,
  "listing":
"resource:org.acme.vehicle.auction.VehicleListing#listing1",
  "member":
"resource:org.acme.vehicle.auction.Member#bob@email.com"
}
```

__35. Verify the transactions in the registry.

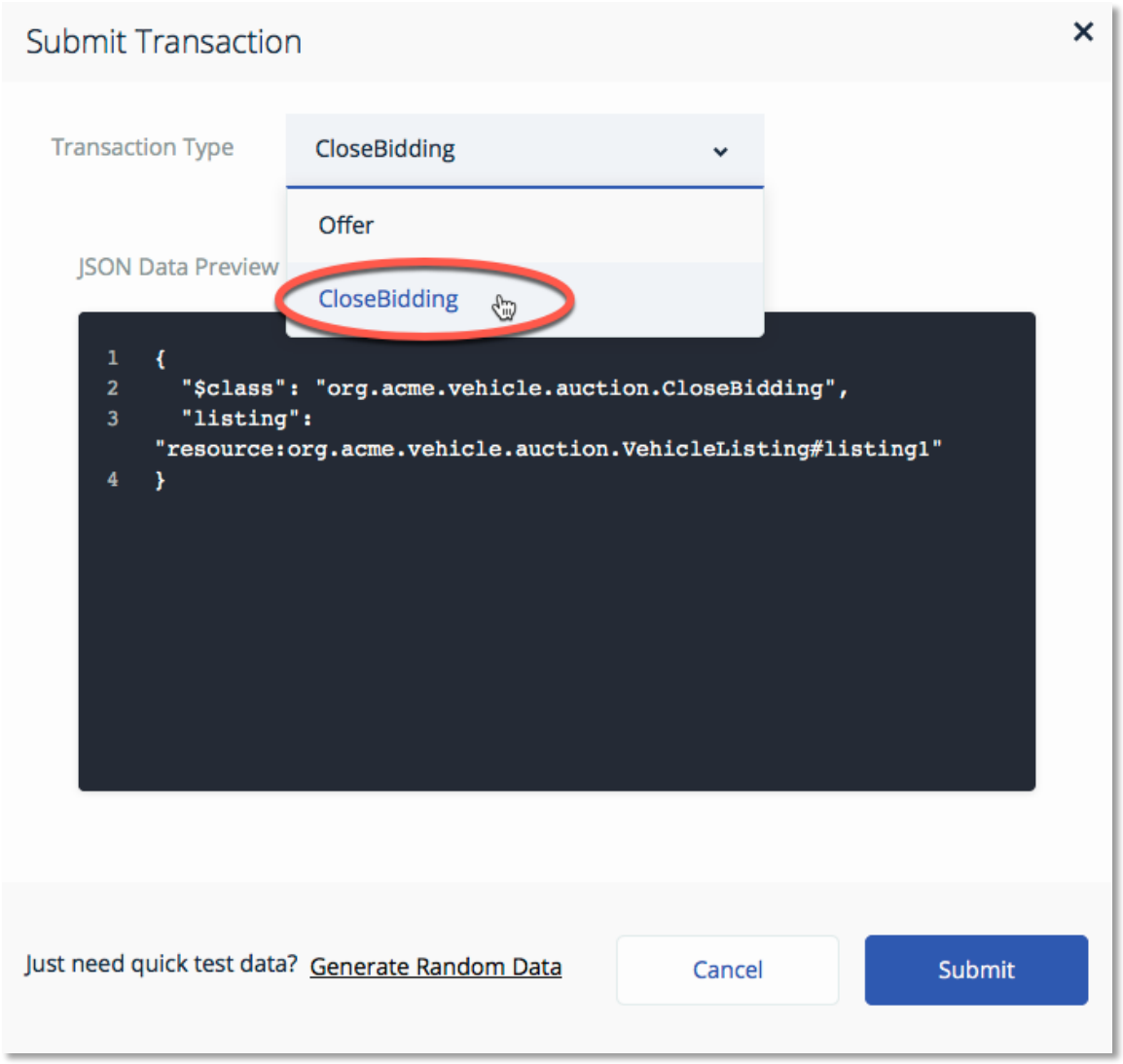


Note that the transactions cannot be edited or individually deleted once submitted; this is one of the defining characteristics of a blockchain.

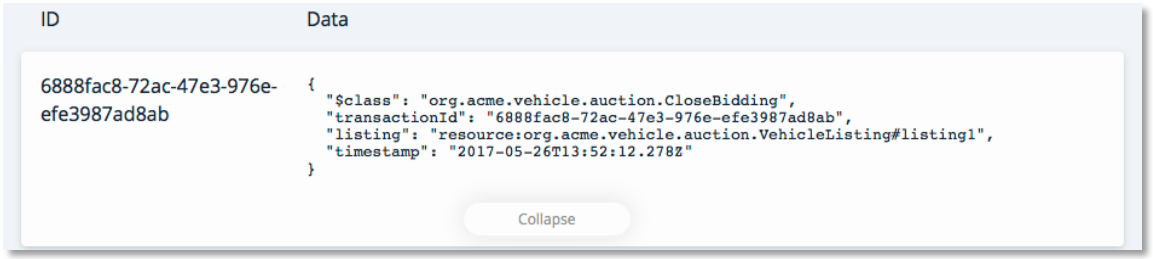
Closing the bidding

To close the bidding on the listing we need to submit a *CloseBidding* transaction.

__36. Submit a new transaction, this time selecting **CloseBidding** from the drop-down 'Transaction Type' field.

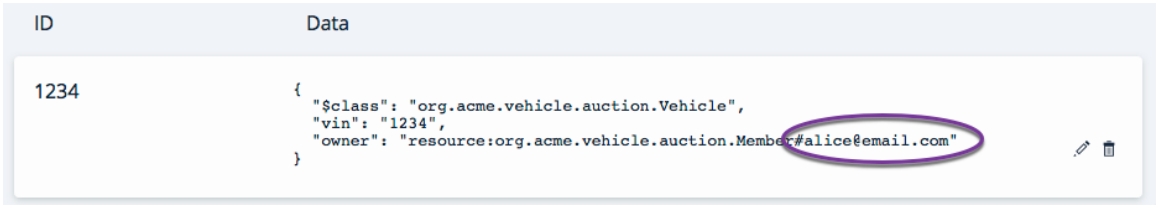


__37. Verify that the transaction has been added to the blockchain transaction registry.



Based on the bids we submitted, Alice should now be the owner as she put in the highest bid. We should also be able to verify that the owner of the car has changed and appropriate balances increased or decreased accordingly.

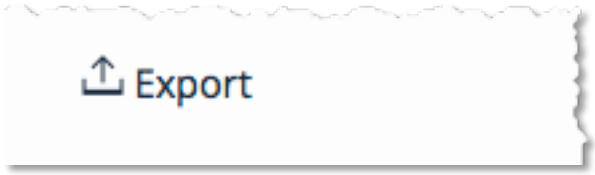
__38. Go to the *Vehicle* asset registry to see the vehicle owner has been updated to Alice.



__39. Go to the *Member* asset registry to see that Charlie's balance has increased by the winning bid amount, and that Alice's balance has decreased by the same.

Export the Business Network Archive

__40. Exporting to a Business Network Archive will save the Read Me, Model File(s), Script File(s) and Access Control rules that can be easily imported to a local developer enviroment, handed to a network operator to deploy to a live network or saved asa backup. More details on local installation at http://fabric-composer.org.


Export

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