HyperLedger Hackethon “Getting Started”

IBM Blockchain Fundamentals

Hands-on Lab

Intro: Getting Started – *overview of the lab exercise*

Estimated Duration: 5 minutes

Part A: IBM Blockchain as a Service – *create a blockchain service, explore the capabilities and features, and invoke some sample code*

Estimated Duration: 15 minutes

Part B: Open Points Application – *use a loyalty points application to create blockchain transactions and examine smart contract functionality*

Estimated Duration: 15 minutes

Part C: Creating Smart Contracts – *using the Open Points application, create new travel offers and add them to the blockchain as smart contracts*

Estimated Duration: 15 minutes

Contents

Intro: Getting started - *overview of the lab exercise*

What you need:

a) **Bluemix account** – to deploy the loyalty points application and to create a blockchain service
Note: *you may use your own ID (if already signed up with Bluemix) or one assigned by the instructor*

b) **Laptop with a web browser** – to login to Bluemix and use Bluemix services
Note: Google Chrome or Firefox browser is recommended

c) **Internet Connectivity**

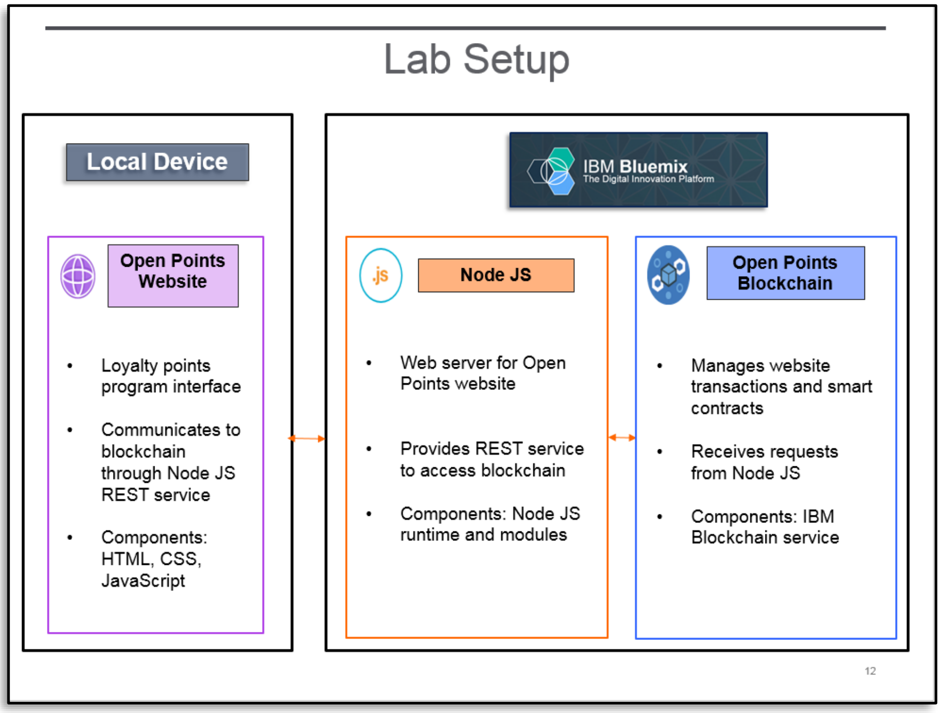
Pre-requisites setup:

The pre-requisite steps will guide you through the setup of a Bluemix account, setup of a JazzHub ID and deployment of the Chat bot application with the associated Watson services.
If you have not completed the pre-requisites, then ask your lab instructors for availability of temporary accounts to use during this lab (limited availability).
If you have completed the pre-requisites for this lab OR you have received a temporary Bluemix account/password from the instructors, then proceed to the next section (***What you will be building***).

Link to the pre-requisite: https://ibm.biz/Bdrp5r

What you will be building:

In this lab you will be building a financial services application that relies on a blockchain network to manage its transactions. As shown in the diagram below, the blockchain service runs on IBM Bluemix and relies on a Node JS runtime to communicate with the financial application. The application itself, which is a loyalty points program for travel customers, runs on the local client web browser.



Lab Setup

Local Device

Open Points Website

- Loyalty points program interface
- Communicates to blockchain through Node JS REST service
- Components: HTML, CSS, JavaScript

IBM Bluemix The Digital Innovation Platform

Node JS

- Web server for Open Points website
- Provides REST service to access blockchain
- Components: Node JS runtime and modules

Open Points Blockchain

- Manages website transactions and smart contracts
- Receives requests from Node JS
- Components: IBM Blockchain service

Each part of the lab will introduce and explain blockchain fundamentals. The primary activities of each lab section are as follows:

Part A: You will be creating a blockchain service that runs on IBM Bluemix. You will use this service to better understand blockchain technology by exploring its primary features, including the blockchain network and the chaincode deployment process.

Part B: You will use the loyalty points application and blockchain service that you deployed in the prerequisites to create blockchain transactions and examine the functionality of smart contracts. The application is a Node JS app that runs a website called Open Points. This website allows you to transfer loyalty points to other users and purchase travel packages using points. Some of these travel packages have travel offers associated with them, and these offers are applied to purchases as smart contracts that run on the blockchain. All transactions for this website are managed by the blockchain service.

Part C: You will use the loyalty points application from Part B to create your own travel offers for travel packages. You will add these travel offers to the blockchain as smart contracts, and test them by purchasing their corresponding travel packages.

Blockchain Terminology:

Blockchain: A distributed system of record (ledger) that stores and manages transactions as a single chain of blocks. Each block contains one or more transactions, and is linked to the previous block of transactions.

Chaincode: Software that controls the behavior of the blockchain network. Common functionality for this software includes adding transactions, retrieving data about existing transactions, and implementing smart contracts.

Network: The collection of computer nodes that run and operate a blockchain. These nodes provide the distributed functionality of blockchain technology. Each node can perform a variety roles, including validating transactions that are submitted to the blockchain or providing user authentication.

Membership Service: The network node that provides user authentication to the blockchain network.

Validating Peer: A network node that validates transactions that are submitted to the blockchain

Smart Contract: Business contract logic that is executed automatically using software.

Part A: IBM Blockchain as a Service – *create a blockchain service, explore the capabilities and features, and deploy some sample code*

Pre-Reqs:

- *You have read the ‘Intro: Getting Started’ section and completed the prerequisites listed there.*

This part of the lab explains how to complete the following tasks:

- *Create a blockchain service using IBM Bluemix*
- *Use IBM Blockchain to monitor the blockchain network and deploy sample chaincode*

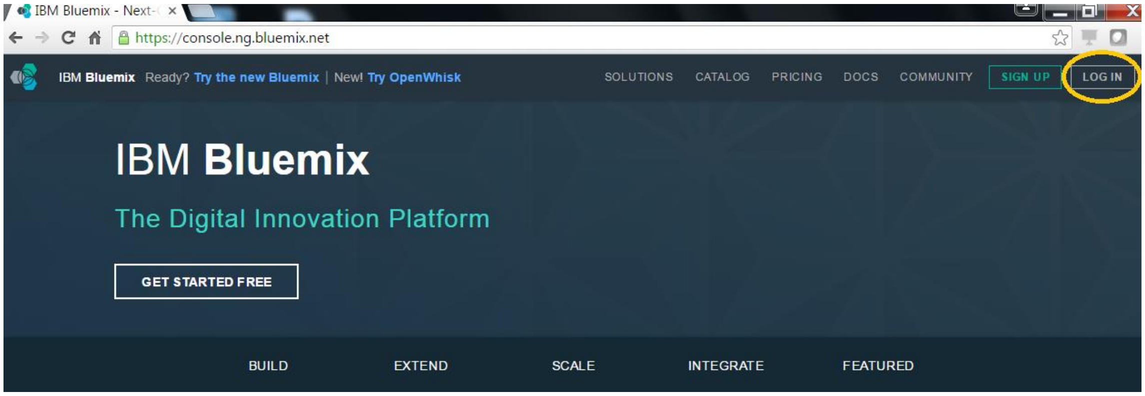
Estimated Duration: 15 minutes

1. Creating a blockchain service

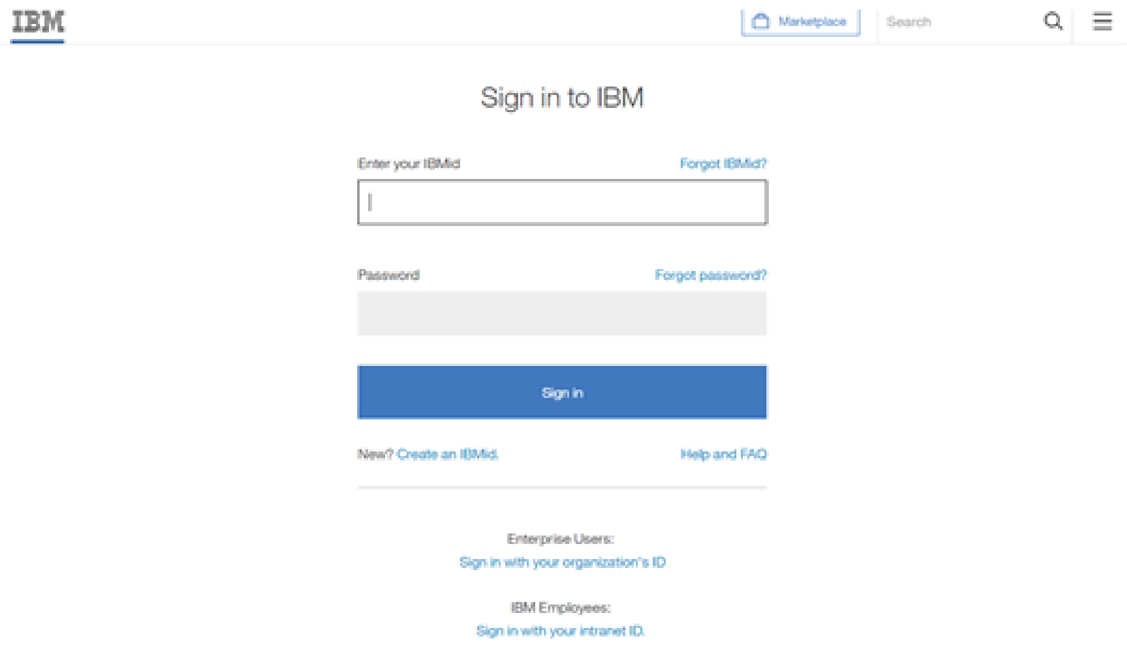
In this section, you will create a new blockchain service running on IBM Bluemix.

a) Open a new browser window

b) Go to the URL https://bluemix.net/and click **LOG IN.**



c) If you are prompted to sign in, enter your IBMid (e.g. ***jsmith@us.ibm.com)*** and password, and then click **Sign in**.



Sign in to IBM

Enter your IBMid

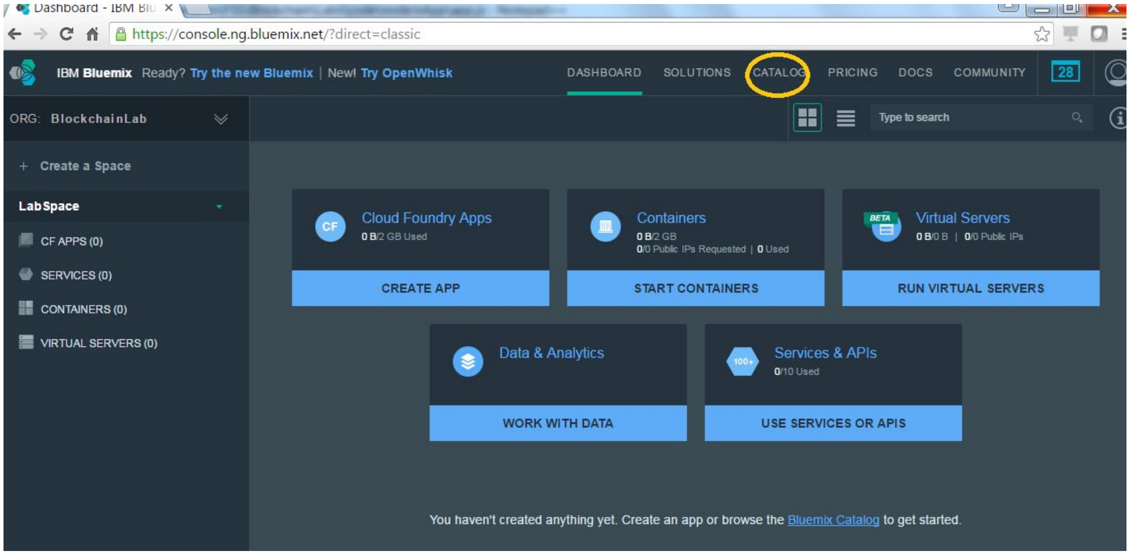
Password

New? Create an IBMid.

Enterprise Users:
Sign in with your organization's ID

IBM Employees:
Sign in with your intranet ID.

d) Once logged in, you will see a page similar to the screen below. Click the **Catalog** button to see all available Bluemix services.



https://console.ng.bluemix.net/?direct=classic

IBM Bluemix Ready? Try the new Bluemix | New! Try OpenWhisk

ORG: BlockchainLab

Cloud Foundry Apps
0 B/2 GB Used

Containers
0 B/2 GB
0/0 Public IPs Requested | 0 Used

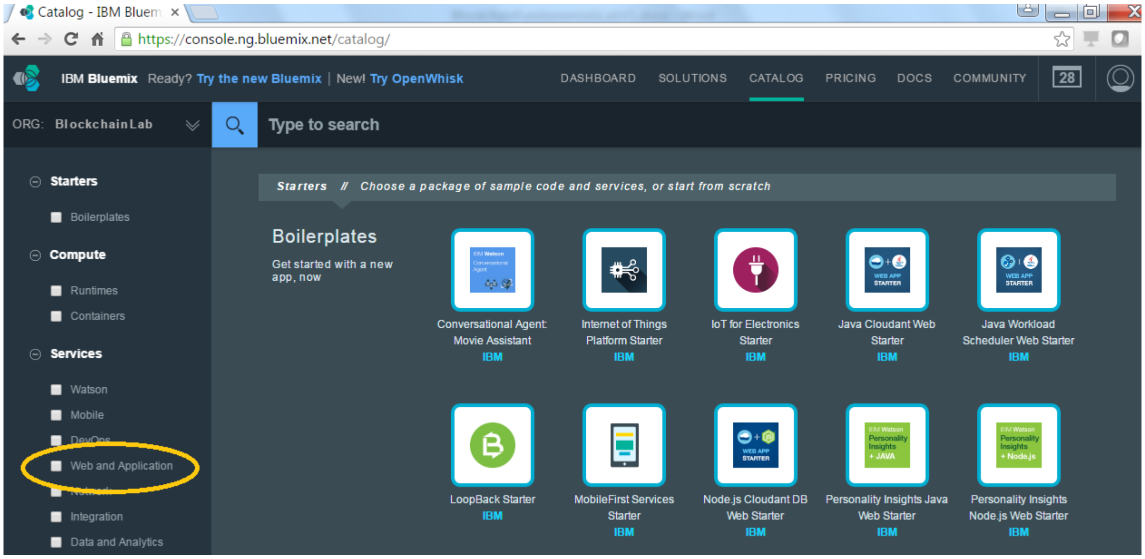
Virtual Servers
0 B/0 B | 0/0 Public IPs

Data & Analytics

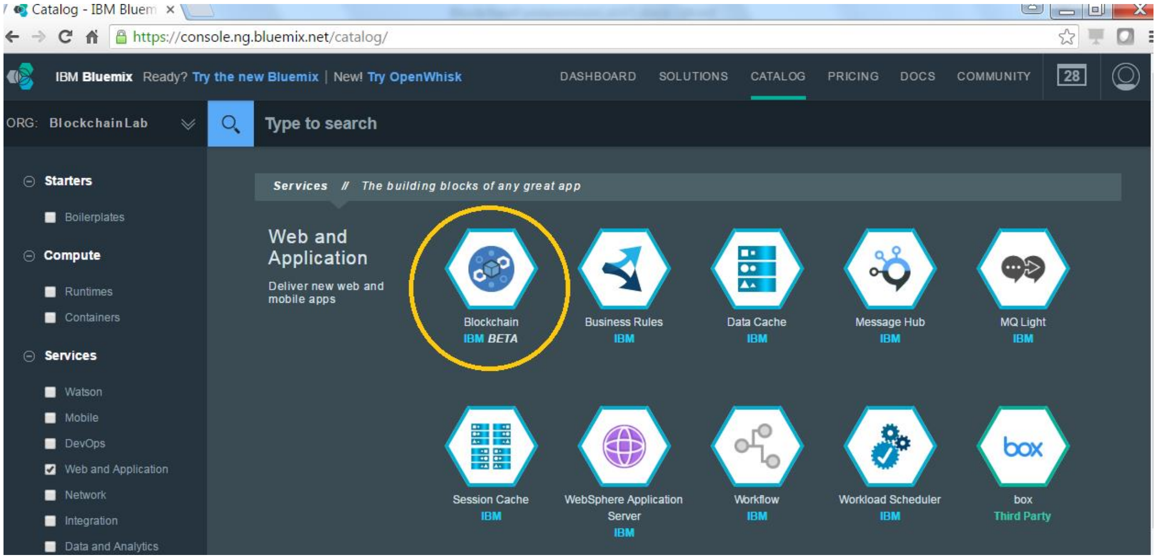
Services & APIs
0/10 Used

You haven't created anything yet. Create an app or browse the Bluemix Catalog to get started.

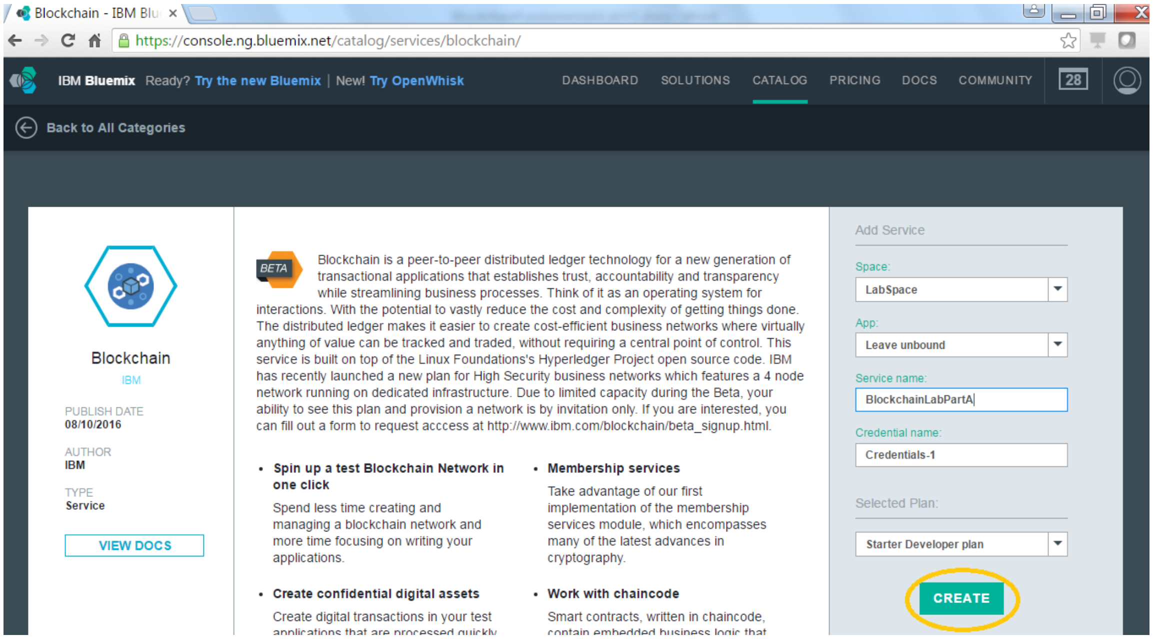
e) From the side panel on the left of the screen, click the **Web and Application** category.


Catalog - IBM Bluem
https://console.ng.bluemix.net/catalog/
IBM Bluemix Ready? Try the new Bluemix | New! Try OpenWhisk
DASHBOARD SOLUTIONS CATALOG PRICING DOCS COMMUNITY 28
ORG: BlockchainLab
Type to search
Starters
Boilerplates
Compute
Runtimes
Containers
Services
Watson
Mobile
DevOps
Web and Application
Network
Integration
Data and Analytics
Starters // Choose a package of sample code and services, or start from scratch
Boilerplates
Get started with a new app, now
Conversational Agent: Movie Assistant IBM
Internet of Things Platform Starter IBM
IoT for Electronics Starter IBM
Java Cloudant Web Starter IBM
Java Workload Scheduler Web Starter IBM
LoopBack Starter IBM
MobileFirst Services Starter IBM
Node.js Cloudant DB Web Starter IBM
Personality Insights Java Web Starter IBM
Personality Insights Node.js Web Starter IBM

f) Click the Blockchain icon from the list of Web and Application Services to create a new blockchain service.



g) Change the blockchain service name to be *BlockchainLabPartA*. Leave all other fields with their default value. Click the **Create** button.



PUBLISH DATE
08/10/2016

AUTHOR
IBM

TYPE
Service

Blockchain is a peer-to-peer distributed ledger technology for a new generation of transactional applications that establishes trust, accountability and transparency while streamlining business processes. Think of it as an operating system for interactions. With the potential to vastly reduce the cost and complexity of getting things done. The distributed ledger makes it easier to create cost-efficient business networks where virtually anything of value can be tracked and traded, without requiring a central point of control. This service is built on top of the Linux Foundations's Hyperledger Project open source code. IBM has recently launched a new plan for High Security business networks which features a 4 node network running on dedicated infrastructure. Due to limited capacity during the Beta, your ability to see this plan and provision a network is by invitation only. If you are interested, you can fill out a form to request acccess at http://www.ibm.com/blockchain/beta_signup.html.

- **Spin up a test Blockchain Network in one click**

  Spend less time creating and managing a blockchain network and more time focusing on writing your applications.

- **Create confidential digital assets**

  Create digital transactions in your test applications that are processed quickly

- **Membership services**

  Take advantage of our first implementation of the membership services module, which encompasses many of the latest advances in cryptography.

- **Work with chaincode**

  Smart contracts, written in chaincode, contain embedded business logic that

Add Service

Space: LabSpace

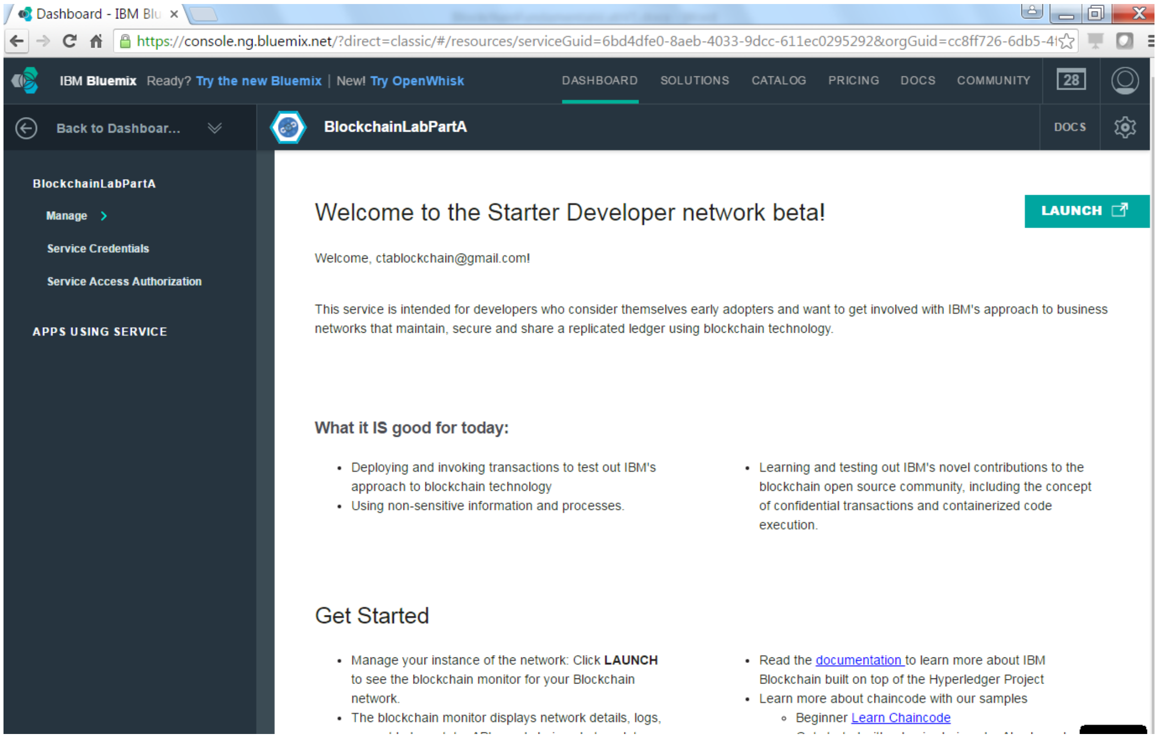
App: Leave unbound

Service name: BlockchainLabPartA

Credential name: Credentials-1

Selected Plan: Starter Developer plan

h) If the service was created successfully, you will see a welcome page similar to the one below. Congratulations, you have created an IBM Bluemix Blockchain service!


Dashboard - IBM Blu ×
https://console.ng.bluemix.net/?direct=classic/#/resources/serviceGuid=6bd4dfe0-8aeb-4033-9dcc-611ec0295292&orgGuid=cc8ff726-6db5-4
IBM Bluemix Ready? Try the new Bluemix | New! Try OpenWhisk
DASHBOARD
SOLUTIONS
CATALOG
PRICING
DOCS
COMMUNITY
28
Back to Dashboar...
BlockchainLabPartA
DOCS
BlockchainLabPartA
Manage
Service Credentials
Service Access Authorization
APPS USING SERVICE
LAUNCH

Welcome to the Starter Developer network beta!

Welcome, ctablockchain@gmail.com!

This service is intended for developers who consider themselves early adopters and want to get involved with IBM's approach to business networks that maintain, secure and share a replicated ledger using blockchain technology.

What it IS good for today:

- Deploying and invoking transactions to test out IBM's approach to blockchain technology
- Using non-sensitive information and processes.
- Learning and testing out IBM's novel contributions to the blockchain open source community, including the concept of confidential transactions and containerized code execution.

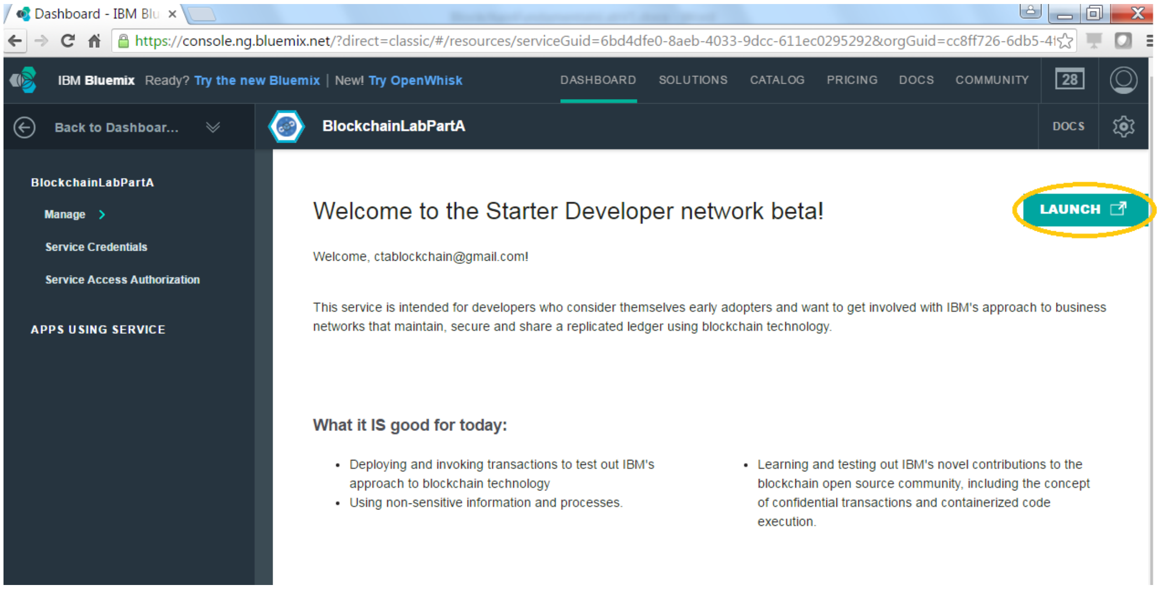
Get Started

- Manage your instance of the network: Click **LAUNCH** to see the blockchain monitor for your Blockchain network.
- The blockchain monitor displays network details, logs,
- Read the documentation to learn more about IBM Blockchain built on top of the Hyperledger Project
- Learn more about chaincode with our samples
  - Beginner Learn Chaincode

2. Exploring the capabilities of IBM Blockchain on Bluemix

In this section, you will explore the features and capabilities of IBM Blockchain and deploy some sample chaincode

a) Launch the blockchain service you created in the previous section by clicking on the green **Launch** button.


Dashboard - IBM Blu
https://console.ng.bluemix.net/?direct=classic/#/resources/serviceGuid=6bd4dfe0-8aeb-4033-9dcc-611ec0295292&orgGuid=cc8ff726-6db5-4
IBM Bluemix Ready? Try the new Bluemix | New! Try OpenWhisk
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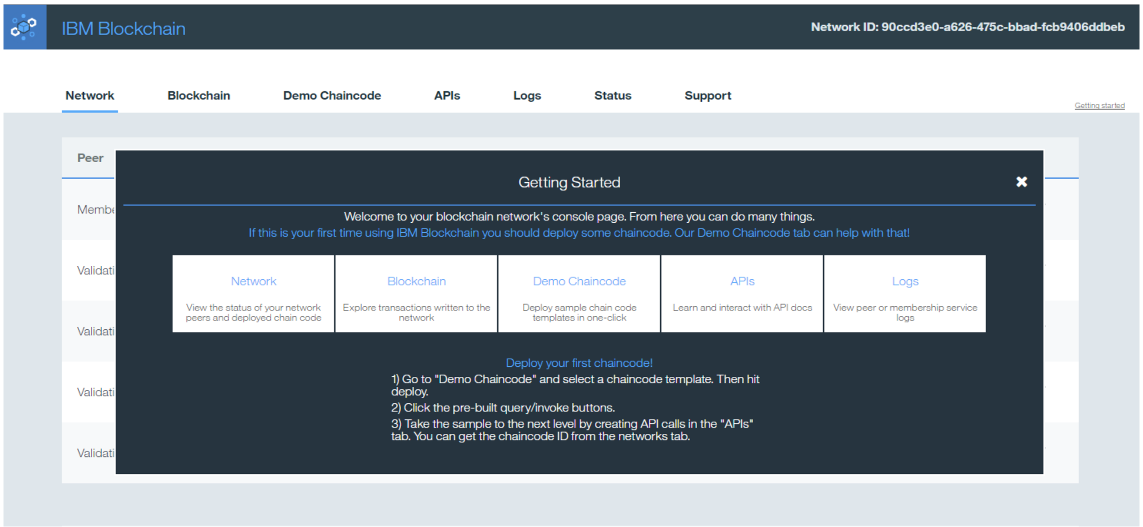
b) After the service launches you will see a welcome page similar to the one shown below. This page describes the blockchain service features. Take a moment to read each feature description and what it offers.



Network ID: 90ccd3e0-a626-475c-bbad-fcb9406ddbeb

Getting Started

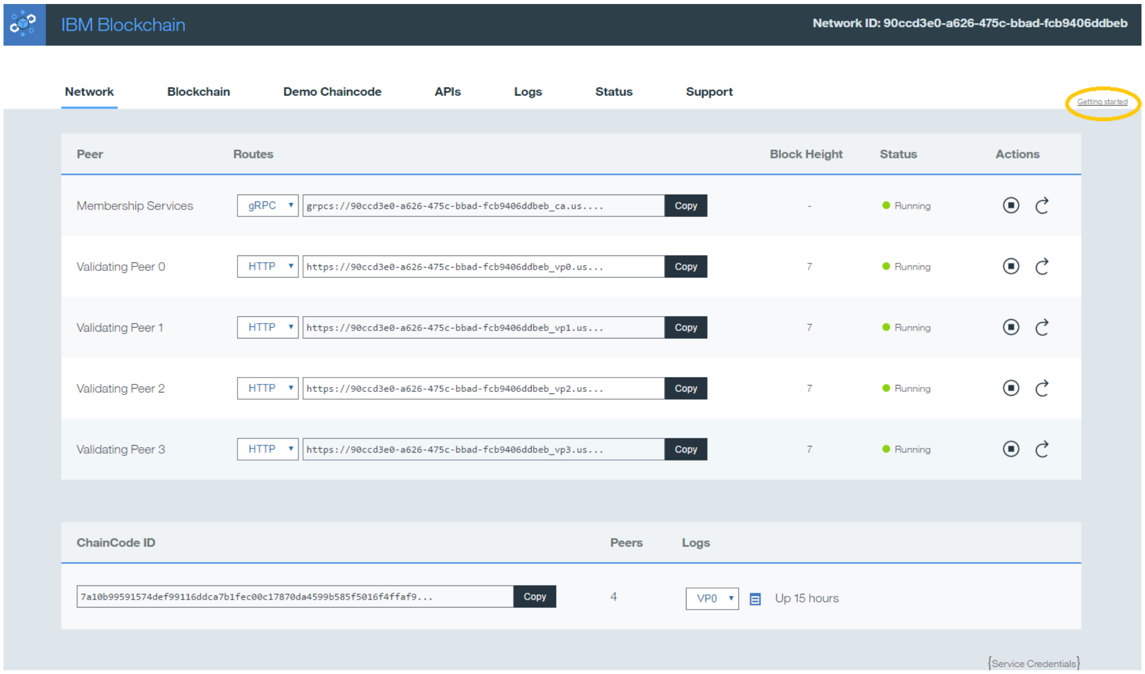
Welcome to your blockchain network's console page. From here you can do many things.
If this is your first time using IBM Blockchain you should deploy some chaincode. Our Demo Chaincode tab can help with that!

Network	Blockchain	Demo Chaincode	APIs	Logs
View the status of your network peers and deployed chain code	Explore transactions written to the network	Deploy sample chain code templates in one-click	Learn and interact with API docs	View peer or membership service logs

Deploy your first chaincode!

1) Go to "Demo Chaincode" and select a chaincode template. Then hit deploy.
2) Click the pre-built query/invoke buttons.
3) Take the sample to the next level by creating API calls in the "APIs" tab. You can get the chaincode ID from the networks tab.

If you do not see the **Getting Started** section that describes each component as shown above, click on the **Getting Started** link to open the section.

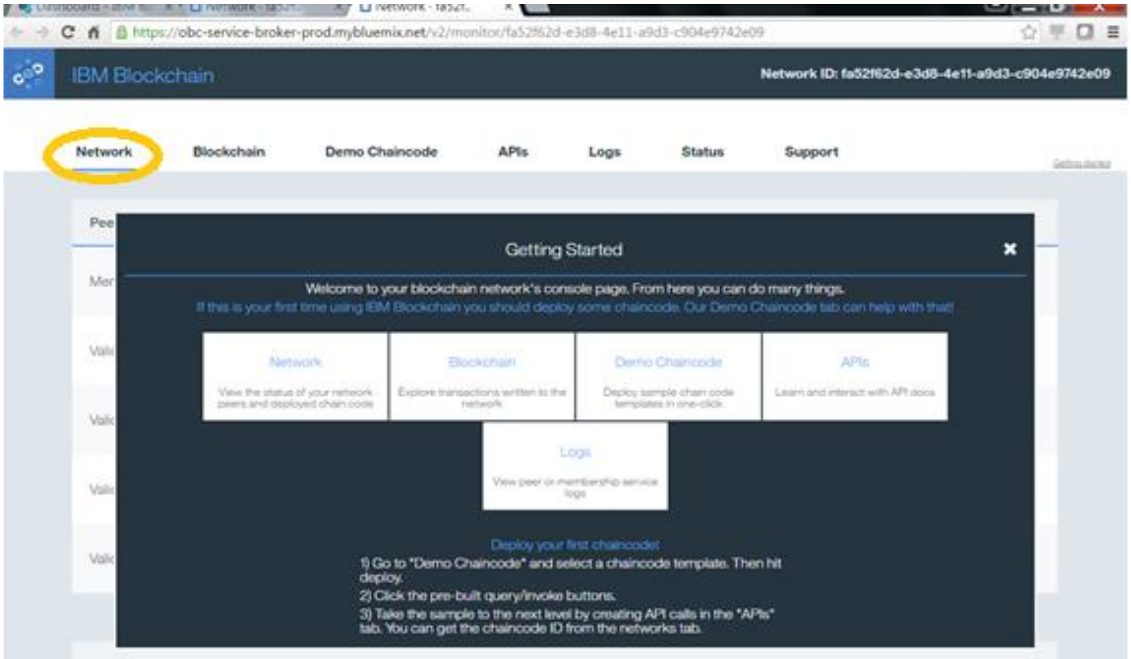


Network ID: 90ccd3e0-a626-475c-bbad-fcb9406ddbeb

Peer	Routes			Block Height	Status	Actions
Membership Services	gRPC ▾	grpcs://90ccd3e0-a626-475c-bbad-fcb9406ddbeb_ca.us....	Copy	-	● Running	⏺ ↻
Validating Peer 0	HTTP ▾	https://90ccd3e0-a626-475c-bbad-fcb9406ddbeb_vp0.us...	Copy	7	● Running	⏺ ↻
Validating Peer 1	HTTP ▾	https://90ccd3e0-a626-475c-bbad-fcb9406ddbeb_vp1.us...	Copy	7	● Running	⏺ ↻
Validating Peer 2	HTTP ▾	https://90ccd3e0-a626-475c-bbad-fcb9406ddbeb_vp2.us...	Copy	7	● Running	⏺ ↻
Validating Peer 3	HTTP ▾	https://90ccd3e0-a626-475c-bbad-fcb9406ddbeb_vp3.us...	Copy	7	● Running	⏺ ↻

ChainCode ID		Peers	Logs
7a10b99591574def99116ddca7b1fec00c17870da4599b585f5016f4ffaf9...	Copy	4	VP0 ▾ ▤ Up 15 hours

c) Click on the **Network** tab.


https://obc-service-broker-prod.mybluemix.net/v2/monitor/fa52f62d-e3d8-4e11-a9d3-c904e9742e09
IBM Blockchain
Network ID: fa52f62d-e3d8-4e11-a9d3-c904e9742e09
Network
Blockchain
Demo Chaincode
APIs
Logs
Status
Support
Network
View the status of your network peers and deployed chain code
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Demo Chaincode
Deploy sample chain code templates in one-click
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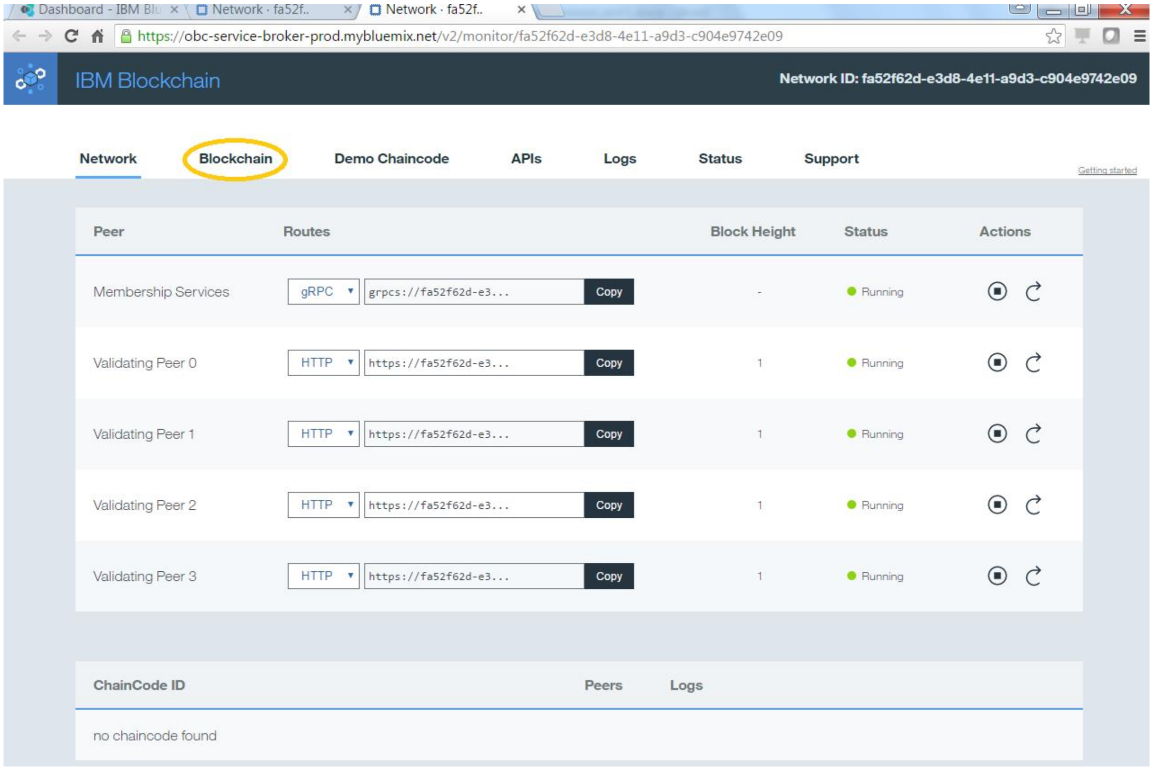
Logs
View peer or membership service logs

Getting Started

Welcome to your blockchain network's console page. From here you can do many things.
If this is your first time using IBM Blockchain you should deploy some chaincode. Our Demo Chaincode tab can help with that!

Deploy your first chaincode!
1) Go to "Demo Chaincode" and select a chaincode template. Then hit deploy.
2) Click the pre-built query/invoke buttons.
3) Take the sample to the next level by creating API calls in the "APIs" tab. You can get the chaincode ID from the networks tab.

d) The **Network** tab shows the status of the blockchain network peers and membership service. This network includes the status of the peers that monitor and approve transactions that are submitted to the blockchain. It also includes the membership service that provides user authentication to the blockchain network. Each of these network members can be stopped and restarted using this status page. The bottom of the network page lists the chaincode IDs of each blockchain that is running on this network. Note that the chaincode ID list is empty because no chaincode has been deployed to the service yet. Now click on the **Blockchain** tab.

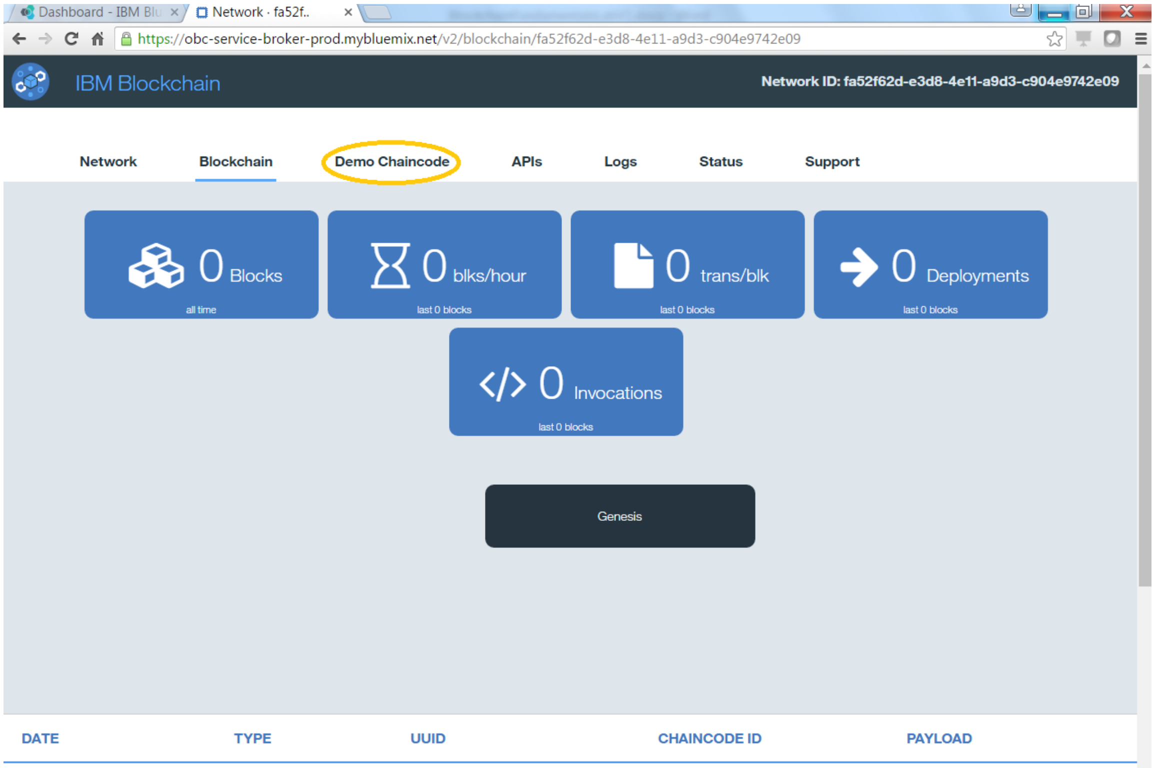


Network ID: fa52f62d-e3d8-4e11-a9d3-c904e9742e09

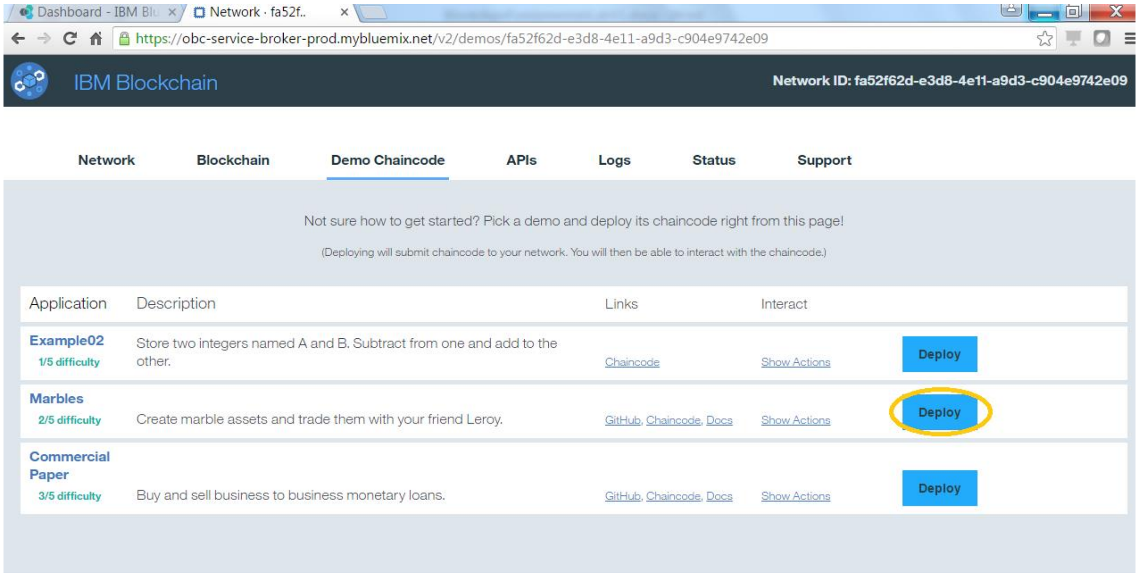
Peer	Routes			Block Height	Status	Actions
Membership Services	gRPC ▾	grpcs://fa52f62d-e3...	Copy	-	● Running	⦿ ↻
Validating Peer 0	HTTP ▾	https://fa52f62d-e3...	Copy	1	● Running	⦿ ↻
Validating Peer 1	HTTP ▾	https://fa52f62d-e3...	Copy	1	● Running	⦿ ↻
Validating Peer 2	HTTP ▾	https://fa52f62d-e3...	Copy	1	● Running	⦿ ↻
Validating Peer 3	HTTP ▾	https://fa52f62d-e3...	Copy	1	● Running	⦿ ↻

ChainCode ID	Peers	Logs
no chaincode found		

e) The blockchain tab provides block-level details about the blockchain itself. This includes the number of blocks in the chain, the block creation rate, the number of chaincode deployments, and the number of chaincode invocations. From this page, you can also see information about each block on the blockchain by clicking the individual blocks in the chain (more on this later). Now click on the **Demo Chaincode** tab.



f) The **Demo Chaincode** tab provides one-click access to some sample applications that run on blockchain. Links to the code repositories and documentation for each sample application are also provided. To test that the blockchain service you created is working correctly, deploy the code for the Marbles sample application by clicking the middle **Deploy** button.

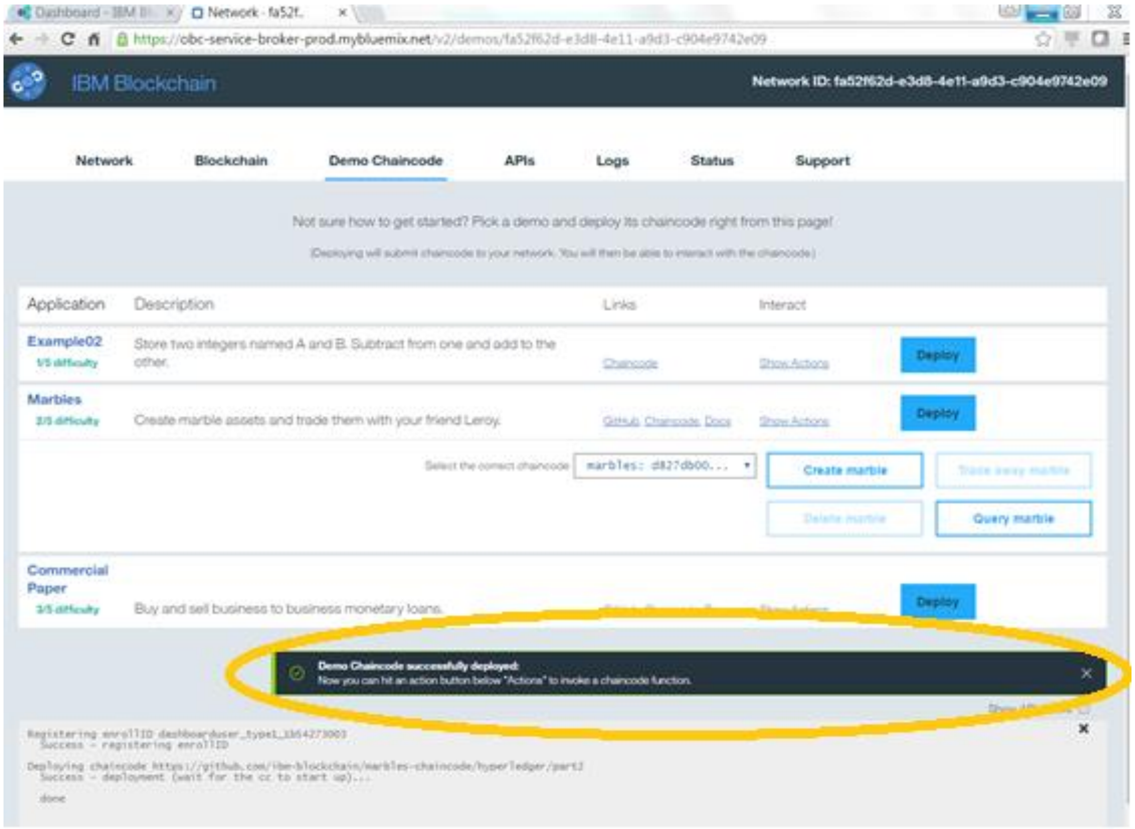

Dashboard - IBM Bl
Network · fa52f..
https://obc-service-broker-prod.mybluemix.net/v2/demos/fa52f62d-e3d8-4e11-a9d3-c904e9742e09
IBM Blockchain
Network ID: fa52f62d-e3d8-4e11-a9d3-c904e9742e09
Network
Blockchain
Demo Chaincode
APIs
Logs
Status
Support

Not sure how to get started? Pick a demo and deploy its chaincode right from this page!

(Deploying will submit chaincode to your network. You will then be able to interact with the chaincode.)

Application	Description	Links	Interact	
Example02 1/5 difficulty	Store two integers named A and B. Subtract from one and add to the other.	Chaincode	Show Actions	Deploy
Marbles 2/5 difficulty	Create marble assets and trade them with your friend Leroy.	GitHub, Chaincode, Docs	Show Actions	Deploy
Commercial Paper 3/5 difficulty	Buy and sell business to business monetary loans.	GitHub, Chaincode, Docs	Show Actions	Deploy

g) The deployment process takes approximately 30 seconds to complete. During this process, status messages are shown in the status box below the sample application list. If the chaincode is deployed successfully, a status message with a green checkmark will appear as shown below.



Not sure how to get started? Pick a demo and deploy its chaincode right from this page!

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Application	Description	Links	Interact
Example02 1/5 difficulty	Store two integers named A and B. Subtract from one and add to the other.	Chaincode	Show Actions
Marbles 2/5 difficulty	Create marble assets and trade them with your friend Leroy.	Github, Chaincode, Docs	Show Actions
Commercial Paper 3/5 difficulty	Buy and sell business to business monetary loans.		

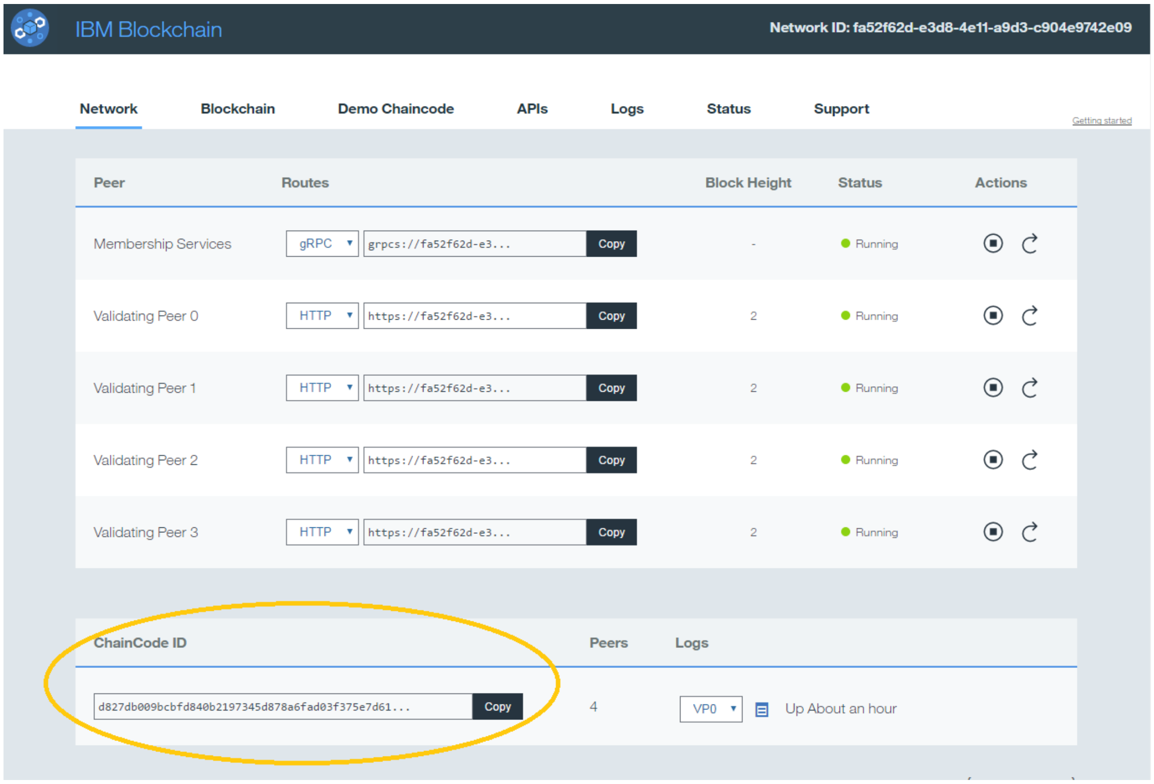
Demo Chaincode successfully deployed:
Now you can hit an action button below "Actions" to invoke a chaincode function.

```
Registering enrollID dashboarduser_type1_1364273003
  Success - registering enrollID

Deploying chaincode https://github.com/ibm-blockchain/marbles-chaincode/hyperledger/part2
  Success - deployment (wait for the cc to start up)...

  done
```

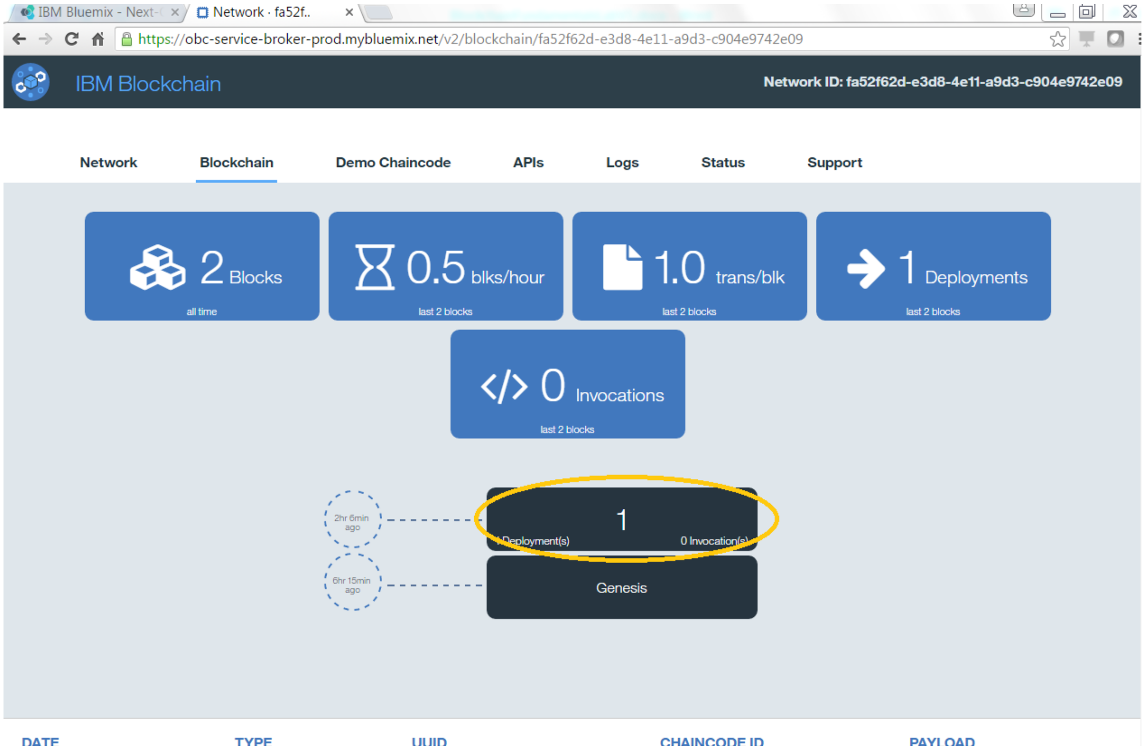
h) Click on the **Network** tab again. Notice that the chaincode ID section at the bottom now has an entry because the Marbles sample chaincode was deployed, and a chaincode is now running on the service.



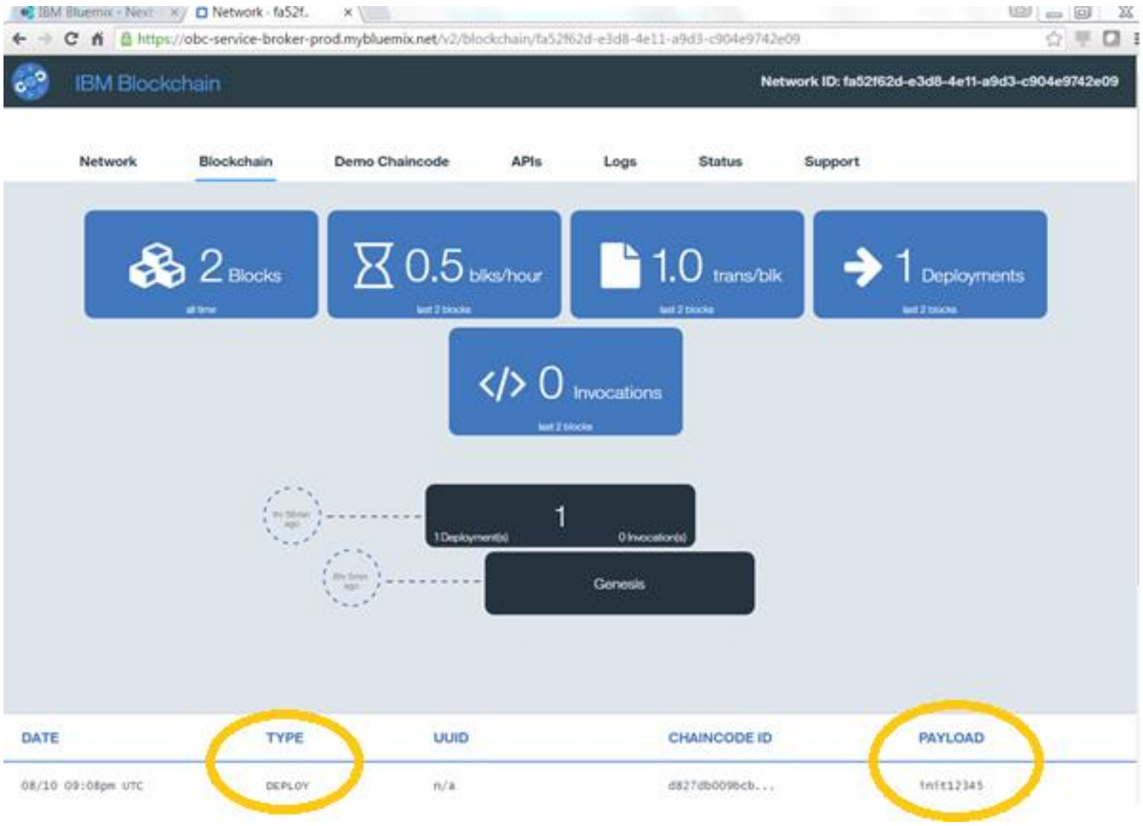
Peer	Routes		Block Height	Status	Actions
Membership Services	gRPC ▾	grpcs://fa52f62d-e3... Copy	-	● Running	⊙ ↻
Validating Peer 0	HTTP ▾	https://fa52f62d-e3... Copy	2	● Running	⊙ ↻
Validating Peer 1	HTTP ▾	https://fa52f62d-e3... Copy	2	● Running	⊙ ↻
Validating Peer 2	HTTP ▾	https://fa52f62d-e3... Copy	2	● Running	⊙ ↻
Validating Peer 3	HTTP ▾	https://fa52f62d-e3... Copy	2	● Running	⊙ ↻

ChainCode ID	Peers	Logs
d827db009bcbfd840b2197345d878a6fad03f375e7d61... Copy	4	VP0 ▾ ☰ Up About an hour

i) Click on the **Blockchain** tab again. Notice that there are two blocks on the chain now: the first block is a genesis block that is created for every blockchain automatically. The second block represents the deployment of the Marbles sample chaincode. Click on the block that has the number **1** to view more information about its contents.



j) After clicking on the block, details including the date, type, and payload of the block are shown in the pane below the blockchain. By looking at the payload details, we can see that this block represents an initialization of the chaincode since it contains an 'init' function call to the blockchain.



DATE	TYPE	UUID	CHAINCODE ID	PAYLOAD
08/10 09:08pm UTC	DEPLOY	n/a	d827db0098cb...	init12345

k) **Optional Challenge:** This blockchain service contains many other features that are beyond the scope of this lab. If you have finished the entire lab ahead of schedule, return to this section and explore the API, Logs, Status, and Support tabs on your own to learn more about these features and what they offer.

Part B: Open Points Application – *use a loyalty points application to create blockchain transactions and examine smart contracts*

Pre-Reqs:

- *You have completed Part A.*
- *You have followed the instructions for deploying the application to your Bluemix account, as described in the ‘Intro: Getting Started’ section*

This part of the lab explains how to complete the following tasks:

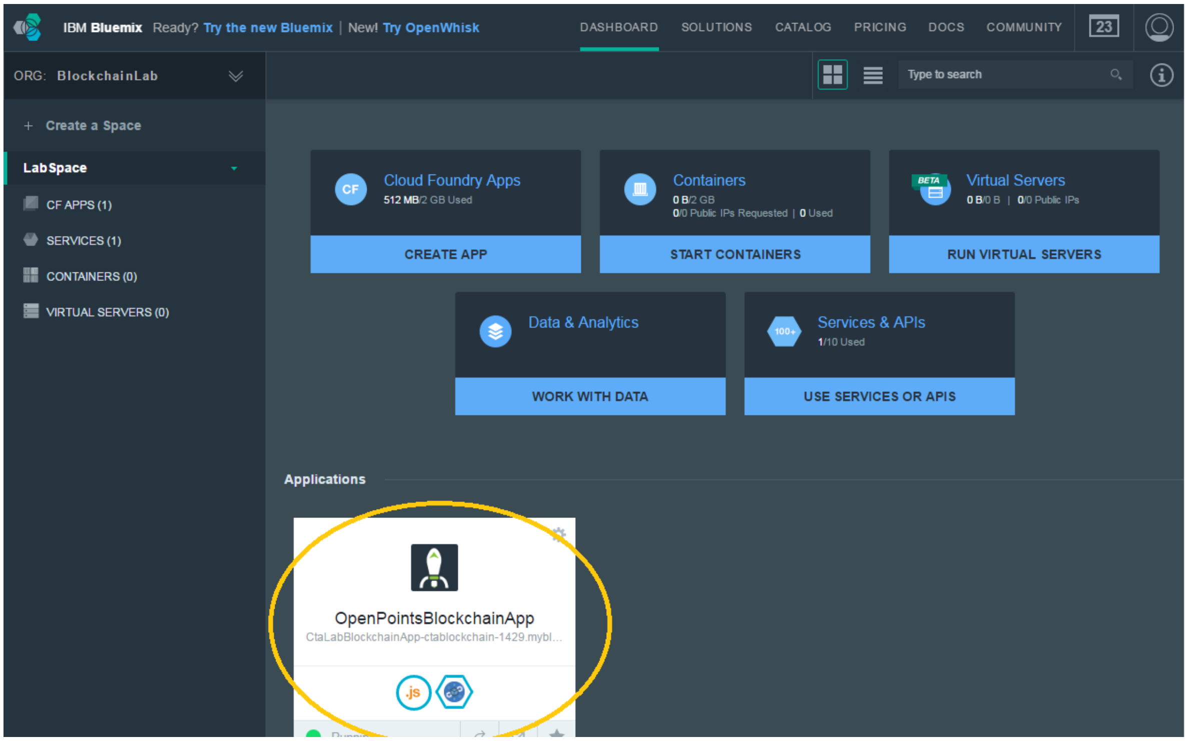
- *Use an application that runs on IBM Blockchain to create transactions and submit them to the blockchain*
- *Apply smart contracts that impact transaction values*
- *Monitor application behavior on the blockchain service*

Estimated Duration: 15 minutes

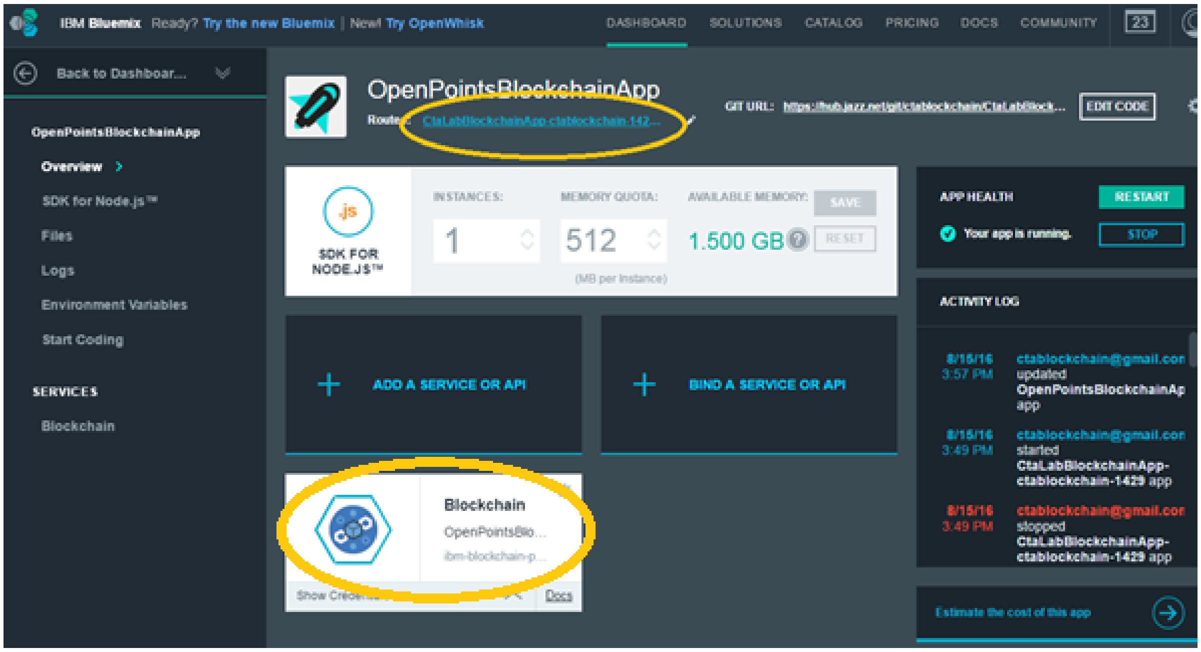
1. Exploring the Open Points application

In this section, you will familiarize yourself with the Open Points application and use it perform basic financial transactions through a blockchain service.

a) From your Bluemix dashboard, click on the app tile that you created as part of the prerequisites for the lab.



b) Clicking on the app tile opens the status page for the application, as shown below. From this page, you can determine if the app is running, restart it, view any associated services, and launch the webpage for the app. Click on the URL below the app name to launch the Open Points website. After the Open Points website opens, return to this page and click on the blockchain service tile to open the blockchain service status page.



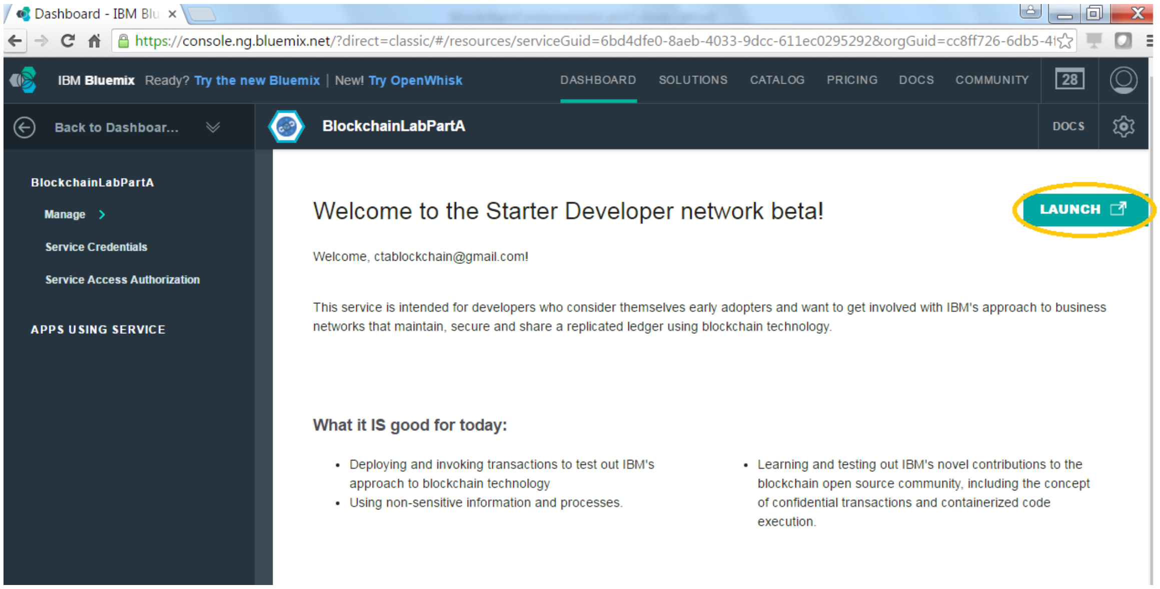
Your app is running.

8/15/16 3:57 PM ctablockchain@gmail.com updated OpenPointsBlockchainApp app

8/15/16 3:49 PM ctablockchain@gmail.com started CtaLabBlockchainApp-ctablockchain-1429 app

8/15/16 3:49 PM ctablockchain@gmail.com stopped CtaLabBlockchainApp-ctablockchain-1429 app

Click on the green **Launch** button to open the blockchain service status page. Keep the blockchain service page open because you will refer back to it often during the remainder of the lab.


Dashboard - IBM Blu
https://console.ng.bluemix.net/?direct=classic/#/resources/serviceGuid=6bd4dfe0-8aeb-4033-9dcc-611ec0295292&orgGuid=cc8ff726-6db5-4
IBM Bluemix Ready? Try the new Bluemix | New! Try OpenWhisk
DASHBOARD
SOLUTIONS
CATALOG
PRICING
DOCS
COMMUNITY
28
Back to Dashboar...
BlockchainLabPartA
DOCS
BlockchainLabPartA
Manage
Service Credentials
Service Access Authorization
APPS USING SERVICE
LAUNCH

Welcome to the Starter Developer network beta!

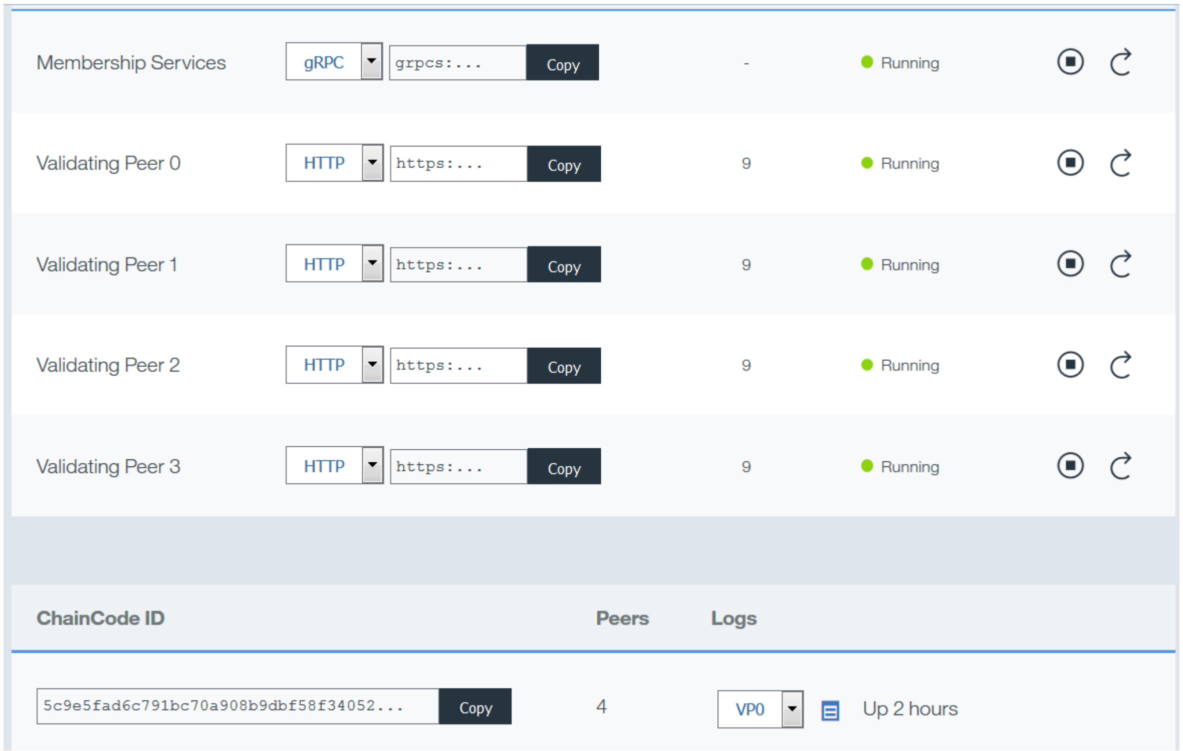
Welcome, ctablockchain@gmail.com!

This service is intended for developers who consider themselves early adopters and want to get involved with IBM's approach to business networks that maintain, secure and share a replicated ledger using blockchain technology.

What it IS good for today:

- Deploying and invoking transactions to test out IBM's approach to blockchain technology
- Using non-sensitive information and processes.
- Learning and testing out IBM's novel contributions to the blockchain open source community, including the concept of confidential transactions and containerized code execution.

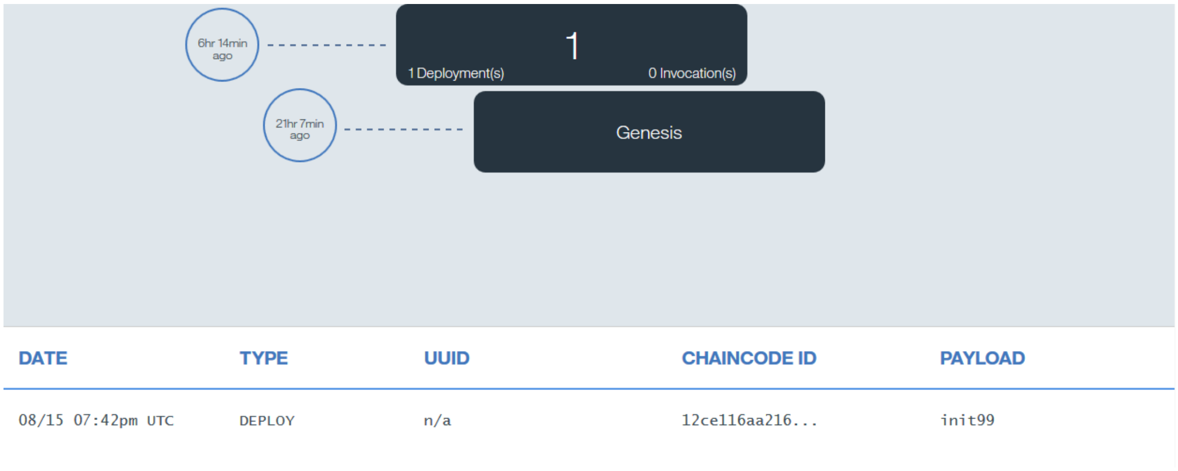
c) From the blockchain service page you just launched, click on the **Network** tab. There should be at least one chaincode ID listed at the bottom of the page.



Membership Services	gRPC	grpcs:...	Copy	-	● Running	⦿ ↻
Validating Peer 0	HTTP	https:...	Copy	9	● Running	⦿ ↻
Validating Peer 1	HTTP	https:...	Copy	9	● Running	⦿ ↻
Validating Peer 2	HTTP	https:...	Copy	9	● Running	⦿ ↻
Validating Peer 3	HTTP	https:...	Copy	9	● Running	⦿ ↻

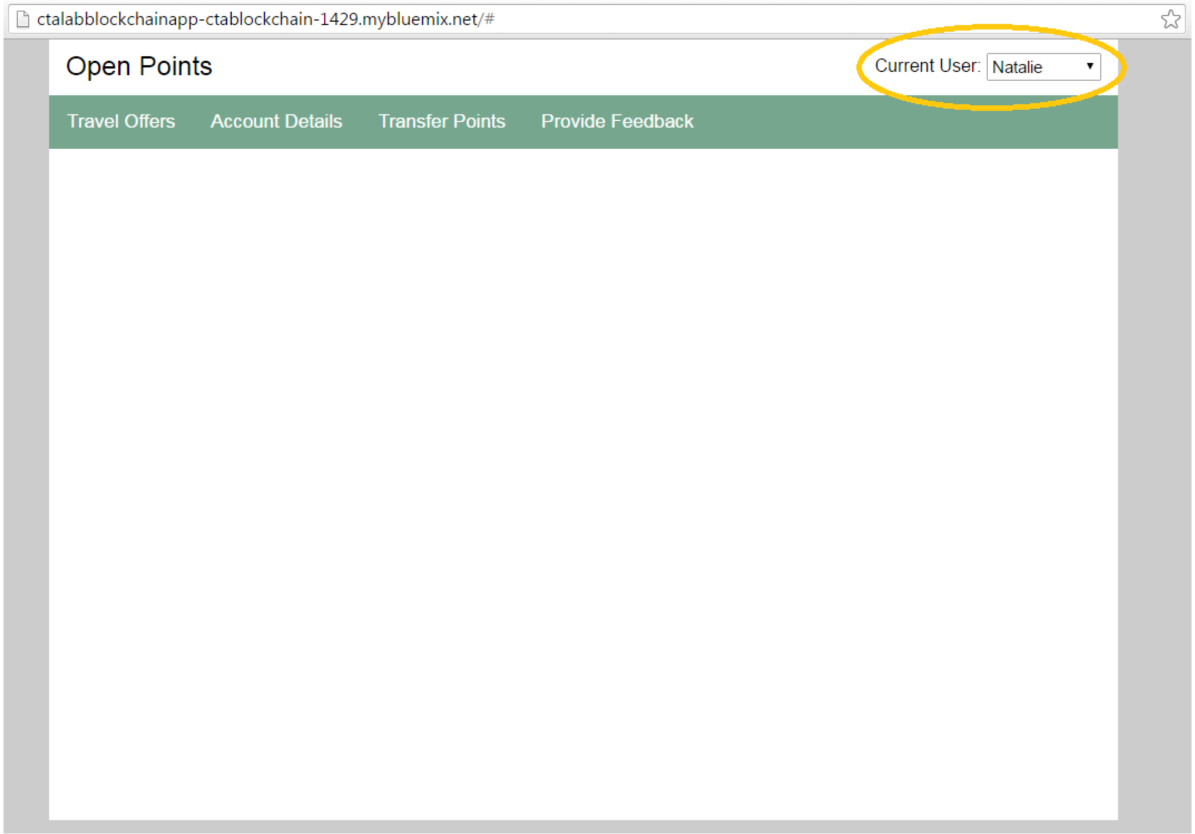
ChainCode ID	Peers	Logs
5c9e5fad6c791bc70a908b9dbf58f34052... Copy	4	VP0 ▾ ▤ Up 2 hours

d) Click on the **Blockchain tab**. The blocks on the blockchain represent the transactions that have taken place since the blockchain was created. Notice that the only block that exists for the Open Points blockchain is a deployment block, which was created when the chaincode for the application was deployed.

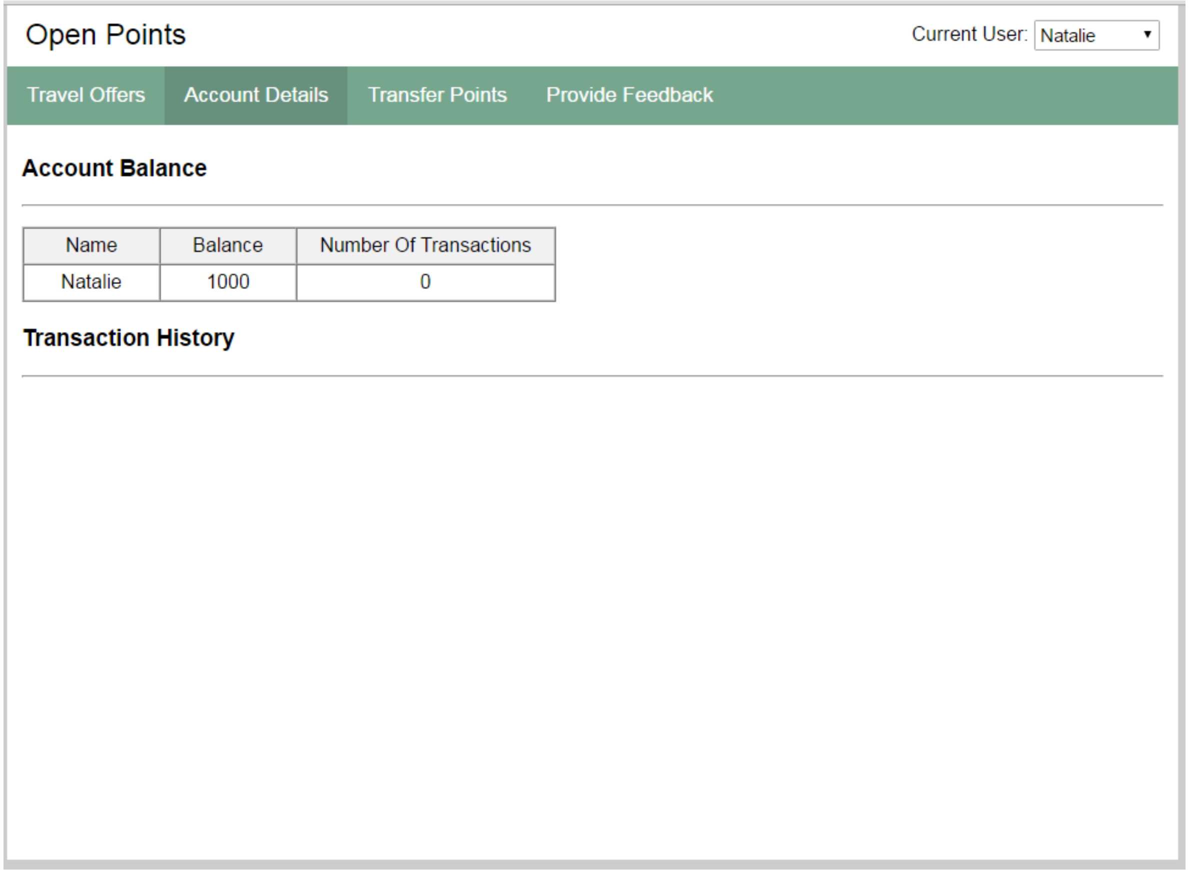


DATE	TYPE	UUID	CHAINCODE ID	PAYLOAD
08/15 07:42pm UTC	DEPLOY	n/a	12ce116aa216...	init99

e) Return to the browser tab or window that contains the Open Points website. The current user that is logged into the site is shown in the upper right corner. The Open Points network has two business users: **OpenFN** is the banking institution that supports the Open Points network and converts points to cash equivalency, and **Open Travel** is a travel agency that sells travel packages to customers. This network also has two customers that perform banking services with **OpenFN** and buy travel packages from **Open Travel**: Natalie and Anthony. When the website first launches, notice that the default user is Natalie.


ctalabblockchainapp-ctablockchain-1429.mybluemix.net/#

f) From this page we see that Natalie has a starting balance of 1000 points and that she currently has no transactions with the Open Points network.



Account Balance

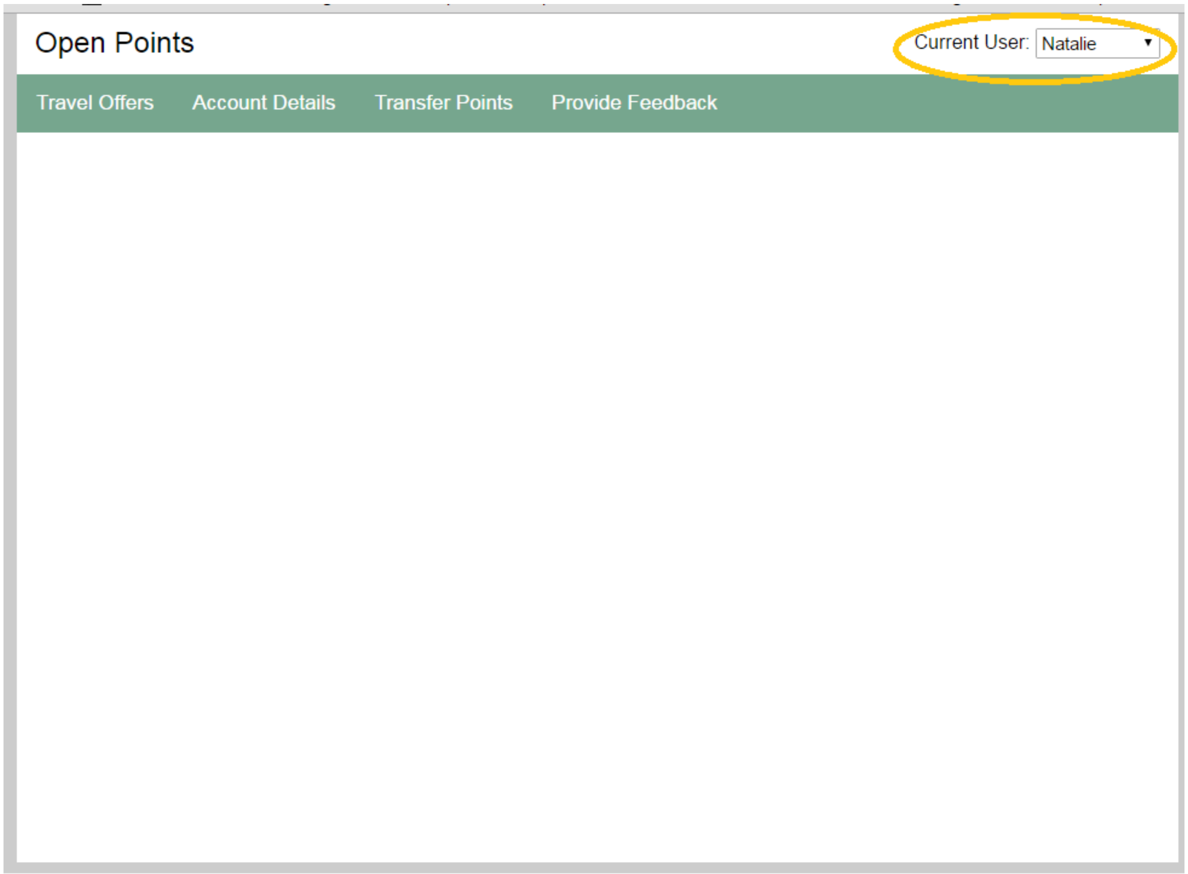
Name	Balance	Number Of Transactions
Natalie	1000	0

Transaction History

2. Transfer Points between Open Points Members

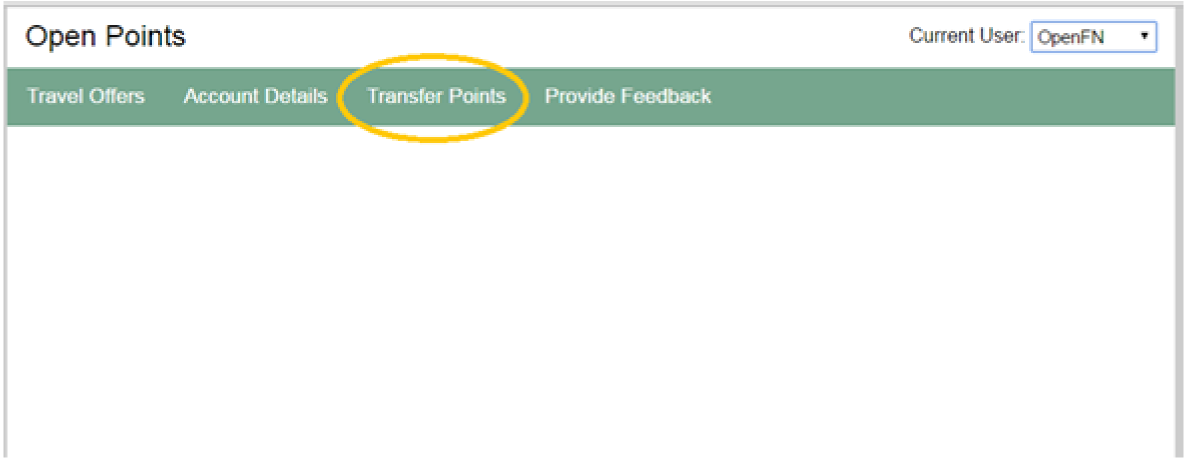
In this section you will create blockchain transactions to transfer points between members of the Open Points network.

a) Natalie has just joined the Open Points network as a new banking customer of OpenFN. As a reward for being a new customer, OpenFN would like to use the Open Points website to award Natalie with a one-time bonus of 99,000 points. In order to begin this point transfer to Natalie, go to the window for the Open Points website and change the current user to OpenFN using the drop-down menu.



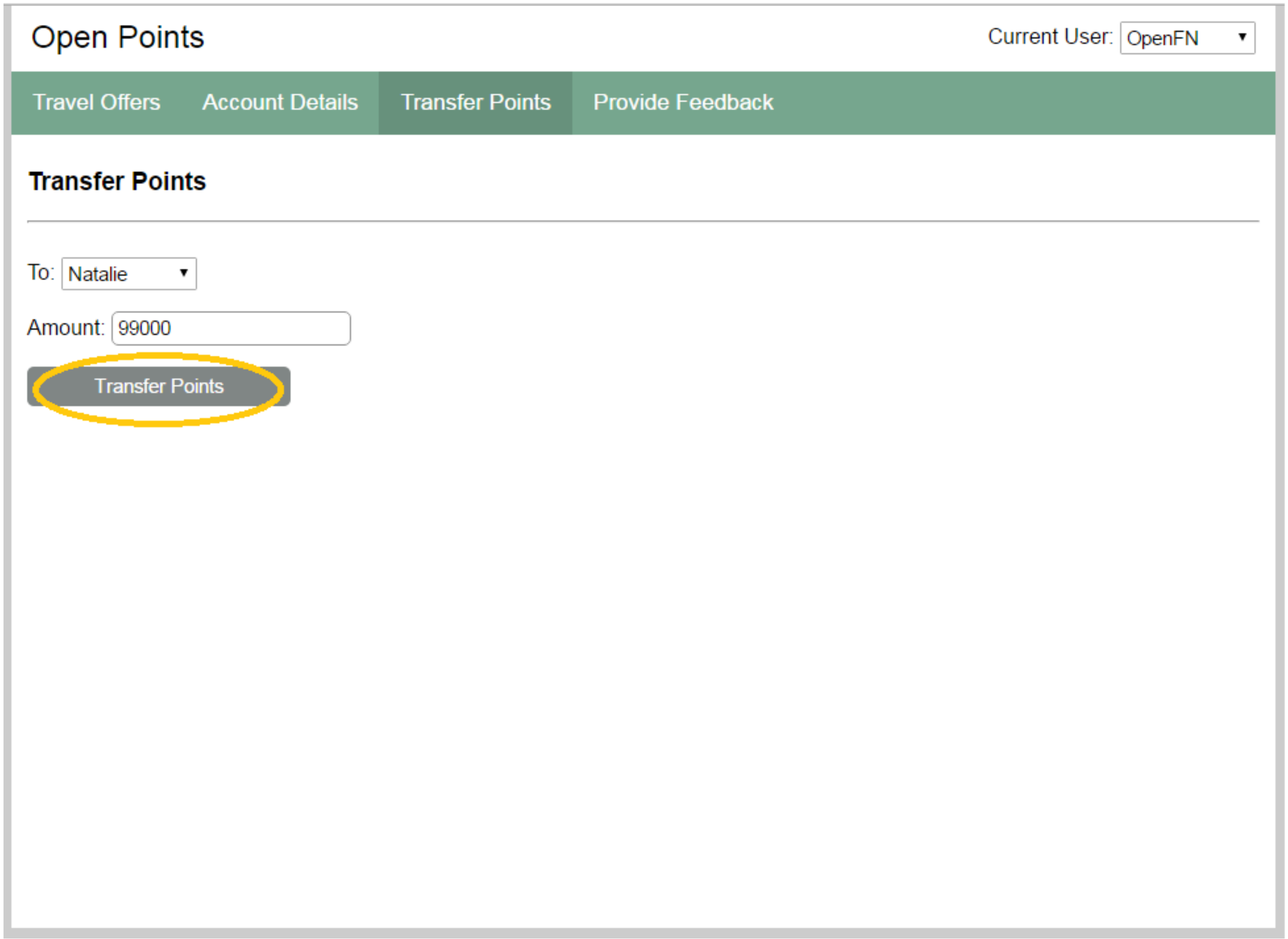
Current User: Natalie

b) Click on the **Transfer Points** tab.



c) In the **Amount** field, enter '99000' as the number of points to transfer from OpenFN to Natalie.

Click the **Transfer Points** button.

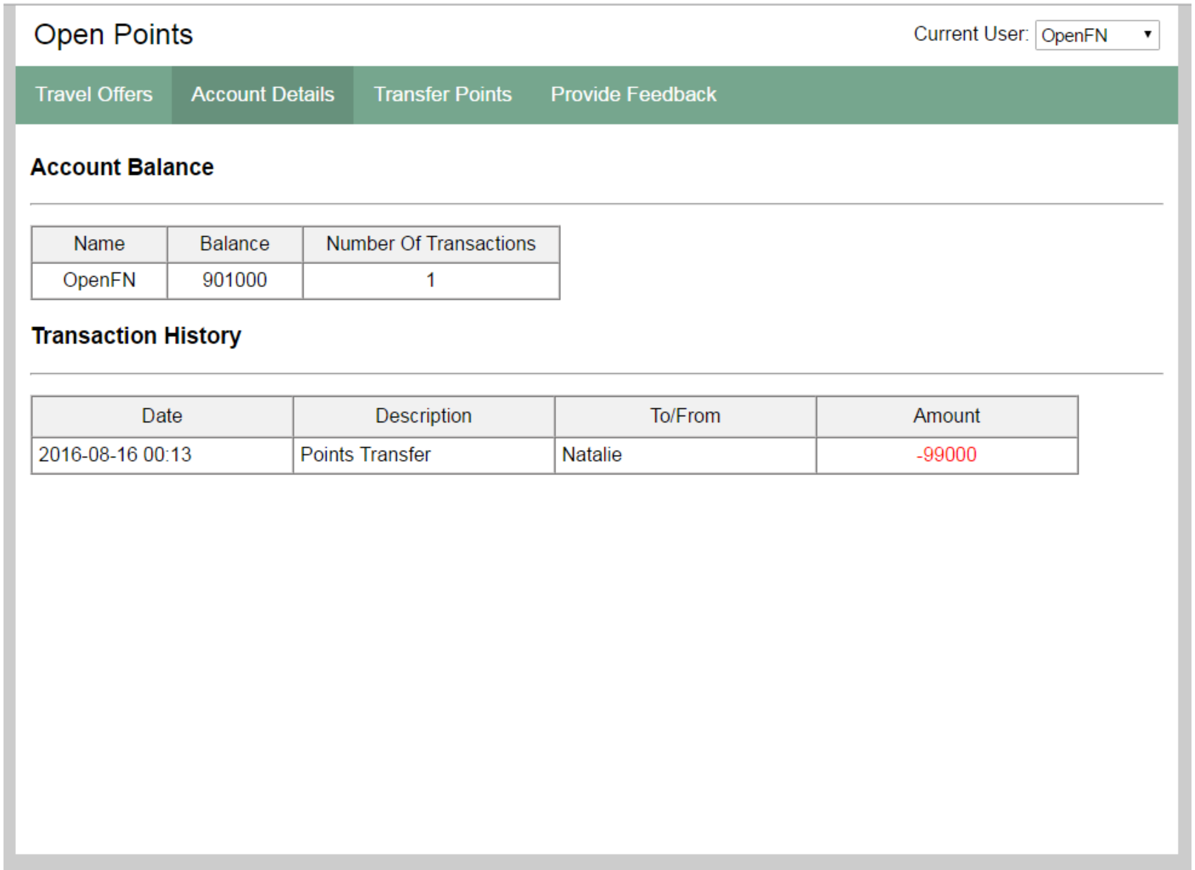


Transfer Points

To: Natalie

Amount: 99000

d) Verify that the points were transferred from OpenFN to Natalie. Click on the **Account Details** tab and notice the balance and transaction history for OpenFN. The current balance should be 901,000 points, and there should be a single transaction listed for the point transfer you just created. The transfer amount is listed in red with a minus sign since this transfer represents a debit to the OpenFN account.



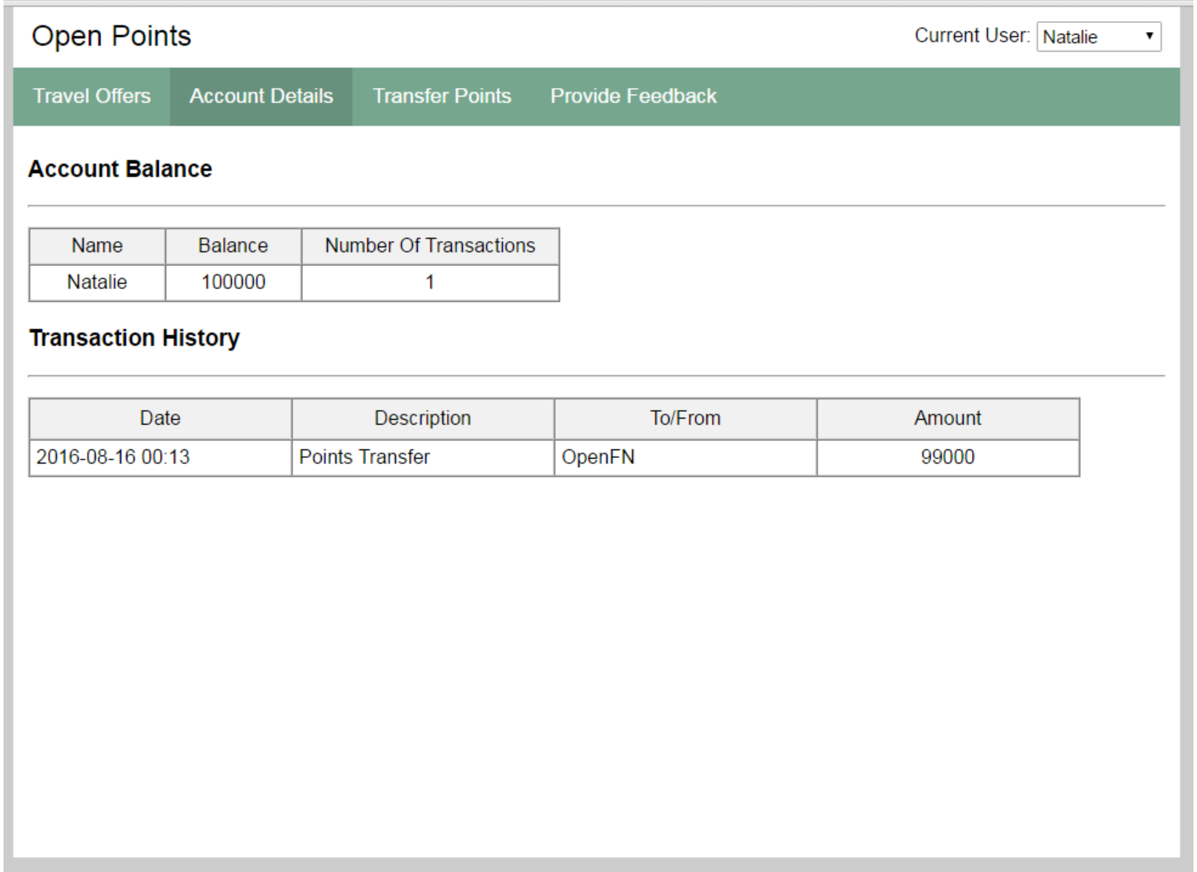
Account Balance

Name	Balance	Number Of Transactions
OpenFN	901000	1

Transaction History

Date	Description	To/From	Amount
2016-08-16 00:13	Points Transfer	Natalie	-99000

e) Verify that Natalie's account also contains the correct transaction information. Change the current user to Natalie using the drop down menu, and click on the **Account Details** tab again to refresh the account profile. Natalie should have a balance of 100000 points, with a single transaction from OpenFN. This transaction is shown in black since it represents a credit to Natalie's account.



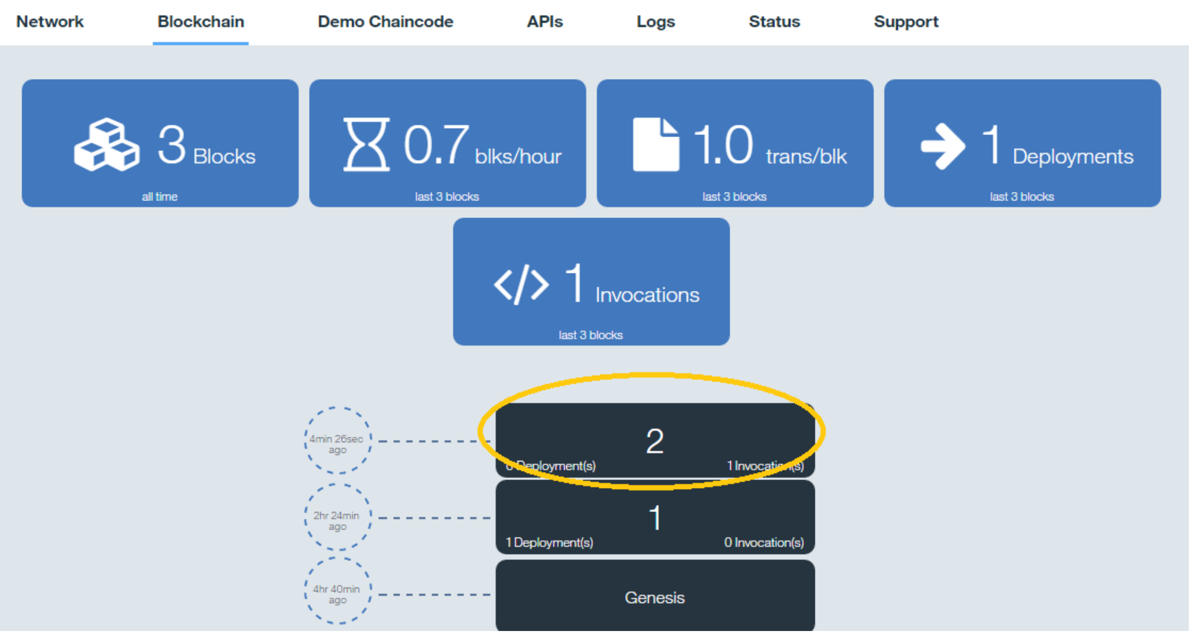
Account Balance

Name	Balance	Number Of Transactions
Natalie	100000	1

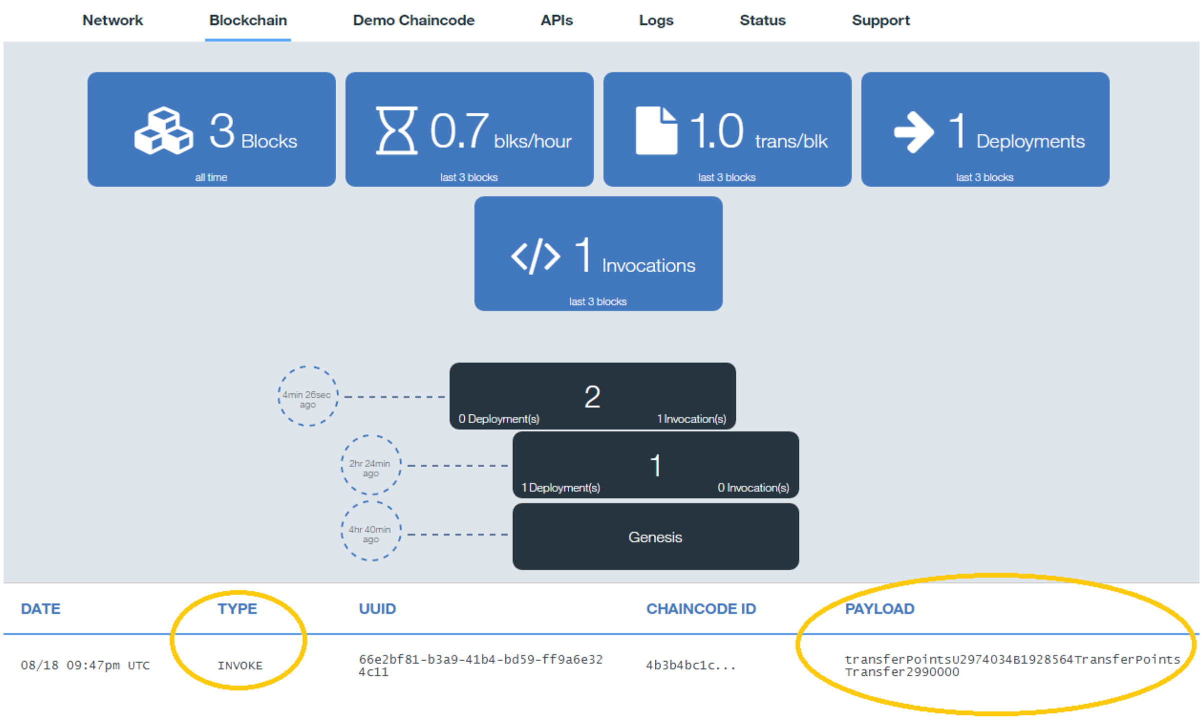
Transaction History

Date	Description	To/From	Amount
2016-08-16 00:13	Points Transfer	OpenFN	99000

f) Verify that this transaction was added to the blockchain. Return to the browser window that contains the blockchain service status page, and click on the **Blockchain** tab. The last block on the chain, which is the block at the top of the list, is a non-deployment block. Click on the block to see the details of the transaction within the lower panel.



g) The type of transaction is an **INVOKE** because it is changing the state of the blockchain information. The payload of the transaction describes a point transfer of 99000 points.

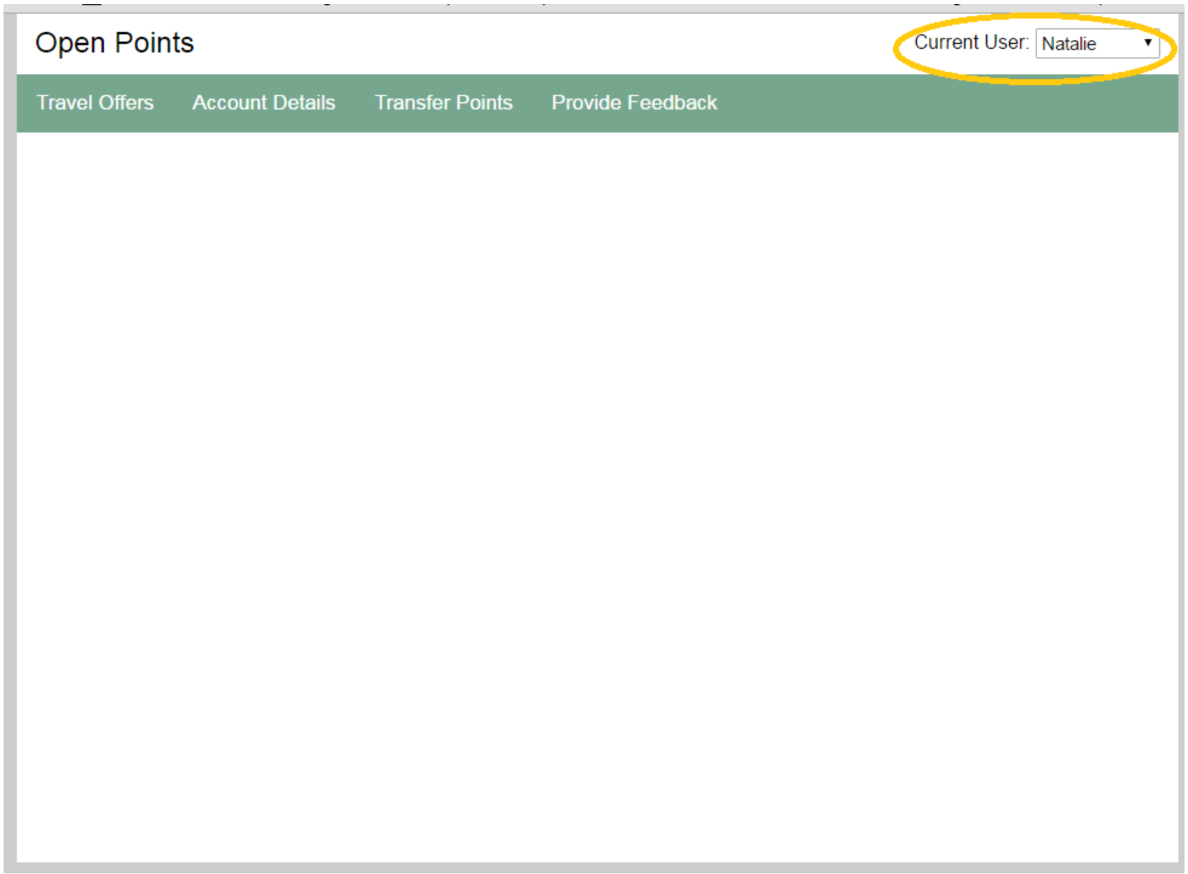


DATE	TYPE	UUID	CHAINCODE ID	PAYLOAD
08/18 09:47pm UTC	INVOKE	66e2bf81-b3a9-41b4-bd59-ff9a6e32 4c11	4b3b4bc1c...	transferPointsU2974034B1928564TransferPoints Transfer2990000

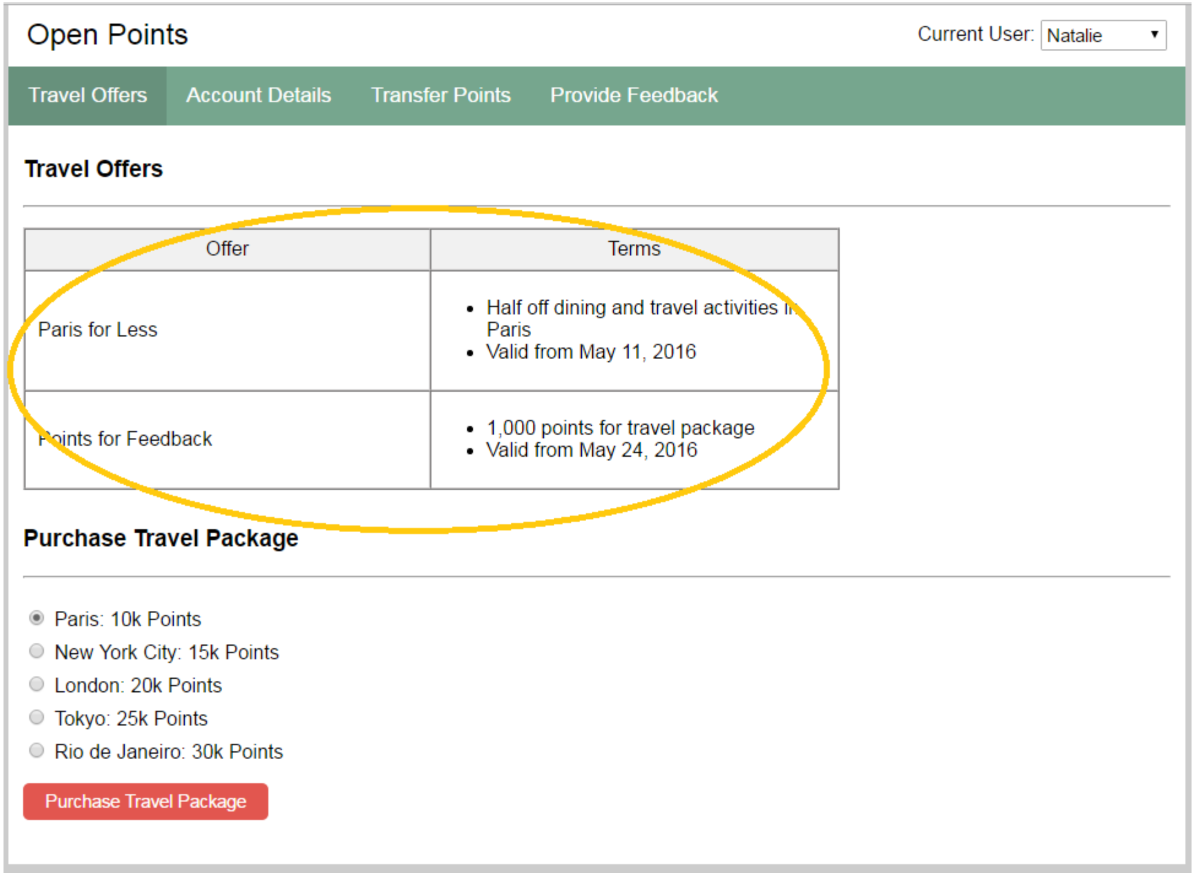
3. *Purchase Travel Packages using Smart Contracts*

In this section you will purchase some travel packages that use smart contracts running on blockchain to manage the travel offers.

a) Return to the browser window that contains the Open Points website. Change the current user to be **Natalie** using the drop down menu.



b) Click on the **Travel Offers** tab. The top section of the page contains two travel offers and their associated terms: *Paris for Less* and *Points for Feedback*. These offers represent smart contracts that are deployed on the blockchain within the chaincode itself. When any transaction that is related to an offer is executed, the corresponding smart contract is also executed and the transaction is modified according to the conditions of that contract.



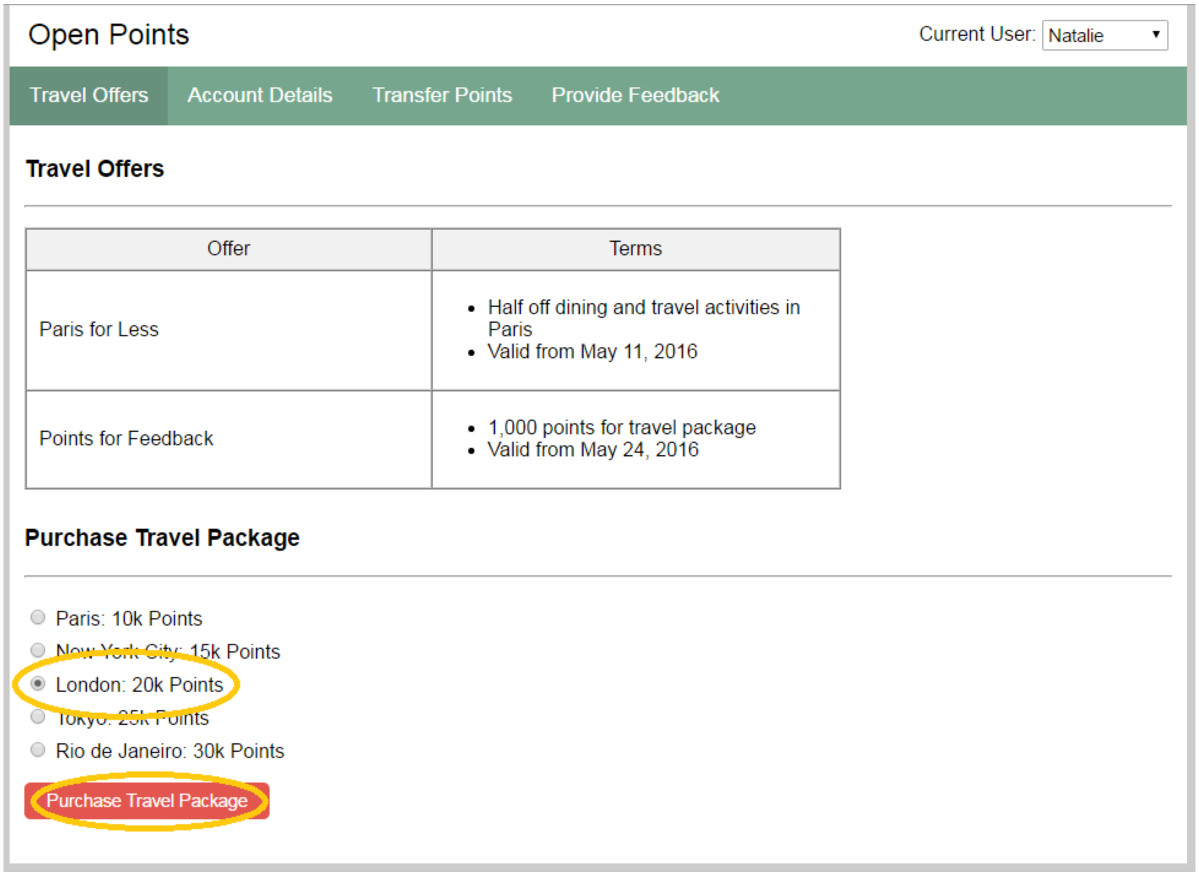
Travel Offers

Offer	Terms
Paris for Less	• Half off dining and travel activities in Paris • Valid from May 11, 2016
Points for Feedback	• 1,000 points for travel package • Valid from May 24, 2016

Purchase Travel Package

● Paris: 10k Points
○ New York City: 15k Points
○ London: 20k Points
○ Tokyo: 25k Points
○ Rio de Janeiro: 30k Points

c) To see how smart contracts can affect transactions, lets first purchase a travel package to London as Natalie and observe how the transaction is executed. Note that there are NO travel offers for London, so the transaction should be processed for the stated point price of 20k points. Select the radio button for the London package, and click the **Purchase Travel Package** button.



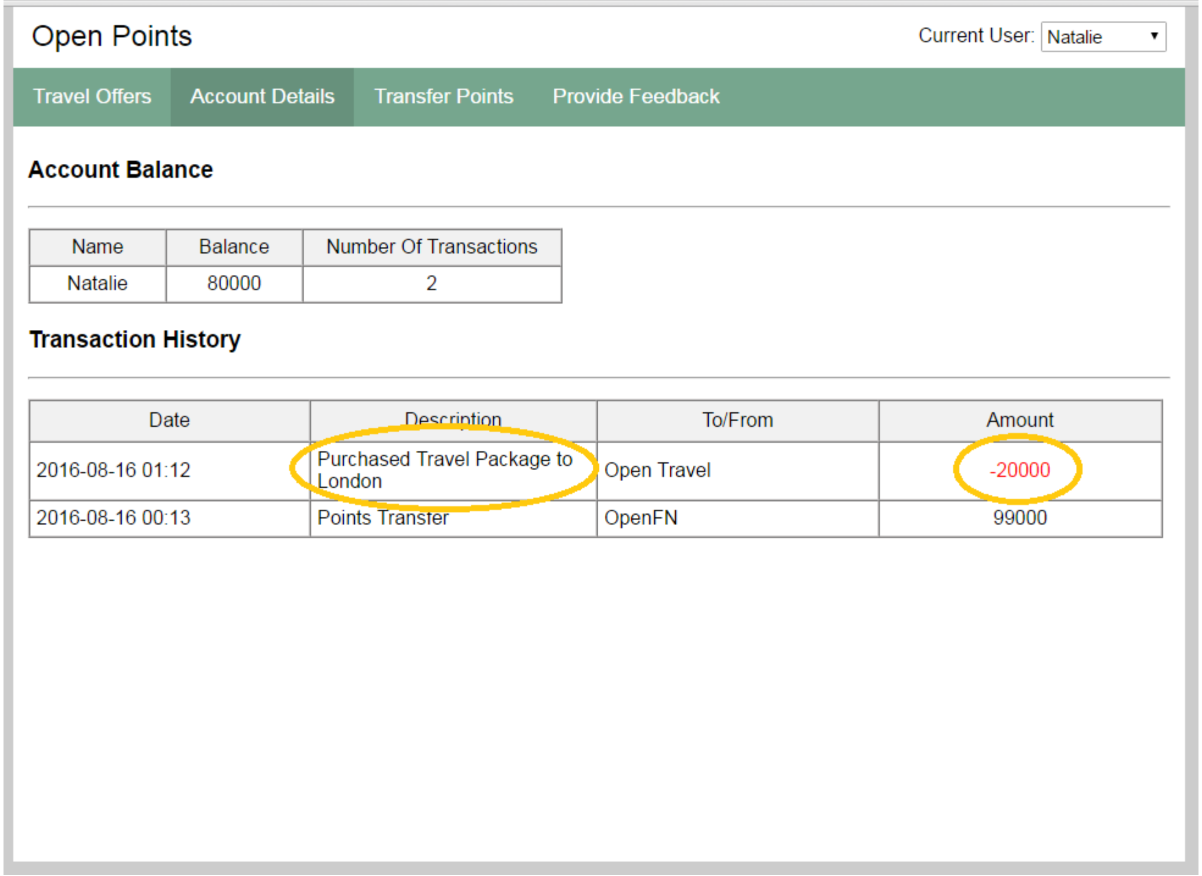
Travel Offers

Offer	Terms
Paris for Less	• Half off dining and travel activities in Paris • Valid from May 11, 2016
Points for Feedback	• 1,000 points for travel package • Valid from May 24, 2016

Purchase Travel Package

○ Paris: 10k Points
○ New York City: 15k Points
● London: 20k Points
○ Tokyo: 25k Points
○ Rio de Janeiro: 30k Points

d) Click on the **Account Details** tab. Natalie now has two transactions. The top transaction in the list shows her purchase for the London travel package at a price of 20000 points. This is the expected price since no smart contracts were applied to this transaction that affected the purchase price.



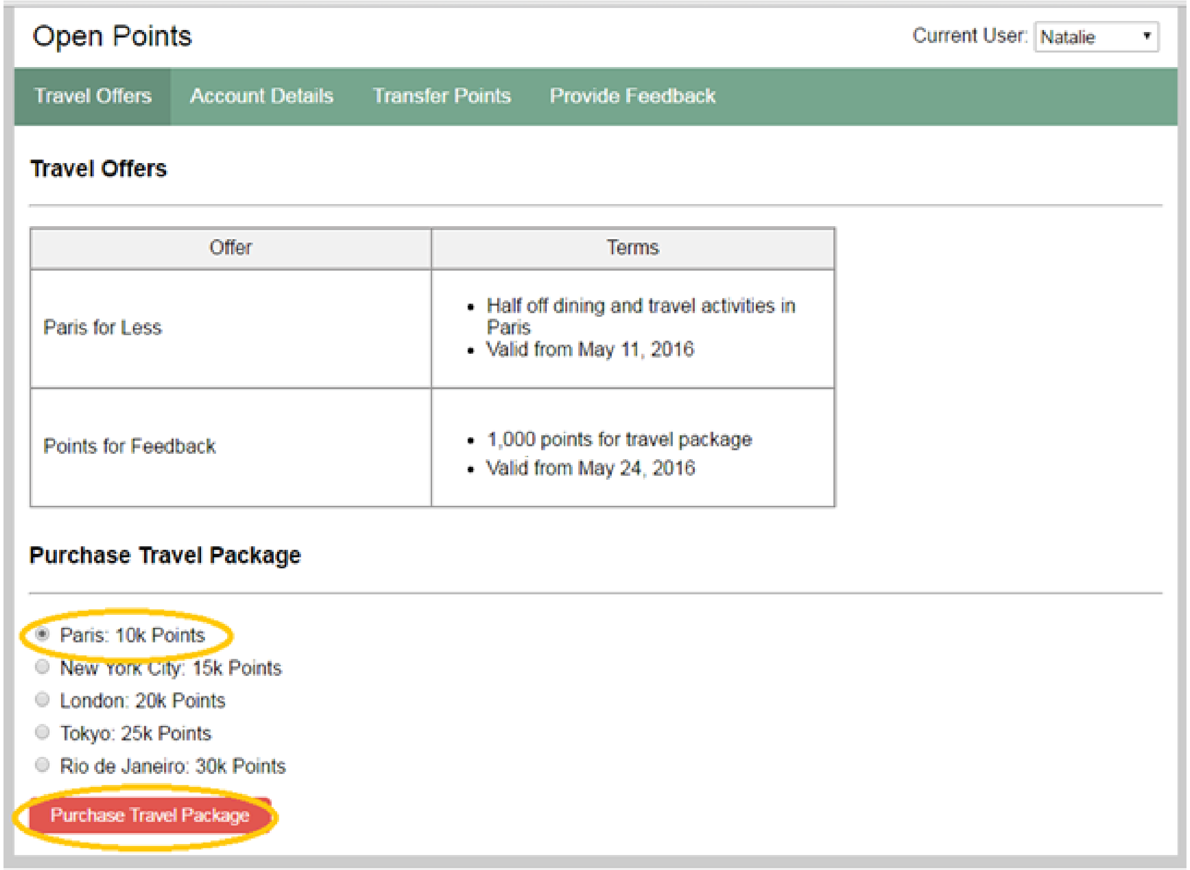
Account Balance

Name	Balance	Number Of Transactions
Natalie	80000	2

Transaction History

Date	Description	To/From	Amount
2016-08-16 01:12	Purchased Travel Package to London	Open Travel	-20000
2016-08-16 00:13	Points Transfer	OpenFN	99000

e) Click on the **Travel Offers** tab. This time, Natalie wants to take advantage of a travel offer instead of paying the full price for a travel package. She sees the *Paris for Less* offer and likes the idea of paying only half of the original point price for a travel package to Paris. Select the radio button for the Paris travel package, and click the **Purchase Travel Package** button.



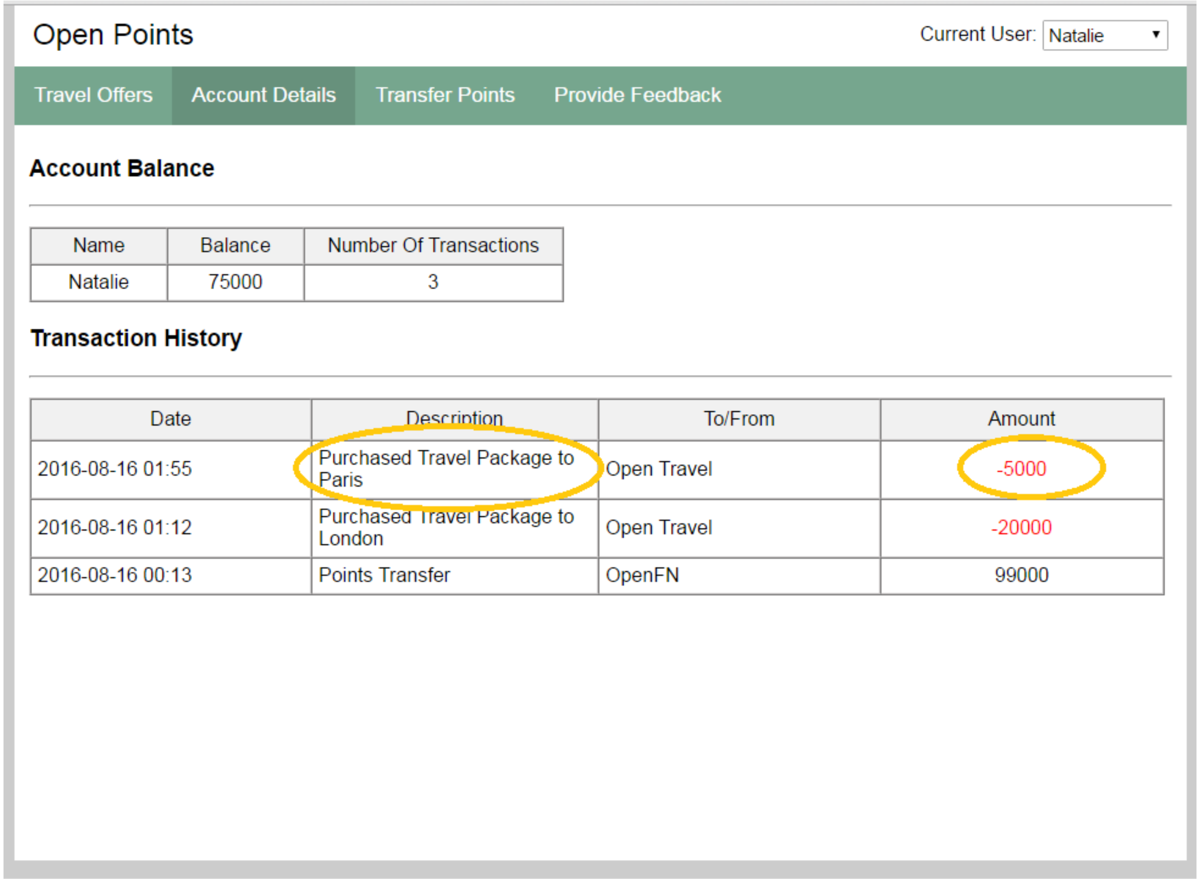
Travel Offers

Offer	Terms
Paris for Less	• Half off dining and travel activities in Paris • Valid from May 11, 2016
Points for Feedback	• 1,000 points for travel package • Valid from May 24, 2016

Purchase Travel Package

● Paris: 10k Points
○ New York City: 15k Points
○ London: 20k Points
○ Tokyo: 25k Points
○ Rio de Janeiro: 30k Points

f) Click on the **Account Details** tab, and notice that Natalie now has three transactions. The first transaction in the list shows her purchase for the Paris travel package. Instead of the original package price of 10,000 points, this transaction shows that Natalie purchased the Paris package for only 5,000 points, which is half of the original price. This is because the Paris travel package is covered by the *Paris for Less* travel offer and its associated smart contract, which guaranteed that all Paris-related purchases are half of the original price.



Account Balance

Name	Balance	Number Of Transactions
Natalie	75000	3

Transaction History

Date	Description	To/From	Amount
2016-08-16 01:55	Purchased Travel Package to Paris	Open Travel	-5000
2016-08-16 01:12	Purchased Travel Package to London	Open Travel	-20000
2016-08-16 00:13	Points Transfer	OpenFN	99000

g) **Optional Challenge:** If you finish the entire lab early, return to this section and take advantage of the *Points for Feedback* travel offer to rate Natalie’s travel experience in Paris using the **Provide Feedback** tab. After you submit your travel feedback, review your account details to check if you received the advertised reward of 1,000 points. Also, check the blockchain service page to ensure that your feedback transaction was submitted to the blockchain.

Part C: Creating Smart Contracts – *using the Open Points application, create new travel offers and add them to the blockchain as smart contracts*

Pre-Reqs:

- *You have completed Part A and B*
- *You have followed the instructions for deploying the application to your Bluemix account, as described in the 'Intro: Getting Started' section*

This part of the lab explains how to complete the following tasks:

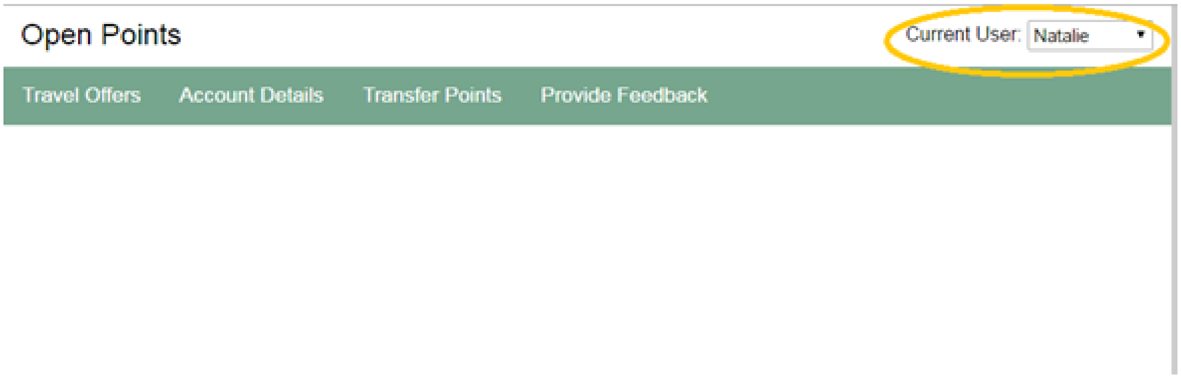
- *Create new travel offers for existing travel packages and add them to the blockchain as smart contracts*
- *Test the functionality of the new travel offers by purchasing travel packages*

Estimated Duration: 15 minutes

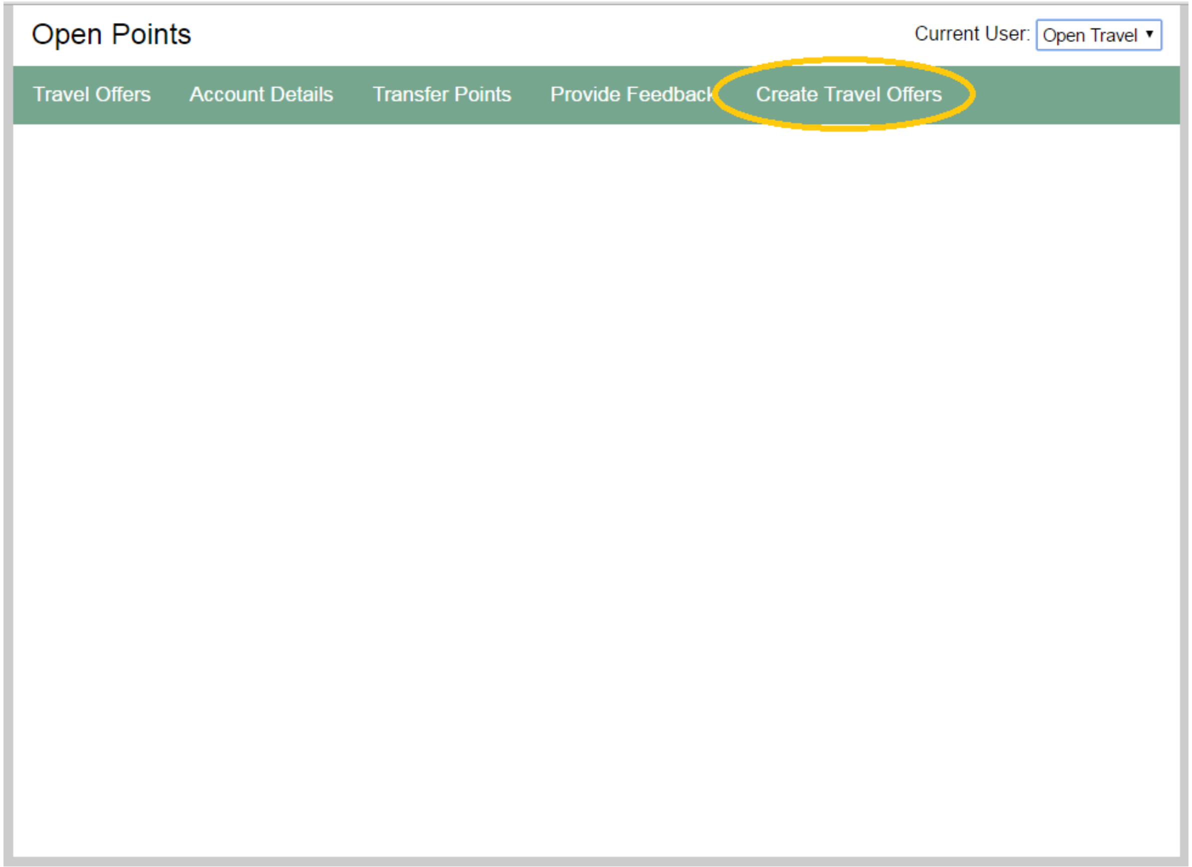
1. Create Smart Contracts for Travel Packages

In this section you will create travel offers for travel packages as smart contracts. These smart contracts will be added to the blockchain and will affect the outcome of travel purchases.

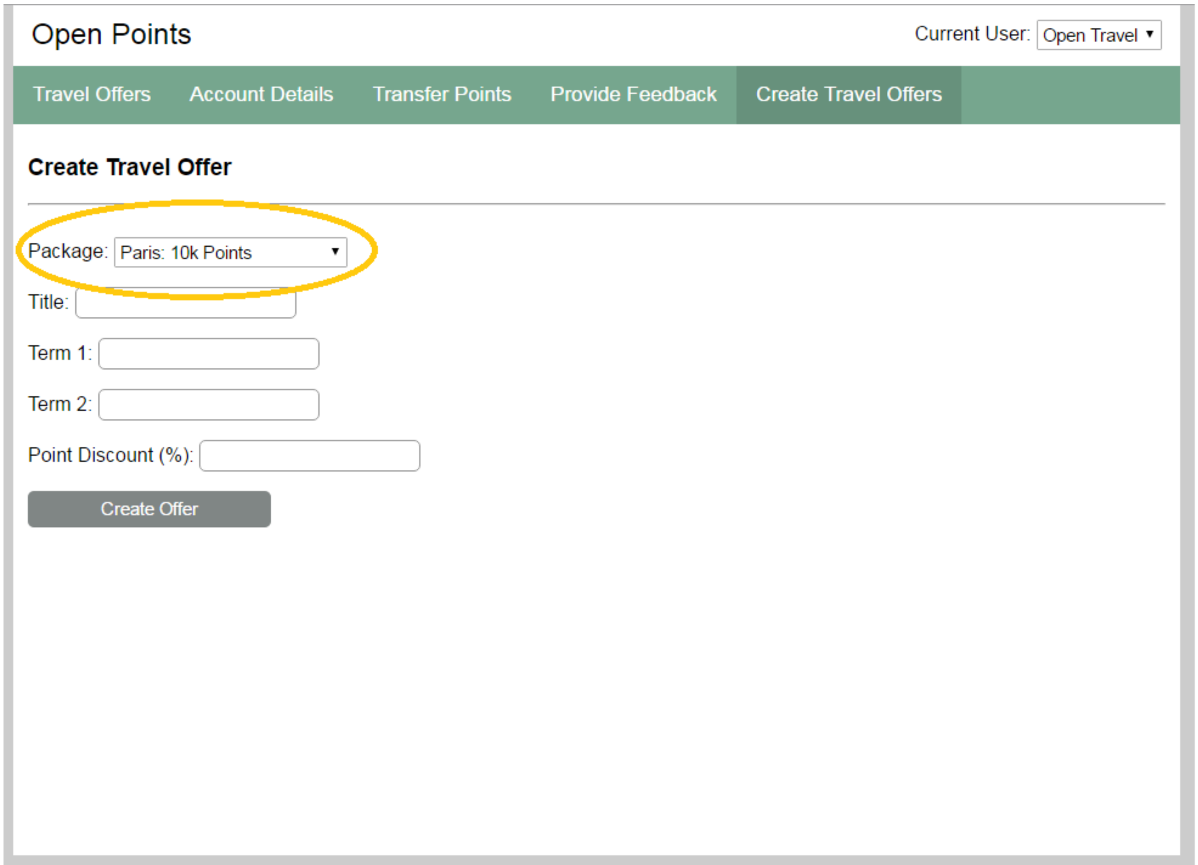
a) Adding travel offers as smart contracts is a feature that that the travel company **Open Travel** needs to use. Change the current website user from **Natalie** to **Open Travel.**



b) After switching the user to be **Open Travel**, a new tab called **Create Travel Offers** appears as the rightmost tab on the website. Click on this tab to create your own smart contract for a travel package.



c) This page allows you to create a smart contract for one of the travel packages provided by **Open Travel.** Let's create a smart contract for the London travel package that will give customers a 50% discount on the purchase price. To start, select the travel package for London from the travel package drop down menu



Create Travel Offer

Package: Paris: 10k Points

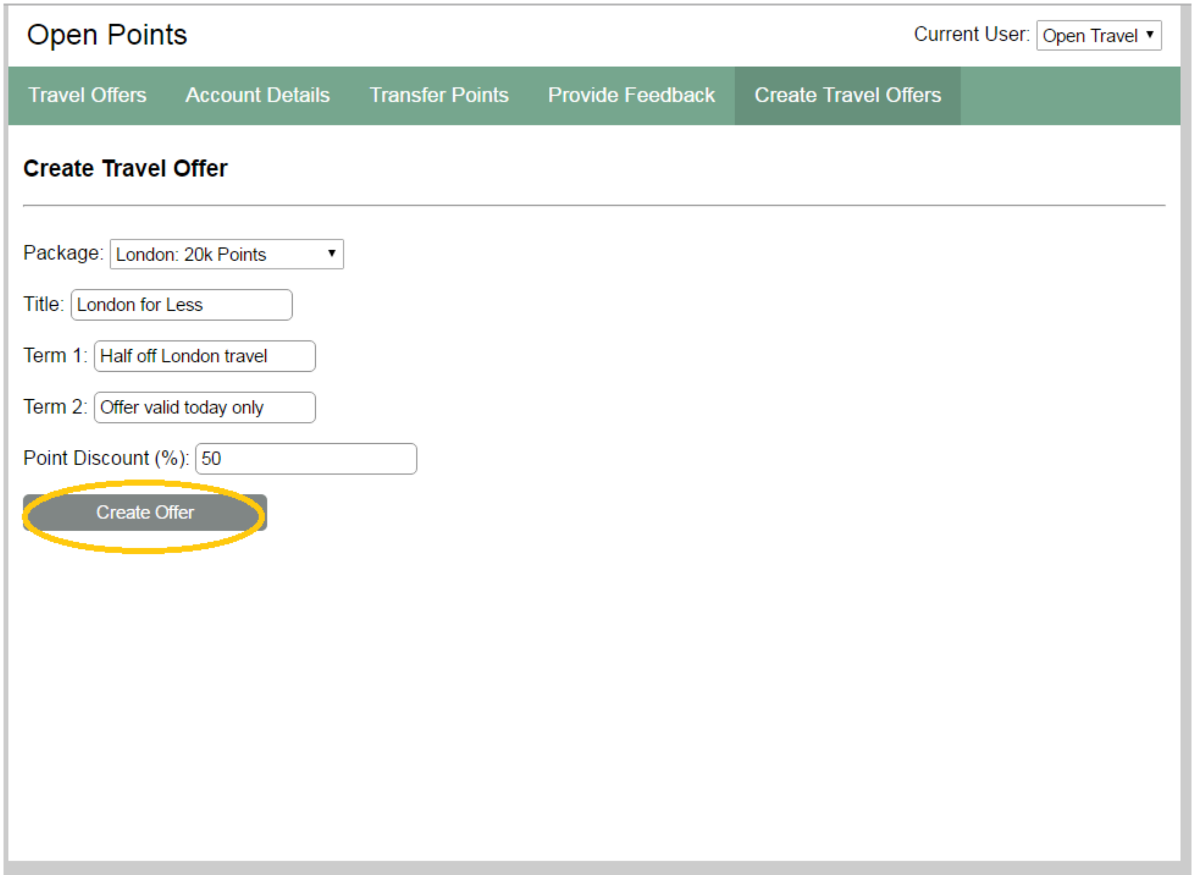
Title:

Term 1:

Term 2:

Point Discount (%):

d) Enter a contract title and two terms that describe the contract for this travel package. For the **Title**, enter: *London for Less*. For **Term 1**, enter: *Half off London travel*. For **Term 2, enter:** *Offer valid today only*. For the **Point Discount** percentage, enter 50. Your travel offer should now look like the one shown below. Click on the **Create Offer** button to add your smart contract to the blockchain.



Package: London: 20k Points ▾

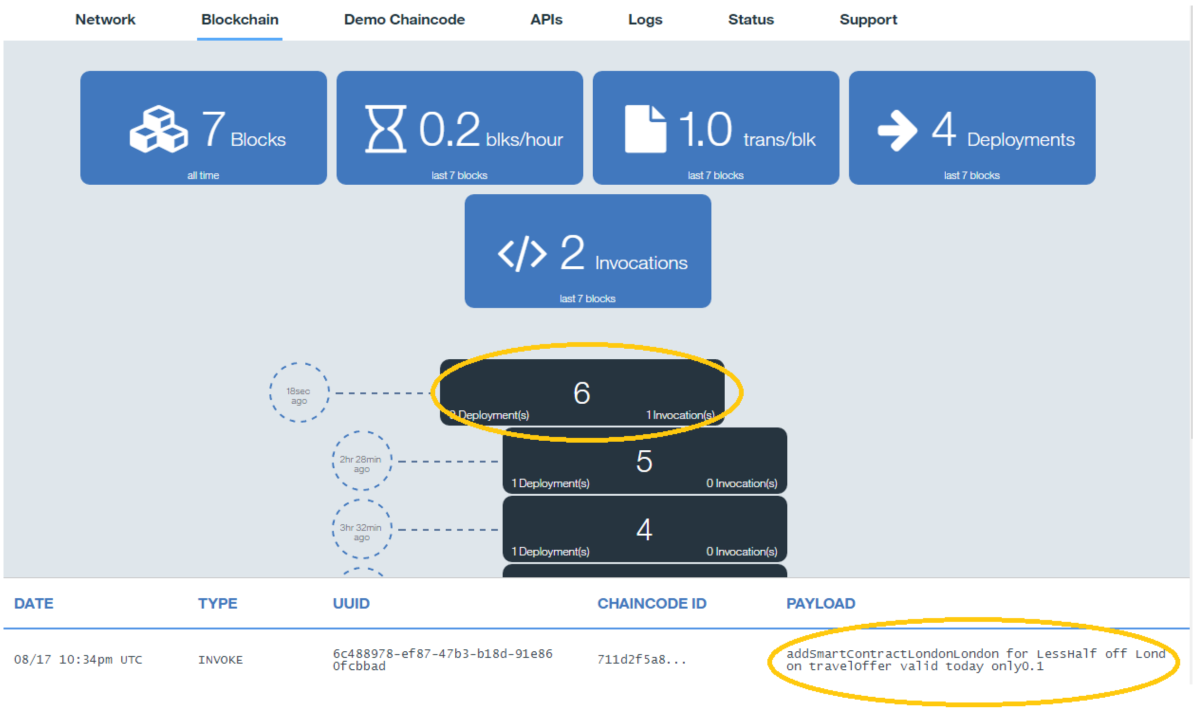
Title: London for Less

Term 1: Half off London travel

Term 2: Offer valid today only

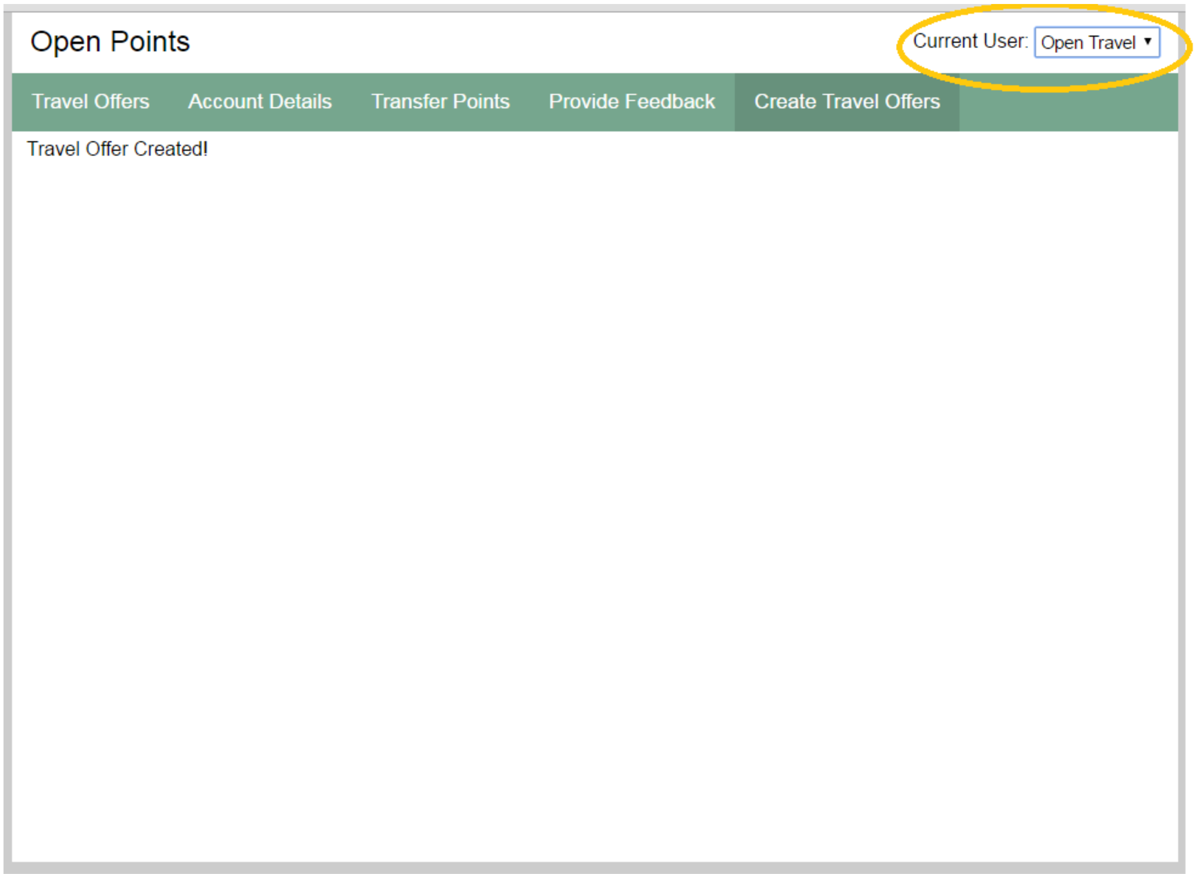
Point Discount (%): 50

e) Verify that this transaction was added to the blockchain. Return to the browser window that contains the blockchain service status page, and click on the **Blockchain** tab. Click on the block at the top of the chain to see the details of the transaction it contains. The payload of the transaction describes the addition of a smart contract for the London travel package.



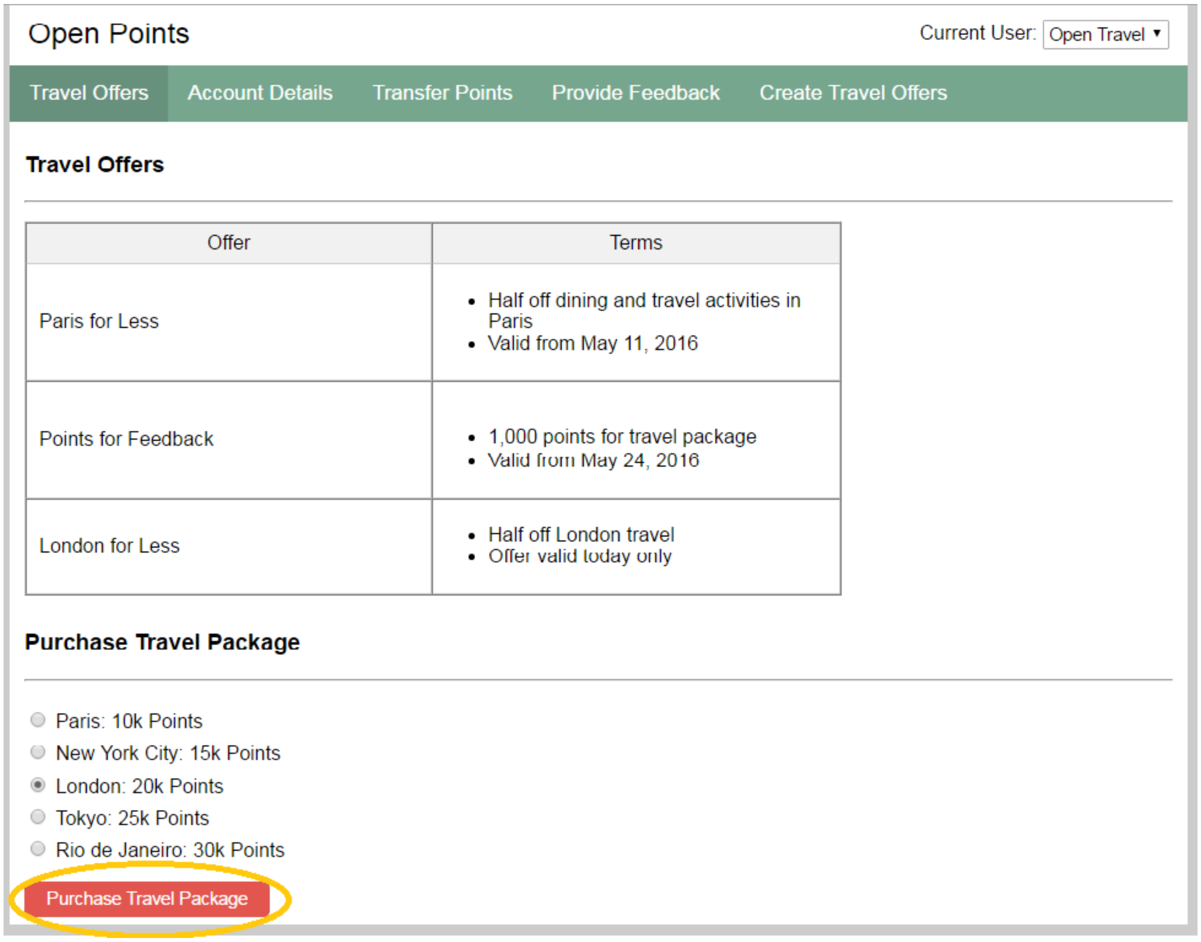
DATE	TYPE	UUID	CHAINCODE ID	PAYLOAD
08/17 10:34pm UTC	INVOKE	6c488978-ef87-47b3-b18d-91e86 0fcbbad	711d2f5a8...	addSmartContractLondonLondon for LessHalf off London traveloffer valid today only0.1

f) Let's test the smart contract you just created by purchasing a travel package to London as **Natalie**. Return to the Open Points website and change the current user to **Natalie**.



Travel Offer Created!

g) Click on the **Travel Offers** tab. Your new smart contract for the London travel package appears in the table of travel offers. From the **Purchase Travel Package** section, select the London travel package and then click the **Purchase Travel Package** button.



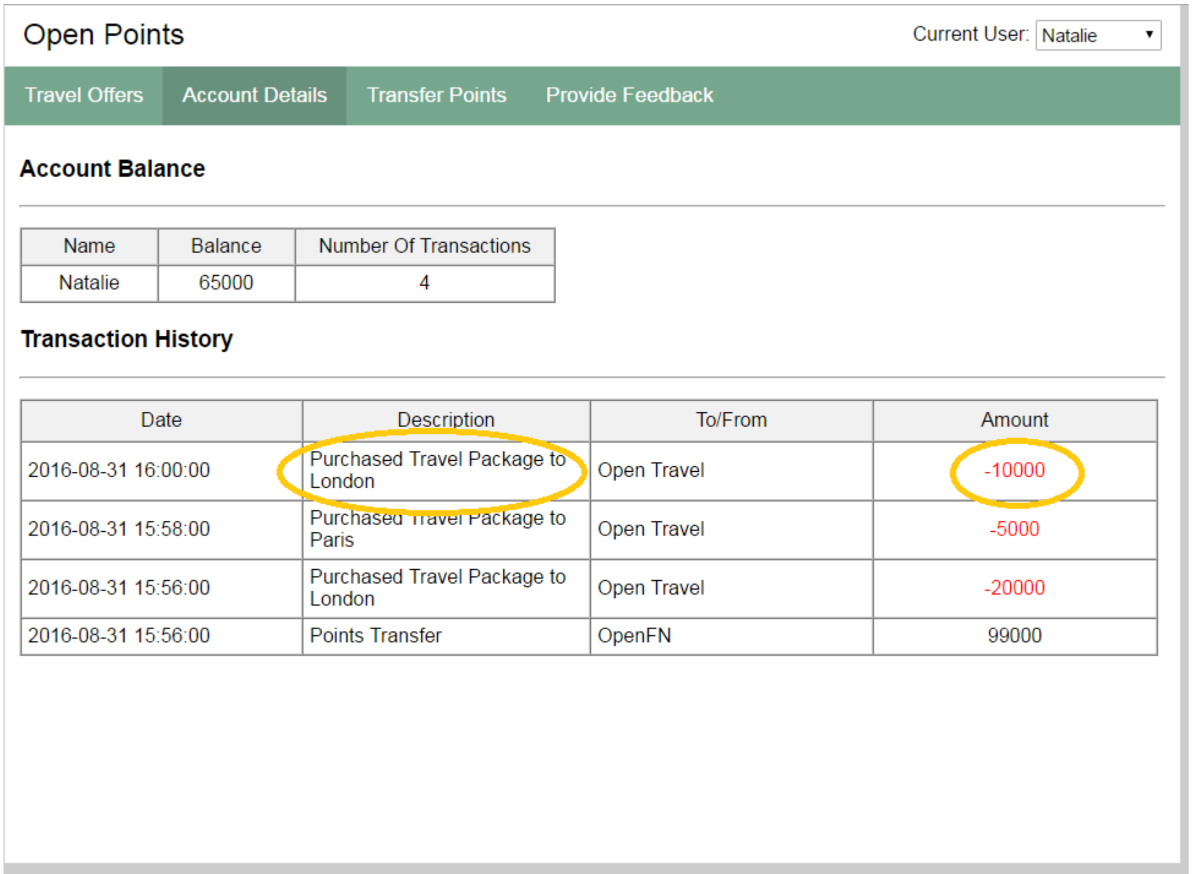
Travel Offers

Offer	Terms
Paris for Less	• Half off dining and travel activities in Paris • Valid from May 11, 2016
Points for Feedback	• 1,000 points for travel package • Valid from May 24, 2016
London for Less	• Half off London travel • Offer valid today only

Purchase Travel Package

○ Paris: 10k Points
○ New York City: 15k Points
● London: 20k Points
○ Tokyo: 25k Points
○ Rio de Janeiro: 30k Points

h) Let's check to make sure that Natalie received the 50% discount on the London travel package that your smart contract guaranteed. Click on the **Account Details** tab and examine Natalie's transaction history. Her last transaction shows a purchase for the London travel package for 10,000 points instead of the 20,000 points that is stated in the purchase price because the smart contract discounted the package by 50%.



Account Balance

Name	Balance	Number Of Transactions
Natalie	65000	4

Transaction History

Date	Description	To/From	Amount
2016-08-31 16:00:00	Purchased Travel Package to London	Open Travel	-10000
2016-08-31 15:58:00	Purchased Travel Package to Paris	Open Travel	-5000
2016-08-31 15:56:00	Purchased Travel Package to London	Open Travel	-20000
2016-08-31 15:56:00	Points Transfer	OpenFN	99000

i) **Optional Challenge:** If there is time remaining in the lab, try to create a new smart contract for the Tokyo travel package that gives users a 10% discount. Review the blockchain service page to ensure that your smart contract was submitted to the blockchain. Verify that the smart contract is active by purchasing the Tokyo package and checking the account details.

Thank you for completing the IBM Blockchain Fundamentals hands-on lab!

For more information about IBM Blockchain:

- ***IBM Blockchain Homepage:*** ***http://www.ibm.com/blockchain***
- ***Hyperledger Project:*** ***https://www.hyperledger.org***