IBM Blockchain Hands-On
The Composer Node.js SDK

Lab Two

Contents

Overview

The aim of this lab is to examine the node.js SDK for creating applications that interact with a Composer network. It will involve a brief overview of creating business networks with the command line tools and then mirror the latter part of Lab 1, creating and manipulating assets using the SDK. Identity management in Composer will also be explored in this lab and the effects of ACLs from the previous lab will be revisited.

Introduction

Pre-requisites:

- 4 cores
- 4GB RAM
- VMWare V10+
- The lab virtual machine

The virtual machine is based on Linux Ubuntu 16.04 and contains Hyperledger Fabric v1.0, Golang, Git, Visual Studio Code, Firefox, Hyperledger Composer v0.72.

A network needs to be visible to the virtual machine (even if the network is just to the host environment). If you do not see the up/down arrows in the status bar at the top of the screen, or if you receive errors about no network being available, please tell the lab leader. The virtual machine might need to be reconfigured in NAT mode.

There are no additional files or software that is proprietary to the lab in the virtual machine. This means that the lab may be run on a machine without the without a lab virtual machine if Hyperledger Fabric and the other pre-requisites have been installed.

It is recommended that students have previously completed the Blockchain Explained and Blockchain Explored labs.

Section 1. CLI Tool and Archiving

In this section we will look at how to create business network archive (.bna) files with the CLI tools. Please refer to the Setup Lab for reference on how these tools are set up on an Ubuntu machine.

1.1. Stand up the network

cd to `~/workspace/composer-getting-started` and run `start.sh`

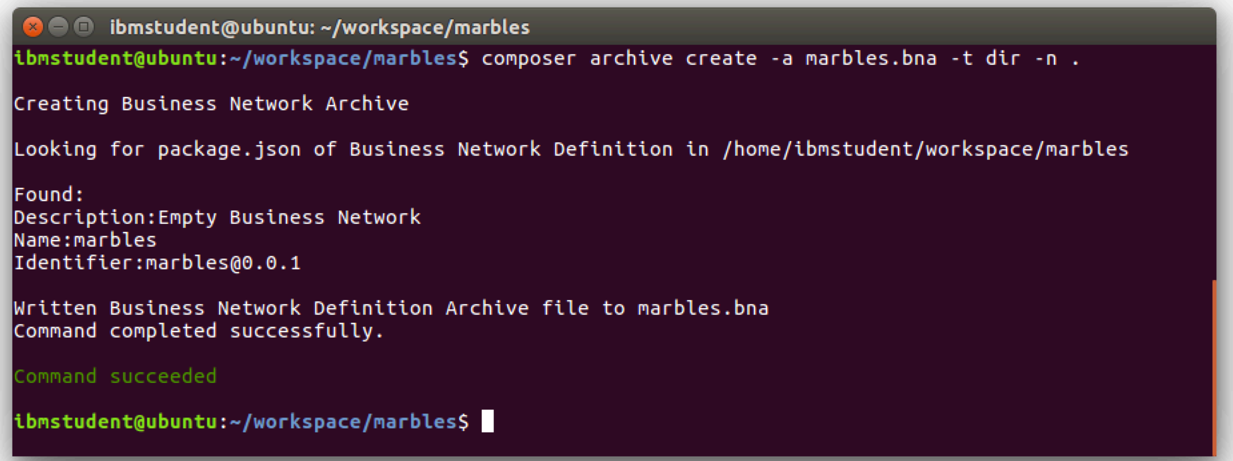
1.2. Creating Archives

Navigate to the directory that you extracted marbles into. Now it has been modified you need to package it back up into a business network archive or `.bna` file ready for re-upload back to the network.

To create an archive use the `composer archive create` command like so:

```
composer archive create -a marbles.bna -t dir -n .
```

This creates an archive called `marbles.bna` from the current directory and outputs it in the current directory. For more information on the command line tools issue `composer --help` or otherwise append the `--help` flag to any command for more information.



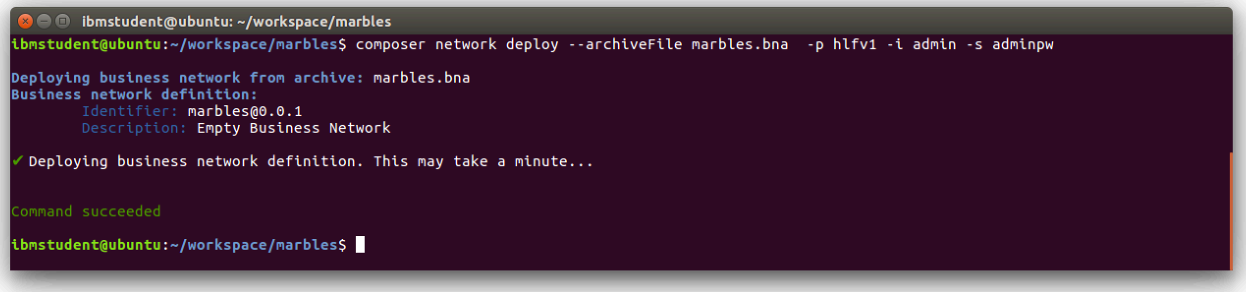
```
ibmstudent@ubuntu: ~/workspace/marbles
ibmstudent@ubuntu:~/workspace/marbles$ composer archive create -a marbles.bna -t dir -n .

Creating Business Network Archive

Looking for package.json of Business Network Definition in /home/ibmstudent/workspace/marbles

Found:
Description:Empty Business Network
Name:marbles
Identifier:marbles@0.0.1

Written Business Network Definition Archive file to marbles.bna
Command completed successfully.

Command succeeded

ibmstudent@ubuntu:~/workspace/marbles$
```

1.3. Deploying Archives

Now we have a business network archive we need to upload it to the network. To do so employs the `composer network deploy` command like so:

```
composer network deploy --archiveFile marbles.bna  -p hlfv1 -i admin -s adminpw
```

This command takes an archive named `marbles.bna` and deploys it to the network specified in the `hlfv1` connection profile, authenticating the transaction with some credentials (in this case the username and password of the inbuilt admin account).



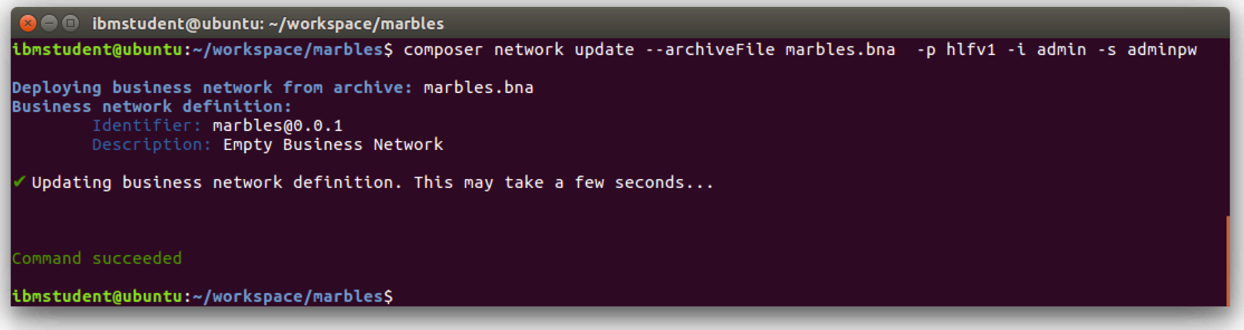
```
ibmstudent@ubuntu: ~/workspace/marbles
ibmstudent@ubuntu:~/workspace/marbles$ composer network deploy --archiveFile marbles.bna  -p hlfv1 -i admin -s adminpw

Deploying business network from archive: marbles.bna
Business network definition:
        Identifier: marbles@0.0.1
        Description: Empty Business Network

✓ Deploying business network definition. This may take a minute...


Command succeeded

ibmstudent@ubuntu:~/workspace/marbles$
```

1.4. Updating Archives

If we make any edits to the business network it will have to be updated, to push the new version recompile the network definition into an archive file (as seen in step 1.2 above) and use the following command to update it:

```
composer network update --archiveFile marbles.bna  -p hlfv1 -i admin -s adminpw
```

The syntax to this is identical to that of the `deploy` command.



```
ibmstudent@ubuntu: ~/workspace/marbles
ibmstudent@ubuntu:~/workspace/marbles$ composer network update --archiveFile marbles.bna  -p hlfv1 -i admin -s adminpw

Deploying business network from archive: marbles.bna
Business network definition:
        Identifier: marbles@0.0.1
        Description: Empty Business Network

✓ Updating business network definition. This may take a few seconds...



Command succeeded

ibmstudent@ubuntu:~/workspace/marbles$
```

Section 2. Manipulating and Adding Resources with the SDK

In this section we will first look at how to connect to a running fabric instance with the composer node.js SDK and secondly follow this by looking at how to add and update resources. If you are stuck at any point please refer to the examples in ~/workspace/composer-samples/Lab 2/ for reference.

2.1. Getting Started

a. Examine the base code

Navigate to `~/workspace/composer-samples/Lab 2/marbles-client` and open a file called `skeleton.js` with Visual Studio Code. it’s contents should look like the following:

```
const BusinessNetworkConnection = require('composer-client')
                                                            .BusinessNetworkConnection;
let bizNetConnection = new BusinessNetworkConnection();

// Connect
bizNetConnection.connect("hlfv1", "marbles", "admin",
"adminpw").then(function(bizNetDef) {
    console.log("Connected to Network");

// Disconnect
}).then(function() {
    console.log("Done!");
    return bizNetConnection.disconnect();

// Exit wuth Success
}).then(function() {
    console.log("Disconnected from Network");
    process.exit(0);

// Catch any errors
}).catch(function (error) {
    console.log(error);
    process.exit(1);
});
```

This is the most rudimentary code to interact with a composer network running on fabric. It connects and then disconnects. Let’s look at how.

b. Connecting

Connections to composer networks are established through a `BusinessNetworkConnection` object. This is a wrapper for the Hyperledger Fabric Client chain object that is customised to interact with Composer. The arguments in the `connect` function are as follows:

```
connect(<connection profile name>, <business network>, <username>, <secret>)
```

Connection profiles can be found in `$HOME/.composer-connection-profiles/` specify connection details for a fabric to connect to. The `hlfv1` profile was generated by `start.sh`.

c. Disconnecting

To disconnect from the composer network make a call to the disconnect method of the `BusinessNetworkConnection` object:

```
bizNetConnection.disconnect();
```

d. Promises

From inspecting the code above you will see that it is formed as a 'promise chain'. A promise is an object returned by asynchronous functions that upon their return triggers an attached callback (the `.then()` functions).

All of the Composer SDK's functions return promises, as such (as will be seen in this lab) code is often structured as a promise chain, with a series of `then()` methods resolving each section.

2.2. Adding Resources

a. Create a new file

`cd` back to `~/workspace` and create a new folder called `marbles-client` and `cd` into it.

Copy the contents of `skeleton.js` into a new file called `add-collector.js`.

b. Get the business network definition

Before and within the first promise callback add the following:

```
let factory;

bizNetConnection.connect("hlfv1", "marbles", "admin", "adminpw").then(function
(bizNetDef) {
      factory = bizNetDef.getFactory();
}) ...
```

The business network definition object is a representation of the business network and produces a factory object that is used to create new resources. Factories are objects that produced pre-formed but empty for us to use (i.e. objects with the current fields but no data). Therefore, we need to save the factory for later use.

c. Get the registry

To add a new resource to the network you need to add it to that resource's registry, as such we will need to fetch the registry object. Below the line of code capturing the factory add the following:

```
return bizNetConnection.getParticipantRegistry("org.acme.model.Collector");
```

This will return a promise so we need a new callback to capture the registry when it is returned. Add a new `then()` after the first and before the disconnection code to capture the registry:

```
    ...
    return bizNetConnection.getParticipantRegistry("org.acme.model.Collector");
}).then(function(collectorRegistry) {
    // Add this
// Disconnect
}).then(function() {
    console.log("Done");
    return bizNetConnection.disconnect();
})
```

d. Create a new resource

Within the body of this new callback, make a call to the factory:

```
    let newCollector = factory.newResource("org.acme.model",
                                          "Collector",
                                          "tom@ibm.com");
```

As said before, factory objects create properly formed by empty objects for us to populate and use. The `newResource` function creates a resource based on the supplied namespace and resource name and assigns it the supplied id.

e. Populate it's attributes

Although we have our new resource, its fields are all empty. As such, we must populate it's attributes with the relevant details. Add the following below the declaration of `newCollector`:

```
    newCollector.firstname = "Tom";
    newCollector.surname = "Appleyard";

    newCollector.address = factory.newConcept("org.acme.model", "Address");
    newCollector.address.house = "IBM Bluemix Garage";
    newCollector.address.street = "1 Fore Street";
    newCollector.address.county = "London"
    newCollector.address.postcode = "EC2Y 9DT";
    newCollector.address.country = "United Kingdom";

    newCollector.sex = "MALE";
```

Concepts are also created with the factory using the `newConcept` function. Much like with resources once a concept is created it's attributes must be populated. Factories are also used to create relationships between resources as we will see when we add a `Marble`.

f. Add it to the registry

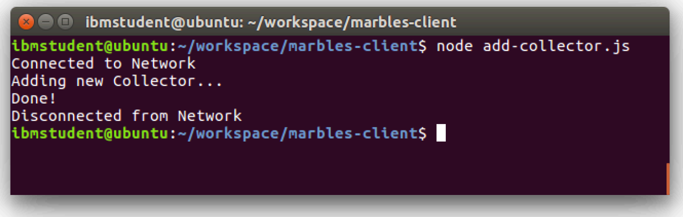
Finally the new resource must be added to the registry for it to exist on the system. Add the following below the code populating the resource:

```
return collectorRegistry.add(newCollector);
```

g. Test add-collector.js

To run the script, issue the following commands from within the marbles-client folder:

```
npm install composer-client
node add-collector.js
```



```
ibmstudent@ubuntu:~/workspace/marbles-client$ node add-collector.js
Connected to Network
Adding new Collector...
Done!
Disconnected from Network
ibmstudent@ubuntu:~/workspace/marbles-client$
```

2.3. Reading Resources

h. Create a new file for reading

Copy the contents of `skeleton.js` into a new file called `read-resources.js`.

i. Get the resources

Resources are stored in registries in composer. Much like with adding resources,to read information we will first need the registry in which they are stored. Add the following in the body of the first promise callback:

```
bizNetConnection.connect("hlfv1", "marbles", "admin", "adminpw").then((bizNetDef) =>
{
    return bizNetConnection.getParticipantRegistry("org.acme.model.Collector");
}).then(function(collectorRegistry) {
    return collectorRegistry.getAll();
}).then(function(collectors) {
}).then(function() {
    return bizNetConnection.disconnect();
})
```

First a call is made to the `BusinessNetworkConnection` object to fetch the registry as was the case with the adding resource code. The registry is then asked to package all the assets it is storing into an array with `getAll()`. The promise chain is continued twice here – first to capture the registry and second to capture the array.

j. Print the resources

The `collectors` argument is an array of objects representing the resources in the registry. Their attributes are accessed in the same manner that any JavaScript object is accessed using dot notation i.e. `<object>.<attribute>`.

Add the following in the body of the `collectors` promise callback:

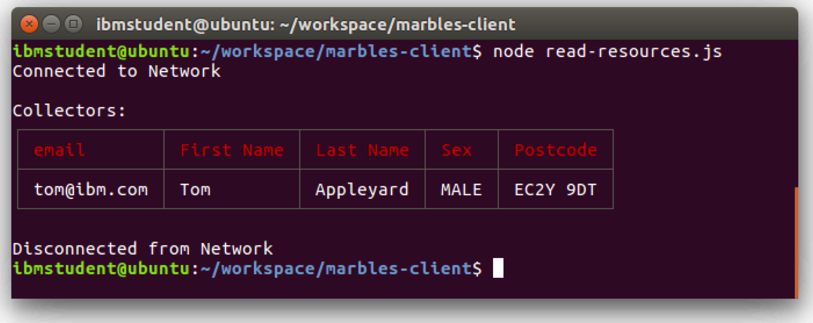
```
}).then(function(collectors) {
    let table = new Table({
        head: ['email', 'First Name', 'Last Name', 'Sex', 'Postcode']
    });

    collectors.forEach(function(collector) {
        let row = [];
        row.push(collector.email);
        row.push(collector.firstname);
        row.push(collector.surname);
        row.push(collector.sex);
        row.push(collector.address.postcode);
        table.push(row);
    });

    console.log("Collectors:");
    console.log(table.toString());
    console.log("");
})
```

In addition to the above, below the require statement importing `BusinessNetworkConnection` at the top of the file add `const Table = require('cli-table');` this is a library for outputting formatted asci tables.

k. Test read-resources.js

To test the read script run the following command:

```
npm install cli-table
node read-resources.js
```



ibmstudent@ubuntu: ~/workspace/marbles-client

```
ibmstudent@ubuntu:~/workspace/marbles-client$ node read-resources.js
Connected to Network

Collectors:
┌──────────────┬────────────┬───────────┬──────┬──────────┐
│ email        │ First Name │ Last Name │ Sex  │ Postcode │
├──────────────┼────────────┼───────────┼──────┼──────────┤
│ tom@ibm.com  │ Tom        │ Appleyard │ MALE │ EC2Y 9DT │
└──────────────┴────────────┴───────────┴──────┴──────────┘

Disconnected from Network
ibmstudent@ubuntu:~/workspace/marbles-client$
```

2.4. Add Marbles and a new Collector

a. Marbles

Based on the instructions in 2.2 and 2.3, write an add-marble.js script. The only difference between the two processes is the following:

`bizNetConnection.get`**`Participant`**`Registry` is `bizNetConnection.get`**`Asset`**`Registry`

As the `owner` attribute is a relationship you will need to employ the `factory` to create a relationship:

```
newMarble.owner = factory.newRelationship("org.acme.model",
                                          "Collector",
                                          "tom@ibm.com")
```

You should set the ID of the marble you will be inputting to `MARBLE001`. Once you have created `add-marble.js`, expand `read-resources.js` so that it reads marbles too.

b. Collectors

When you have finished Marbles, comment out the code in add-collector.js that adds `tom@ibm.com` and replace it with code that creates a collector with the following attributes:

```
email = "mgk@ibm.com"
firstname = "Matthew"
surname = "Golby-Kirk"
address.house = "IBM Hursley"
address.street = "Hursley Park"
address.county = "Hampshire”
address.postcode = "SO21 2JN"
address.country = "United Kingdom"
sex = "MALE"
```

Run the updated code with `node add-collector.js`

2.5. Issuing Transactions

a. Create a new file

Copy the contents of `skeleton.js` into a new file called `transfer-marble.js`.

b. Create a new transaction

Add the following to the first promise callback:

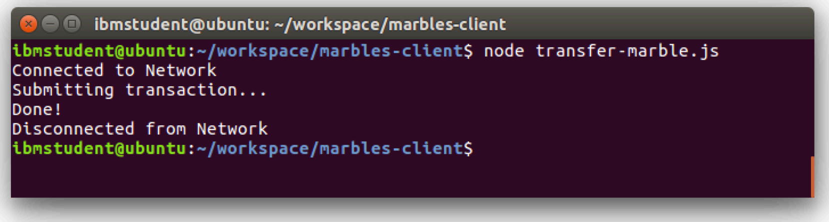
```
bizNetConnection.connect("hlfv1", "marbles", "admin",
"adminpw").then(function(bizNetDef) {
    console.log("Connected to Network");
    bizNetDefinition = bizNetDef;
    factory = bizNetDef.getFactory();

     // Create & Submit a new transaction
    console.log("Submitting transaction...");

    let newTransaction = factory.newTransaction("org.acme.model", "ChangeOwner");
    newTransaction.marble = factory.newRelationship("org.acme.model", "Marble",
                                                    "MARBLE001");
    newTransaction.newOwner = factory.newRelationship("org.acme.model", "Collector",
                                                      "mgk@ibm.com");

    return bizNetConnection.submitTransaction(newTransaction);
})
```

As you can see, transactions are created in an almost identical manner to other resources and are submitted by calling on the `BusinessNetworkConnection` to submit them.

c. Test

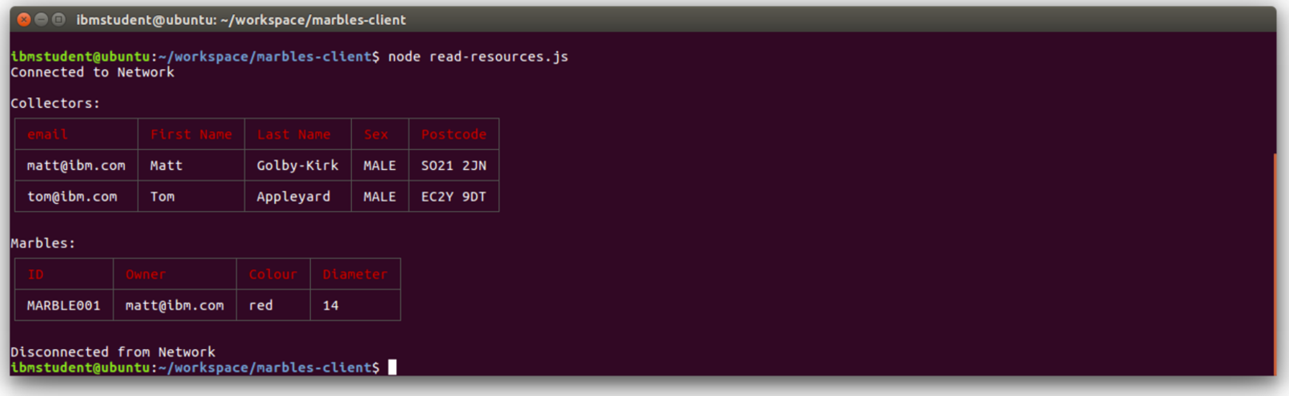
To test the transaction code, run the following:

```
node transfer-marble.js
```



```
ibmstudent@ubuntu:~/workspace/marbles-client$ node transfer-marble.js
Connected to Network
Submitting transaction...
Done!
Disconnected from Network
ibmstudent@ubuntu:~/workspace/marbles-client$
```

When this is complete, run `read-resouces.js` again, the marble should have changed owners:



```
ibmstudent@ubuntu:~/workspace/marbles-client$ node read-resources.js
Connected to Network

Collectors:
┌──────────────┬────────────┬────────────┬──────┬──────────┐
│ email        │ First Name │ Last Name  │ Sex  │ Postcode │
├──────────────┼────────────┼────────────┼──────┼──────────┤
│ matt@ibm.com │ Matt       │ Golby-Kirk │ MALE │ SO21 2JN │
├──────────────┼────────────┼────────────┼──────┼──────────┤
│ tom@ibm.com  │ Tom        │ Appleyard  │ MALE │ EC2Y 9DT │
└──────────────┴────────────┴────────────┴──────┴──────────┘

Marbles:
┌───────────┬──────────────┬────────┬──────────┐
│ ID        │ Owner        │ Colour │ Diameter │
├───────────┼──────────────┼────────┼──────────┤
│ MARBLE001 │ matt@ibm.com │ red    │ 14       │
└───────────┴──────────────┴────────┴──────────┘

Disconnected from Network
ibmstudent@ubuntu:~/workspace/marbles-client$
```

Section 3. CLI Tool and Identity Management

3.1. Issuing Identities

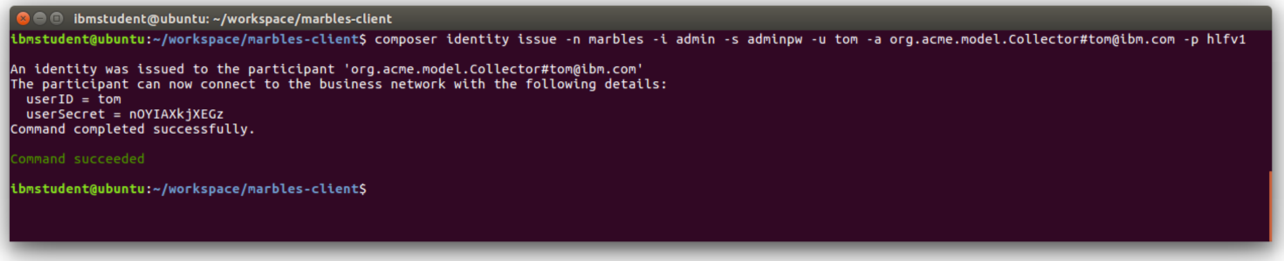
To issue an identity open a terminal and run the following command:

```
composer identity issue -n marbles -i admin -s adminpw -u tom -a
org.acme.model.Collector#tom@ibm.com -p hlfv1
```

The grammar is as follows:

```
composer identity issue -n <business network name> -i <username> -s <secret> -u
<username to be issued> -a <participant to be attached to> -p <connection profile>
```

You will be provided with a userID and a secret with which to verify your identity.



```
ibmstudent@ubuntu:~/workspace/marbles-client$ composer identity issue -n marbles -i admin -s adminpw -u tom -a org.acme.model.Collector#tom@ibm.com -p hlfv1

An identity was issued to the participant 'org.acme.model.Collector#tom@ibm.com'
The participant can now connect to the business network with the following details:
  userID = tom
  userSecret = nOYIAXkjXEGz
Command completed successfully.

Command succeeded

ibmstudent@ubuntu:~/workspace/marbles-client$
```

Issue another ID for `mgk@ibm.com`. Record these are they will only be presented to you once.

3.2. Using Identities

The username + secret combination presented can be used in any of the situations where composer has requested a username + secret. The most obvious example of this is in conjunction with the scripts written earlier.

Open up `transfer-marble.js` and replace the appropriate fields:

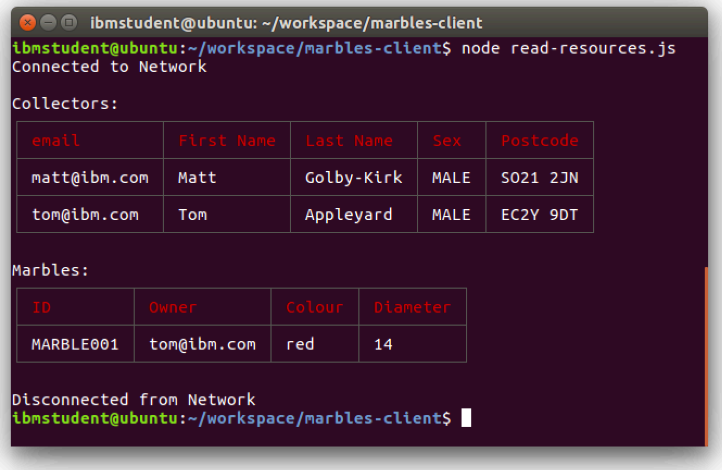
```
//bizNetConnection.connect("hlfv1", "marbles", "admin", "adminpw")
//bizNetConnection.connect("hlfv1", "marbles", “mgk”, "uSUeHZQTjzly")
bizNetConnection.connect("hlfv1", "marbles", "tom", "nOYIAXkjXEGz")
```

Recall the ACL rule that restricts updating assets to their owners:

```
rule OnlyOwnerCanEdit {
    description: "Only an owner can edit a marble"
    participant(p): "org.acme.model.Collector"
    operation: UPDATE
    resource(r): "org.acme.model.Marble"
    condition: (r.owner.getIdentifier() == p.getIdentifier())
    action: ALLOW
}
```

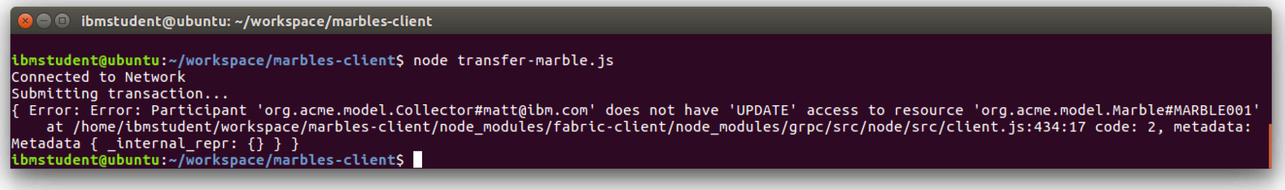
Now run `transfer-marble.js` and see the different response:

State:



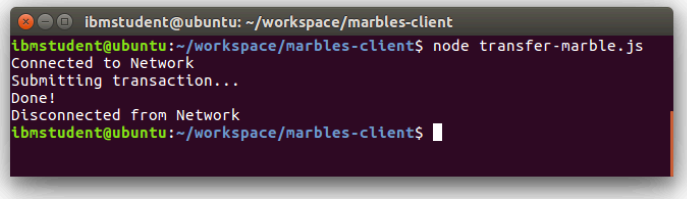
```
ibmstudent@ubuntu:~/workspace/marbles-client$ node read-resources.js
Connected to Network

Collectors:
┌────────────────┬───────────┬────────────┬──────┬──────────┐
│ email          │ First Name│ Last Name  │ Sex  │ Postcode │
├────────────────┼───────────┼────────────┼──────┼──────────┤
│ matt@ibm.com   │ Matt      │ Golby-Kirk │ MALE │ SO21 2JN │
├────────────────┼───────────┼────────────┼──────┼──────────┤
│ tom@ibm.com    │ Tom       │ Appleyard  │ MALE │ EC2Y 9DT │
└────────────────┴───────────┴────────────┴──────┴──────────┘

Marbles:
┌────────────┬─────────────┬────────┬──────────┐
│ ID         │ Owner       │ Colour │ Diameter │
├────────────┼─────────────┼────────┼──────────┤
│ MARBLE001  │ tom@ibm.com │ red    │ 14       │
└────────────┴─────────────┴────────┴──────────┘

Disconnected from Network
ibmstudent@ubuntu:~/workspace/marbles-client$
```

As MGK (not the owner):



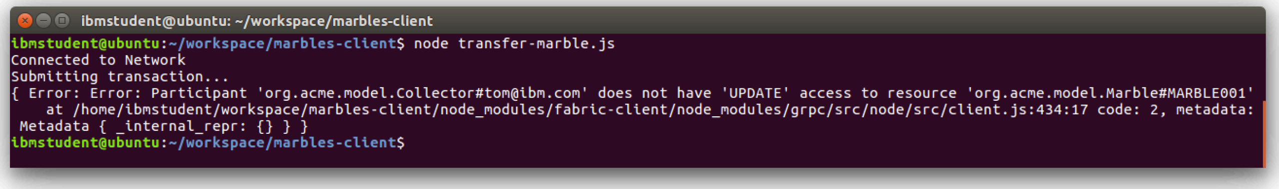
```
ibmstudent@ubuntu:~/workspace/marbles-client$ node transfer-marble.js
Connected to Network
Submitting transaction...
{ Error: Error: Participant 'org.acme.model.Collector#matt@ibm.com' does not have 'UPDATE' access to resource 'org.acme.model.Marble#MARBLE001'
    at /home/ibmstudent/workspace/marbles-client/node_modules/fabric-client/node_modules/grpc/src/node/src/client.js:434:17 code: 2, metadata:
Metadata { _internal_repr: {} } }
ibmstudent@ubuntu:~/workspace/marbles-client$
```

As Tom (the owner):



```
ibmstudent@ubuntu:~/workspace/marbles-client$ node transfer-marble.js
Connected to Network
Submitting transaction...
Done!
Disconnected from Network
ibmstudent@ubuntu:~/workspace/marbles-client$
```

As Tom (no longer the owner):



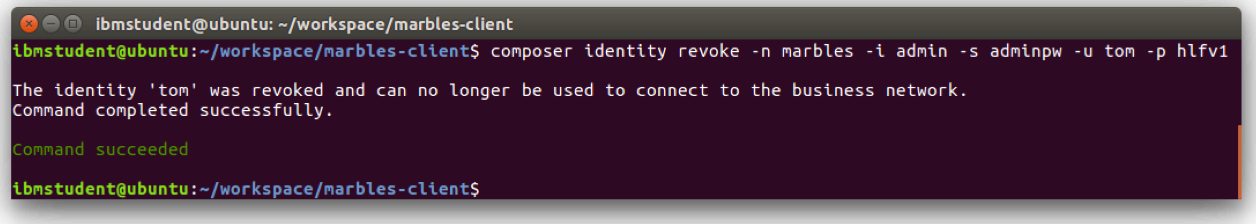
```
ibmstudent@ubuntu:~/workspace/marbles-client$ node transfer-marble.js
Connected to Network
Submitting transaction...
{ Error: Error: Participant 'org.acme.model.Collector#tom@ibm.com' does not have 'UPDATE' access to resource 'org.acme.model.Marble#MARBLE001'
    at /home/ibmstudent/workspace/marbles-client/node_modules/fabric-client/node_modules/grpc/src/node/src/client.js:434:17 code: 2, metadata:
 Metadata { _internal_repr: {} } }
ibmstudent@ubuntu:~/workspace/marbles-client$
```

3.3. Revoking Identities

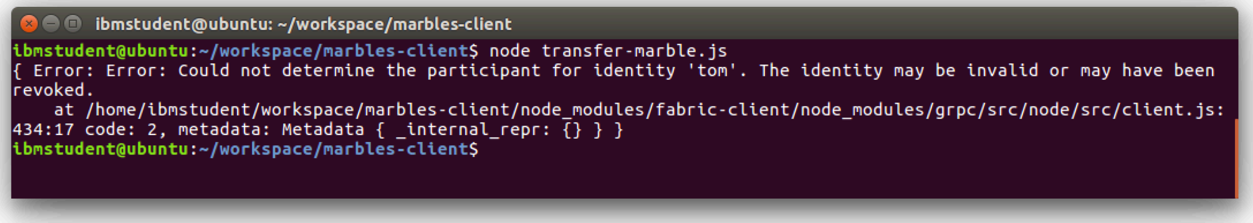
Identities can of course be revoked as well as issued. To revoke an identity issue the following:

```
composer identity revoke -n marbles -i admin -s adminpw -u tom -p hlfv1
```

Flags denote the same as the previous command.



```
ibmstudent@ubuntu:~/workspace/marbles-client$ composer identity revoke -n marbles -i admin -s adminpw -u tom -p hlfv1

The identity 'tom' was revoked and can no longer be used to connect to the business network.
Command completed successfully.

Command succeeded

ibmstudent@ubuntu:~/workspace/marbles-client$
```



```
ibmstudent@ubuntu:~/workspace/marbles-client$ node transfer-marble.js
{ Error: Error: Could not determine the participant for identity 'tom'. The identity may be invalid or may have been
revoked.
    at /home/ibmstudent/workspace/marbles-client/node_modules/fabric-client/node_modules/grpc/src/node/src/client.js:
434:17 code: 2, metadata: Metadata { _internal_repr: {} } }
ibmstudent@ubuntu:~/workspace/marbles-client$
```

Notices

Appendix A. Trademarks and copyrights

NOTES

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