

# Developing and Deploying Microservices to IBM Cloud private

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Find the latest version here:  
<http://ibm.biz/StockTraderLab>

Click this link and login with your IBM ID to get to your Skytap image:

<https://bluedemos.com/event/326/session/1823>  
password: indexsf2018

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## 1. Introduction

In this lab, you will use and update an application in an IBM Cloud Private environment, built on Kubernetes. The lab will use a Skytap-hosted virtual machine (VM), which, for the purpose of the lab can be considered to be your on-premises environment running IBM Cloud Private that hosts your application and its required services.

The Skytap VM provided to you contains all necessary artifacts for the lab. The application artifacts are also available for review at <https://github.com/IBMStockTrader/>. You can learn more about this application and how to deploy it in your own IBM Cloud Private environment via a series of blog posts from the IBM Hybrid Cloud CTO Office:

- Introduction to the StockTrader microservices application -  
[https://www.ibm.com/developerworks/community/blogs/5092bd93-e659-4f89-8de2-a7ac980487f0/entry/Building\\_Stock\\_Trader\\_in\\_IBM\\_Cloud\\_Private\\_2\\_1\\_using\\_Production\\_Services?lang=en](https://www.ibm.com/developerworks/community/blogs/5092bd93-e659-4f89-8de2-a7ac980487f0/entry/Building_Stock_Trader_in_IBM_Cloud_Private_2_1_using_Production_Services?lang=en)
- Developing Microservices for IBM Cloud private -  
[https://www.ibm.com/developerworks/community/blogs/5092bd93-e659-4f89-8de2-a7ac980487f0/entry/Developing\\_microservices\\_for\\_IBM\\_Cloud\\_private?lang=en](https://www.ibm.com/developerworks/community/blogs/5092bd93-e659-4f89-8de2-a7ac980487f0/entry/Developing_microservices_for_IBM_Cloud_private?lang=en)

The lab is divided into four main parts:

1. First, you will familiarize yourself with the StockTrader application and the Kubernetes cloud it's running in. StockTrader consists of multiple, small, specialized services (microservices) which work together as a stock portfolio-management system.
2. Second, you will learn how management of applications and services occurs within IBM Cloud Private and Kubernetes. You will learn how to scale up and down containers based upon workload requirements.
3. Third, you will deploy your own instance of MQ using ICP's helm chart catalog.
4. Fourth, you will edit code in one of the StockTrader microservices and deploy this new version into your IBM Cloud Private environment. This simulates the actual operations an administrator may perform when deploying and updating workloads. You will also use a Kubernetes tool to visualize how the various microservices interact at runtime.



The Skytap VM features Ubuntu 16.04.3 LTS (xenial) as the operating system and has the following software installed:

- Docker 17.03.1-ce
- IBM Cloud Private - 2.1.0.1 (with Kubernetes 1.8.3)
- kubectl CLI version 1.9.1
- git CLI version 2.7.4
- Java 8
- Apache Maven version 3.5.0
- VS Code version 1.20

This particular Skytap VM is configured to host all portions of IBM Cloud Private: a master node for managing the environment, a proxy node for servicing network requests, and a worker node for hosting workloads. A more realistic environment would have separate virtual machines for each configuration, but for the purpose of this lab we've combined them into a single VM for convenience.

In addition to the above software, the Skytap VM also contains the artifacts needed to complete the lab. The following table points out the most important artifacts.

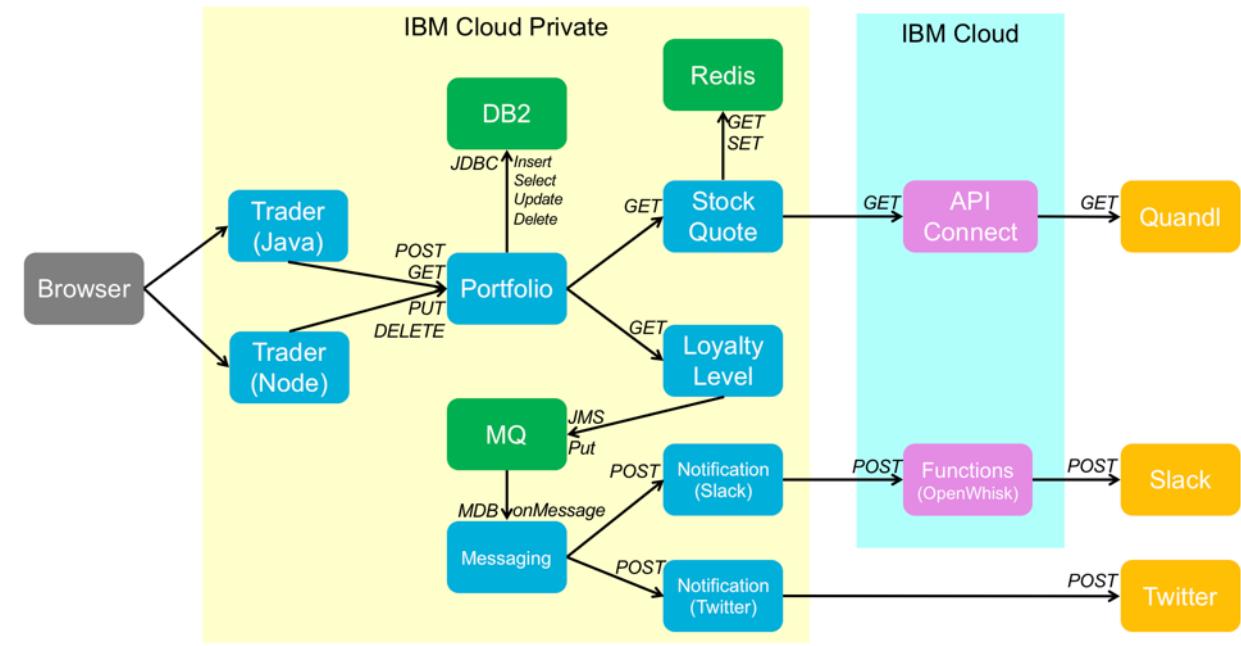
Directory	Description	Notes
/StockTrader/trader	Front-end User Interface	Java servlets
/StockTrader/portfolio	Portfolio management API	Uses JDBC to persist portfolios to DB2
/StockTrader/stock-quote	Stock prices via API Connect/Quandl	Uses Redis for caching
/StockTrader/loyalty-level	Determines a portfolio's level (Silver, Gold, etc.), and sends a message when it changes	Uses JMS to deliver messages to MQ
/StockTrader/messaging	Receives messages about loyalty level changes	Message Driven Bean (EJB)
/StockTrader/notification-twitter	Sends tweets	Uses Twitter4J
/StockTrader/notification-slack	Posts to a Slack channel <b>Not used in this lab</b>	Uses IBM Cloud Functions



The application in this lab, **StockTrader**, is a microservice-based application utilizing various features of IBM WebSphere Liberty runtime (JAX-RS, JDBC, JMS, etc.) to interact with a set of database tables in DB2 via JDBC and to send notifications over MQ via JMS to Twitter. It also uses API Connect in the IBM public cloud to get stock quotes, and uses Redis for caching of those quotes.

As you can see in the following diagram (also shown at <https://github.com/IBMStockTrader/trader>, in its README.md), most microservice-to-microservice communication occurs via REST calls. There are two variants of the front-end web user interface – we'll use the Java Servlet based client for this lab. The *portfolio* microservice uses JDBC to talk to DB2 for persistence. Two microservices, *loyalty-level* and *messaging*, use JMS to talk to MQ for their communications. Everything in the yellow box is running in IBM Cloud Private. Microservices are colored in blue, their prerequisites are green. They reach out to services in the IBM public cloud (cyan), shown as purple boxes (they also authenticate against IBMid, an OpenID Connect provider in the IBM public cloud). And some services out on the internet are used as well, shown in orange. You can see how the microservices work together in the following diagram (note that the Slack notification is not enabled in this lab, as the Slack server to which it posts requires an internal IBM intranet id/pwd – so all notifications will be via Twitter in this lab).

## Stock Portfolio sample for IBM Cloud Private



The end-to-end flow of the application is as follows: A user opens their browser and navigates to *trader*'s web page where they can interact with various stock portfolios. When the user takes an action, such as buying stock, *trader* makes a REST call to *portfolio* to perform the requested action. As part of the buy stock action *portfolio* calls the *stock-quote* service to get the current stock price. *stock-quote* first checks a **Redis** cache for the stock price and if the price is not found in the cache *stock-quote* calls an **API Connect** service that fronts a **Quandl** Stock Data API for the price and stores the value in **Redis** before returning the value back to *portfolio*. Then *portfolio* calculates the total purchase price (number



of shares \* stock price) before storing that data in the user's portfolio within DB2. *portfolio* next calls *loyalty-level* to see if the new total portfolio value has changed the customer's loyalty level. If such a change occurs a message is put on an MQ queue and the new loyalty level is returned back to *portfolio* for storage in DB2. Finally, *portfolio* returns all this data as a JSON object back to *trader* for rendering in the user's browser. Asynchronously, an MDB in the *messaging* microservice receives the MQ message and calls either *notification-twitter* to send a tweet, or *notification-slack* (not used in this lab) to call IBM Cloud Functions to post to a Slack channel.

Finally, we will use the Consolas font for any commands you should enter in a terminal window. For example:

```
kubectl get deployments
```

should be entered in a terminal window (but not yet). Any actions you should take or forms to fill in will be **bolded**.



## Prepare: Log Into Skytap

We are using Skytap, and each of you will have your own VM environment.

Click this link to get to your Skytap image:

<https://bluedemos.com/event/326/session/1823>

password: indexsf2018

If you step away from the lab and need to log back in to the Skytap VM the password is **A1rb0rn3**.

You can also click the keys icon  in the Skytap menu bar and click the **Insert** button next to the password for user **skytap**.



### Skytap Tips:

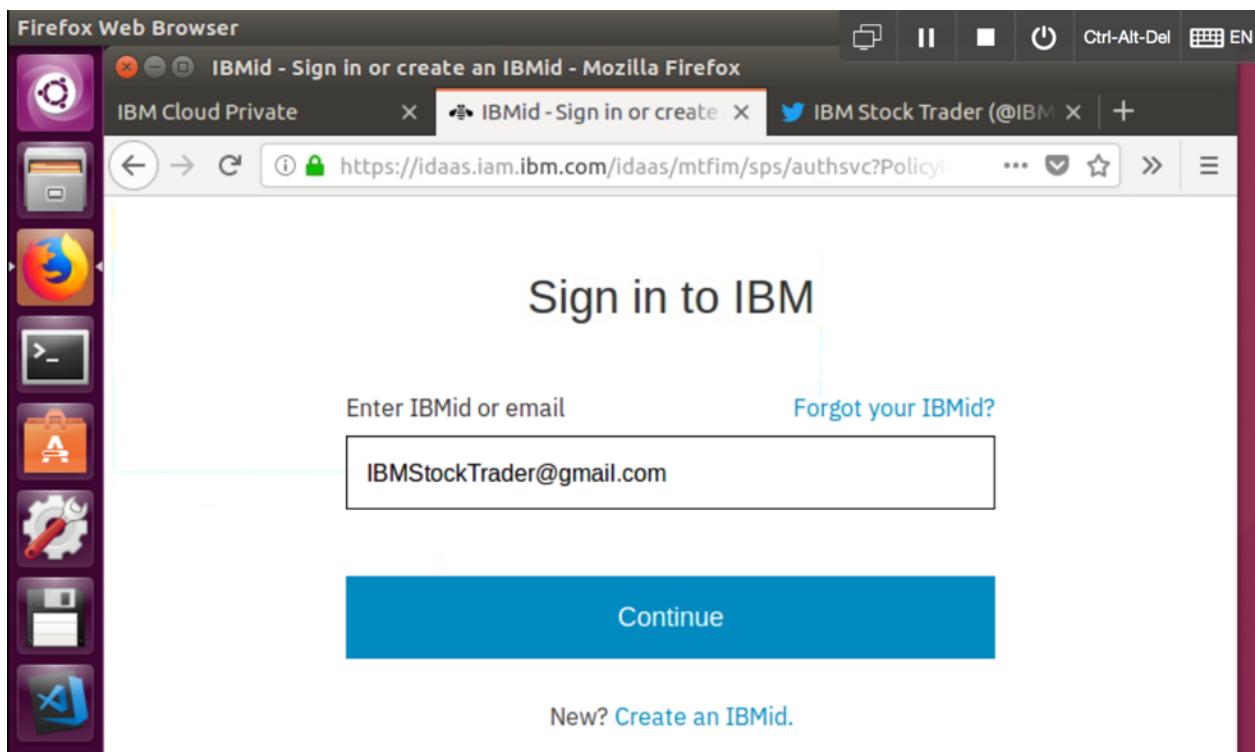
- All commands will be performed from a Terminal window within the Skytap VM in the browser (not directly from your laptop, which will not have connectivity to the Skytap VM other than working with its desktop via the web browser)
- Click out of the browser before performing any laptop keyboard shortcuts, otherwise the keyboard shortcuts will be done in the Skytap VM Linux OS
- Use the right click copy/paste, don't use keyboard shortcuts...they often don't work.
- To copy from the Skytap VM into your laptop, right click in the VM to copy the content, go to the top icon  and then copy the content again...this will add the content into your laptops cut/paste buffer.



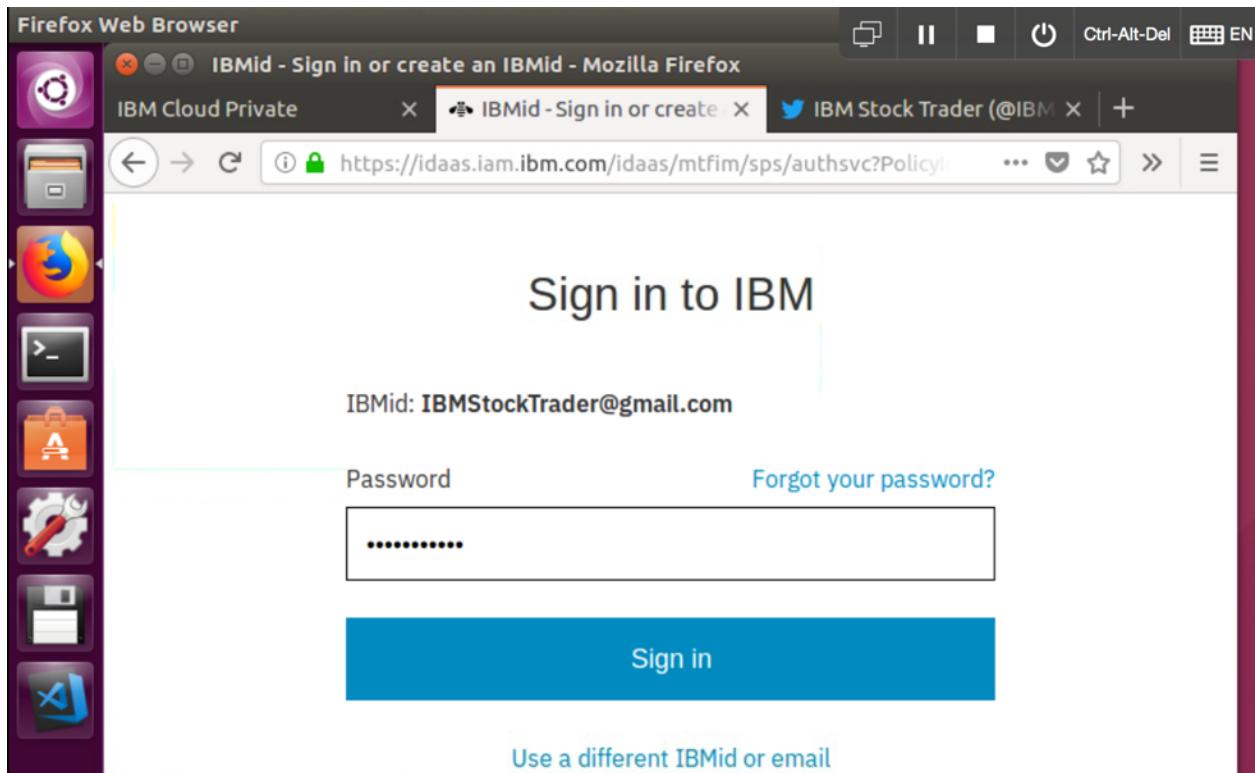
## 2. Introduction to the StockTrader sample

As noted in the introduction, StockTrader is a microservice-based stock portfolio management application which utilizes IBM WebSphere Liberty, IBM DB2, IBM MQ, Redis, and IBM API Connect as the underlying runtime and storage mechanisms. All services, except API Connect (which runs in the IBM public cloud), are configured to run in the IBM Cloud Private instance within your Skytap VM.

1. Open the Firefox browser and navigate to <https://10.0.0.1:32389/trader/summary>
2. You will be rerouted to an OpenID Connect authentication page. To log in, enter your **IBM ID**. Your IBM ID is the same email you used to register for this conference. If you don't have an IBM ID, click the "Create an IBMID" link and follow the instructions (an email will be sent with a confirmation code once you submit your info, and the account won't be activated until you enter that code).



3. Enter your password for your IBM ID. Note that IBM employees using their work e-mail addresses will be routed to a different page to do a w3id login with their intranet ID and password.

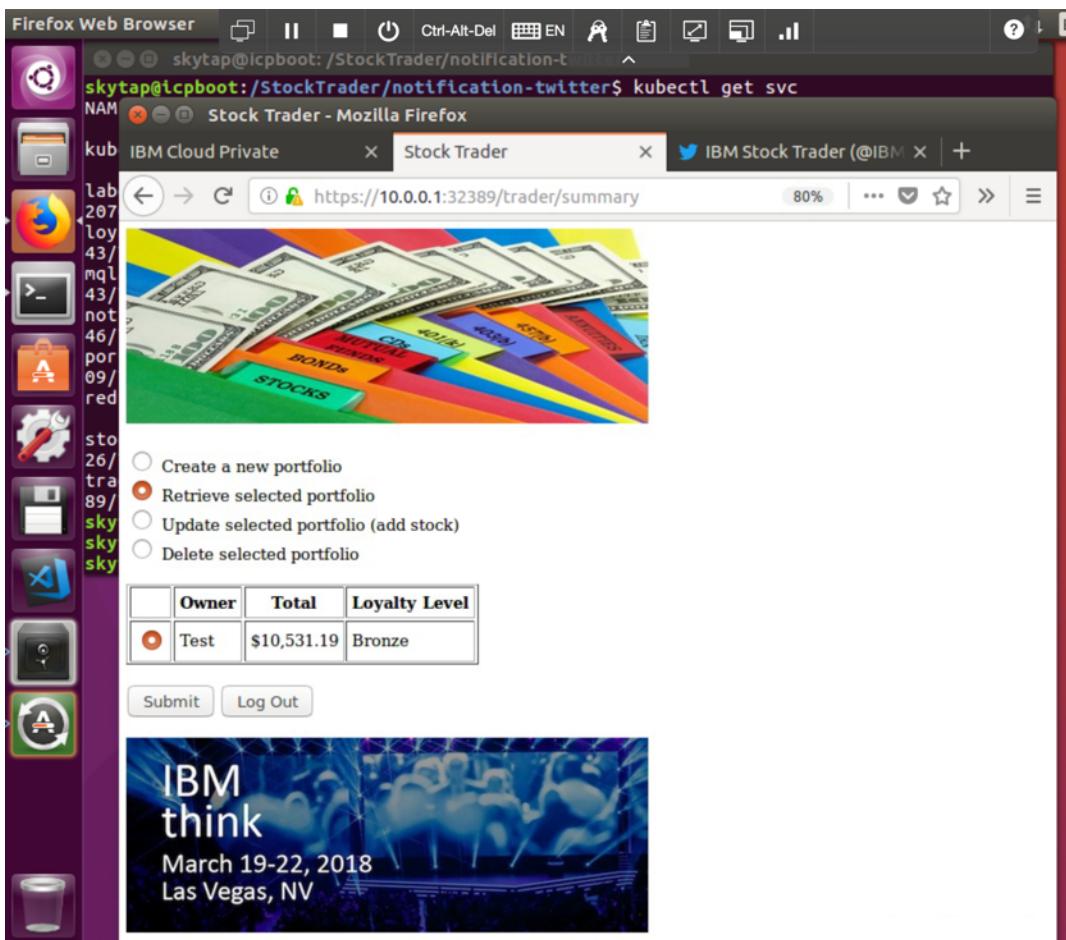


You may get told that you need to perform two-factor authentication, due to this being the first time your IBM ID has logged in from this location (in SkyTap). If so, it will send you a confirmation code, as a text to your mobile device or to your e-mail, and you will need to enter that code to complete your login.

4. Upon a successful login, you will see the StockTrader landing page, which provides a list of the stock portfolios you manage along with a set of actions you can take for each portfolio. The list should be pre-populated with a portfolio named Test, which contains a wide variety of stocks.

Note that there is a daily limit on how many stock quotes can be served up from **Quandl** to our **API Connect** service, and with many lab participants all running the sample simultaneously, that rate limit may be hit. In that case, the sample will revert to using values already cached in Redis, and the price for any new stock symbols not already in Redis will not be available, resulting in the UI showing “Error” for that stock. This will also be shown if an invalid stock ticker symbol is entered.





5. Select the **Create a new portfolio** radio button and click **Submit** to create a new portfolio, as shown here.

Create a new portfolio  
 Retrieve selected portfolio  
 Update selected portfolio (add stock)  
 Delete selected portfolio

	Owner	Total	Loyalty Level
<input checked="" type="radio"/>	Test	\$10,531.19	Bronze

**Submit**

6. Provide a name for the new portfolio owner and click the **Submit** button to create the new portfolio. Make sure not to enter any spaces in the name, or other values that would be illegal as part of a URL.



Owner:

When you click Submit, the *trader* service (our user interface) makes a REST call to *portfolio* service which inserts a new row in DB2's portfolio table. Now that you've created a portfolio you need to buy some stocks for that person.

7. Click the **Update selected portfolio (add stock)** radio button and the radio button next to your newly created portfolio before clicking **Submit**.

- Create a new portfolio  
 Retrieve selected portfolio  
 Update selected portfolio (add stock)  
 Delete selected portfolio

	Owner	Total	Loyalty Level
<input type="radio"/>	EM	\$5,688.93	Basic
<input type="radio"/>	EM1	\$2,158,753.68	Platinum
<input checked="" type="radio"/>	Fred	\$0.00	Basic

8. On the Add Stock page you enter a **Stock Symbol** and a **Number of Shares** you want to buy. You can enter any actual NYSE stock symbol and any number of shares before clicking the **Submit** button (as shown on the next diagram).

**Owner:**

**Stock Symbol:**

**Number of Shares:**

9. When you click Submit *trader* calls *portfolio* which then calls *stock-quote* to retrieve the current stock price for that stock. There are some smarts in *stock-quote*: A Redis database caches previously retrieved stock prices to reduce load against the Quandl back end stock quote service (and to improve performance). If there is no cached value in Redis, *stock-quote* calls an API Connect service, which calls Quandl for the most recent market price, stores the value in Redis, and returns the quote back to *portfolio*. The *portfolio* service updates DB2 with the new stocks and portfolio contents which you'll see when you're returned back to the main landing page.



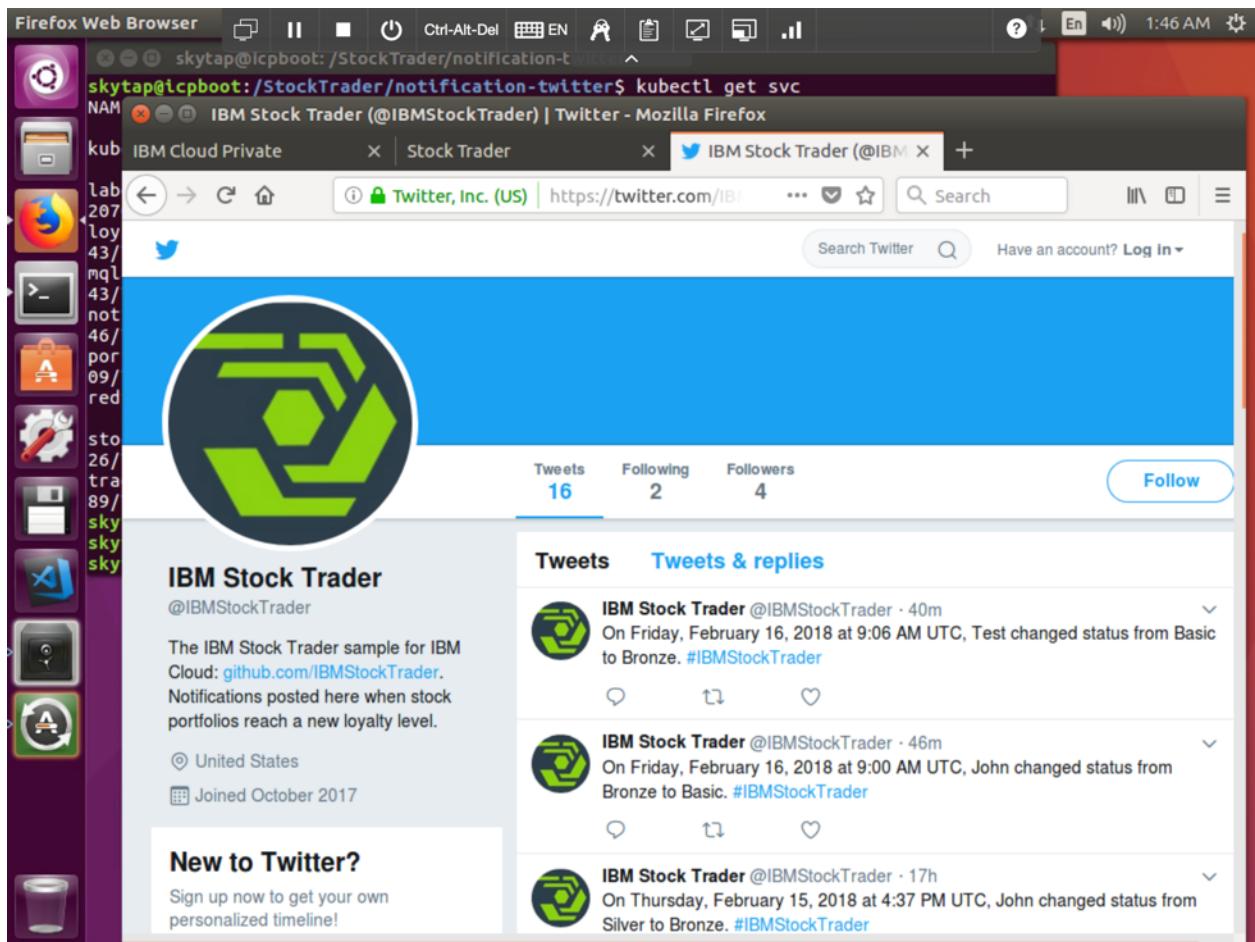


- Create a new portfolio
- Retrieve selected portfolio
- Update selected portfolio (add stock)
- Delete selected portfolio

	Owner	Total	Loyalty Level
<input checked="" type="radio"/>	EM	\$5,688.93	Basic
<input type="radio"/>	EM1	\$2,158,753.68	Platinum
<input type="radio"/>	Fred	\$7,328.00	Basic

10. Feel free to add more stocks to your new portfolio by repeating step 8. If you want to *sell* a stock enter a **negative** number for the number of shares you'd like to buy. You may notice that the loyalty level changes from Basic when a certain portfolio value threshold is reached. Any time a stock transaction takes place *portfolio* calls the *loyalty-level* service to compute the current loyalty level for the portfolio. When a threshold is reached, the database is updated with the new loyalty value and a JMS message is put onto an MQ queue. The *messaging* service contains a Message Driven Bean which reads from this queue and calls a *notification-twitter* service, which sends a message to Twitter about that change in level.
11. The various loyalty levels are defined as:
  - Basic: < \$10,000
  - Bronze: < \$50,000
  - Silver: < \$100,000
  - Gold: < \$1,000,000
  - Platinum: > \$1,000,000
12. Feel free to buy or sell more stocks to change the different loyalty levels. You can open a new tab in your browser and go to <https://twitter.com/IBMStockTrader> to see the tweets:





13. You can also view the full details for your selected portfolio by selecting the **Retrieve selected portfolio** radio button and the portfolio you'd like to see before clicking the **Submit** button.

Create a new portfolio  
 Retrieve selected portfolio  
 Update selected portfolio (add stock)  
 Delete selected portfolio

	Owner	Total	Loyalty Level
<input type="radio"/>	EM	\$5,688.93	Basic
<input type="radio"/>	EM1	\$2,158,753.68	Platinum
<input checked="" type="radio"/>	Fred	\$8,218.56	Basic

Submit



### Stock Portfolio for Fred:

Symbol	Shares	Price	Date Quoted	Total
IBM	50	\$146.56	2017-09-26	\$7,328.00
T	23	\$38.72	2017-09-26	\$890.56

Total Portfolio Value: \$8,218.56

Loyalty Level: Basic

**OK**

Here, the *trader* service has again called *portfolio* to gather all the details for this particular portfolio from DB2. Click the **OK** button to return to the portfolio list.

14. You can also delete a portfolio (and all of its stocks) by clicking the **Delete selected portfolio** radio button, clicking on a portfolio, and then clicking **Submit**. This is shown in the following diagram.

- Create a new portfolio
- Retrieve selected portfolio
- Update selected portfolio (add stock)
- Delete selected portfolio

	Owner	Total	Loyalty Level
<input type="radio"/>	EM	\$5,688.93	Basic
<input checked="" type="radio"/>	EM1	\$2,158,753.68	Platinum
<input type="radio"/>	Fred	\$8,218.56	Basic

**Submit**

- 
- Create a new portfolio
  - Retrieve selected portfolio
  - Update selected portfolio (add stock)
  - Delete selected portfolio

	Owner	Total	Loyalty Level
<input checked="" type="radio"/>	EM	\$5,688.93	Basic
<input type="radio"/>	Fred	\$8,218.56	Basic

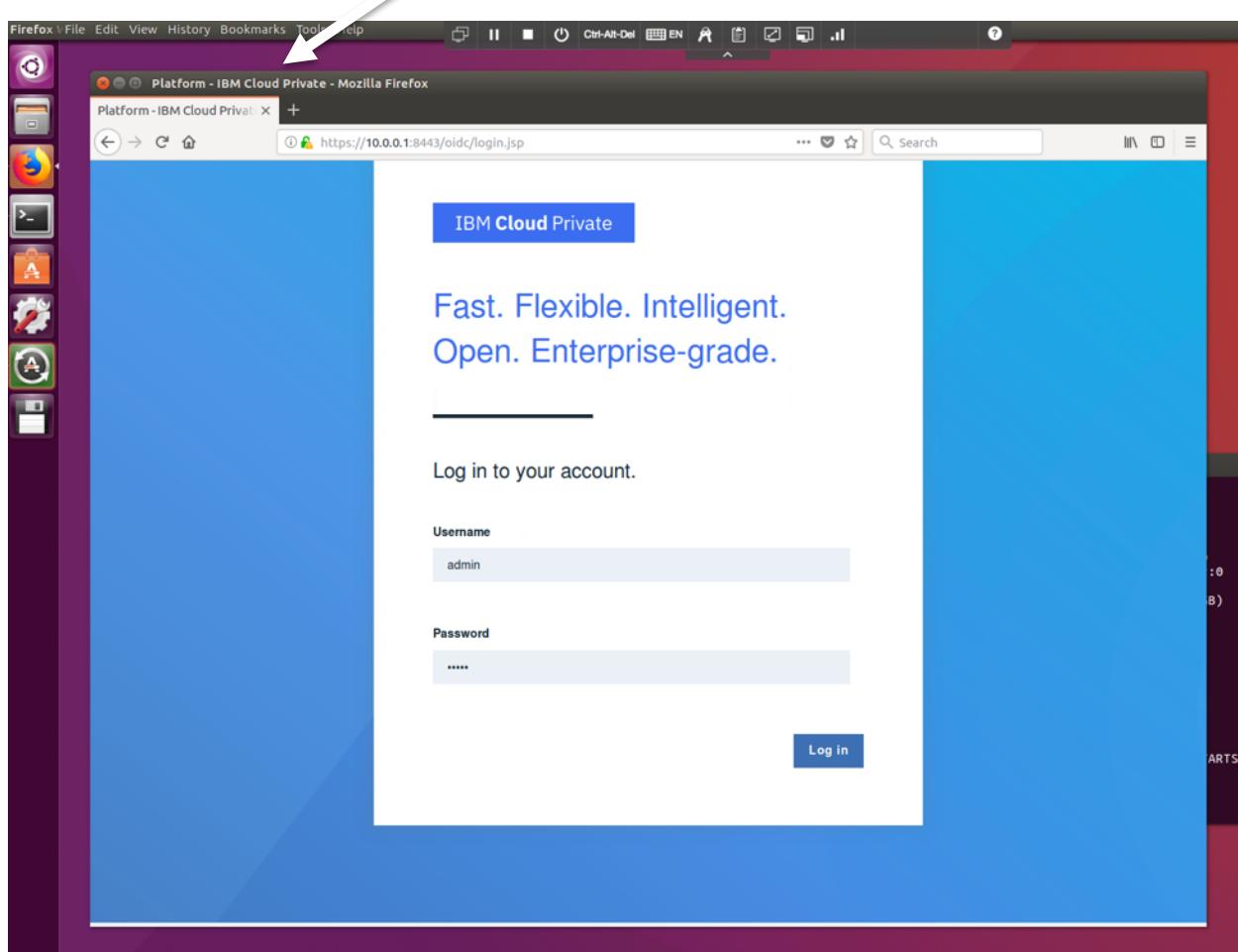
**Submit**



### 3. Introduction to IBM Cloud Private User Interface

In this section, you will utilize the IBM Cloud Private web console to view how StockTrader is deployed within IBM Cloud Private.

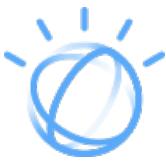
1. Within Firefox you should see a tab called **IBM Cloud private**. Click on this tab to continue.



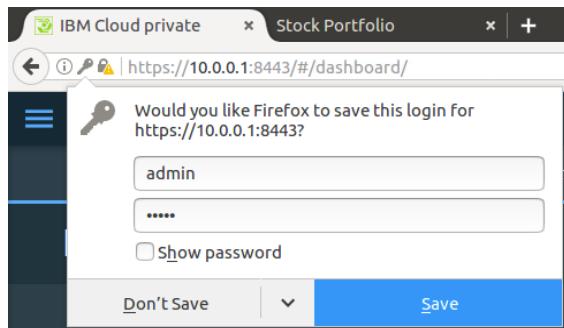
If there is no IBM Cloud Private tab in Firefox please navigate to <https://10.0.0.1:8443>

2. Enter the following usernames and passwords before clicking the “**Log in**” button:

User ID	<b>admin</b>
Password	<b>admin</b>



If prompted by Firefox to save this login select **Don't save** to dismiss the dialog.



You've arrived at the IBM Cloud Private Dashboard landing page which provides a brief overview of your environment.

The **System Overview** section provides a high-level health about the worker nodes where workloads actually run (titled **Nodes**, first widget), the Shared Storage utilization for persistent workloads (titled **Shared Storage**, second widget), and the status of all deployed applications (titled **Applications**, final widget).

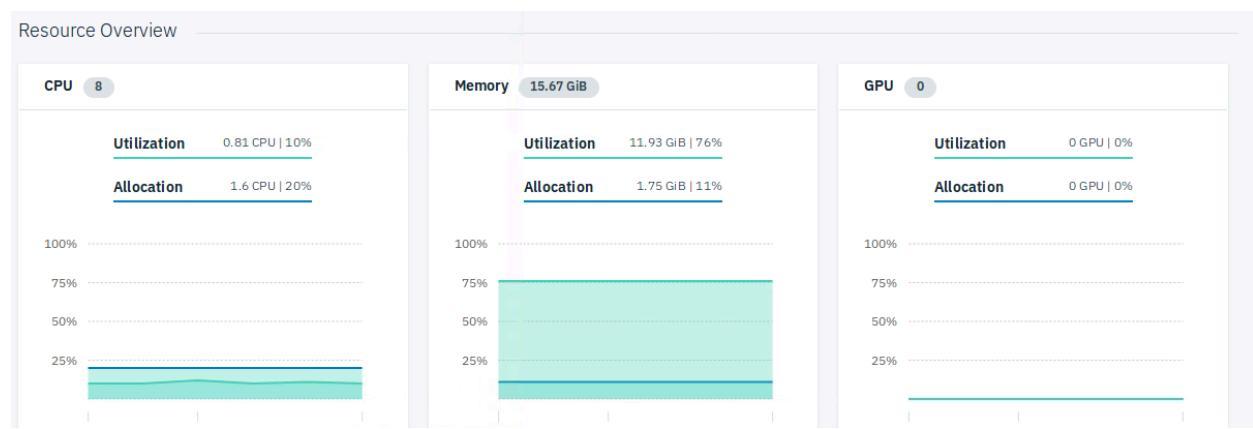
In the **Nodes** widget, we see there is one active worker node. This worker node is where our workloads, or applications and services, are deployed. These applications and services are Dockerized versions of IBM WebSphere Liberty, IBM DB2, IBM MQ, Redis, along with other Kubernetes internal services.

The **Shared Storage** widget shows that we have 49GB of shared storage utilized by workloads to store persistent data. This does not mean all 49GB have been utilized, only claimed. Since our workloads and services are Dockerized it is important to remember that Docker containers should be considered ephemeral and any data stored within a container will disappear if that container is deleted. Shared storage allows data persistence outside a Docker container and outside the Docker lifecycle.



The **Applications** widget shows that there are 17 applications/services deployed and started in our environment. This includes not only the various microservices for StockTrader but also the dependent services, like IBM DB2, StockTrader depends on along with other internal Kubernetes services.

If you scroll down the landing page you'll find the **Resources Overview** section. This includes current **CPU**, **Memory**, and **GPU** utilization and allocation.



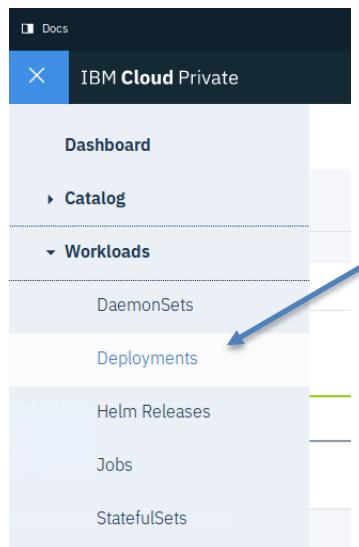
The **CPU** widget shows the total number of CPUs available across all the worker nodes, how much of the CPU is utilized and how much is allocated. Here we have 8 CPUs available across all workers (this VM has eight CPUs), the various workloads are using a total of 2.86 CPUs while only 0.4 CPUs have been directly assigned to a workload (dedicated compute resource)

Likewise, the **Memory** widget shows our workers have a total of 7.8 GB of RAM (this VM has 8GB of RAM), and that RAM is 90% utilized but only 7% has been directly requested or dedicated to a workload.

Finally, the **GPU** widget shows how many GPU resources are configured and available. If our workers had access to NVIDIA GPUs they would appear in this list and become available for analytics workloads to exploit.

3. Scroll back to the top of the browser window and select the menu icon in the upper left corner . This opens the Menu sidebar.





Click on **Workloads** and then **Deployments** in the menu.

This opens the list of applications and microservices (called *deployments* in Kubernetes) currently running in this IBM Cloud Private environment.



The screenshot shows the IBM Cloud Private console interface. The main window displays the 'Deployments' page. The table lists 28 items across 2 pages. The columns are: NAME, NAMESPACE, DESIRED, CURRENT, READY, AVAILABLE, CREATION TIME, and ACTION. The 'NAMESPACE' column shows that most entries are in the 'kube-system' namespace, while 'labdb2-ibm-db2oltp-dev' is in the 'default' namespace. The 'CREATION TIME' column shows dates ranging from Jan 4th 2018 to Feb 6th 2018. A blue circle highlights the 'labdb2-ibm-db2oltp-dev' row.

NAME	NAMESPACE	DESIRED	CURRENT	READY	AVAILABLE	CREATION TIME	ACTION
<a href="#">calico-policy-controller</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:52 AM	⋮
<a href="#">catalog-catalog-controller-manager</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:58 AM	⋮
<a href="#">default-http-backend</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">elasticsearch-client</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">elasticsearch-master</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">heapster</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">helm-api</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:59 AM	⋮
<a href="#">helmrepo</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:59 AM	⋮
<a href="#">kube-dns</a>	kube-system	1	1	1	1	Jan 4th 2018 at 9:53 AM	⋮
<a href="#">labdb2-ibm-db2oltp-dev</a>	default	1	1	1	1	Feb 6th 2018 at 10:00 AM	⋮

Items running in the *kube-system* namespace are internal IBM Cloud Private/Kubernetes services and can usually be ignored. StockTrader microservices and dependencies are running in the *default* namespace. Applications can also create their own custom namespaces; we will see an example of this later on, when we install Weave.

You will notice that there is a DB2 deployment named **labdb2-ibm-db2oltp-dev**; this hosts the DB2 database StockTrader uses for storing portfolio information. Endpoint and credential info for this DB2 database are stored in a Kubernetes secret (named *db2* in this case) used by *portfolio*, which allows such info to be configured at deployment time, rather than being hard-coded in the microservice's source code. Values in the secret are exposed to the microservice as environment variables, and can be updated (like if a password gets updated) without having to modify and redeploy the microservice.



db2

100 items per page | 1-1 of 1 items

Create Deployment +

NAME	NAMESPACE	DESIRED	CURRENT	READY	AVAILABLE	CREATION TIME	ACTION
<a href="#">labdb2-ibm-db2oltp-dev</a>	default	1	1	1	1	Feb 6th 2018 at 10:00 AM	⋮

The data in this table indicate that for this DB2 deployment, there is one desired container instance, one currently running instance, one instance which has the currently desired configuration, and one instance that is up and running (corresponding to columns *Desired*, *Current*, *Ready*, and *Available*, respectively).

If you click on the namespace dropdown at the top right and choose *default*, it will filter the view down to just the StockTrader microservices: *trader*, *portfolio*, *stock-quote*, *loyalty-level*, *messaging*, and *notification-twitter* (and the *db2* and *redis* dependencies).

IBM Cloud Private - Mozilla Firefox

IBM Cloud Private

Docs admin Create resource Support

Deployments default

Search items Create Deployment +

20 items per page | 1-8 of 8 items

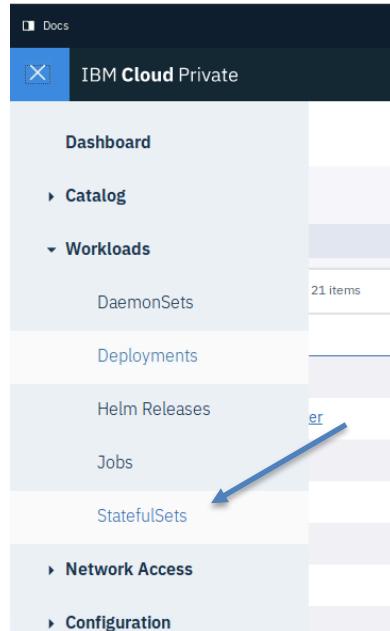
NAME	NAMESPACE	DESIRED	CURRENT	READY	AVAILABLE	CREATION TIME	ACTION
<a href="#">labdb2-ibm-db2oltp-dev</a>	default	1	1	1	1	Feb 6th 2018 at 10:00 AM	⋮
<a href="#">loyalty-level</a>	default	1	1	1	1	Feb 12th 2018 at 12:34 PM	⋮
<a href="#">messaging</a>	default	1	1	1	1	Feb 15th 2018 at 11:57 PM	⋮
<a href="#">notification-twitter</a>	default	1	1	1	1	Feb 16th 2018 at 12:59 AM	⋮
<a href="#">portfolio</a>	default	1	1	1	1	Feb 12th 2018 at 12:30 PM	⋮
<a href="#">redislabs-redis</a>	default	1	1	1	1	Feb 6th 2018 at 11:30 AM	⋮
<a href="#">stock-quote</a>	default	1	1	1	1	Feb 12th 2018 at 12:33 PM	⋮
<a href="#">trader</a>	default	1	1	1	1	Feb 12th 2018 at 12:29 PM	⋮



Later in this lab you will scale up and scale down one of our microservices. You can perform scaling operations on this page via the action icon (the three vertical dots) in the right-most column.

4. While most applications deploy as “Deployments”, a few services deploy as “Stateful Sets”, including MQ, used by Stock Trader. In fact, soon you will deploy your own instance of MQ.

Open the menu again and click on **Workloads** then **StatefulSets**.



The screenshot shows the 'StatefulSets' list view. At the top, there is a search bar and a 'Create StatefulSet' button. Below is a table with the following data:

NAME	NAMESPACE	DESIRED	CURRENT	CREATION TIME	ACTION
elasticsearch-data	kube-system	1	1	Jan 4th 2018 at 9:57 AM	⋮
icp-ds	kube-system	1	1	Jan 4th 2018 at 9:53 AM	⋮
image-manager	kube-system	1	1	Jan 4th 2018 at 9:57 AM	⋮
mqlab-ibm-mq	default	1	1	Feb 6th 2018 at 1:12 PM	⋮

Here you can see there are four StatefulSets: one for IBM MQ (*mqlab-ibm-mq*) and three used by IBM Cloud Private itself. Remember, the *kube-system* namespace is used by IBM to run essential services like image management and elastic search. A StatefulSet allows you to maintain unique information



across pod reschedules or restarts. This is important for IBM MQ since it relies on unique server information to maintain internal state. If a container should fail this unique data is persisted and reused as part of recovery.



5. Back in the Menu click on **Network Access** then **Services**. This page lists how our applications are exposed to the outside world and to each other.

The screenshot shows the IBM Cloud Private dashboard. The top navigation bar includes 'Docs' and the 'IBM Cloud Private' logo. The main menu on the left has items: 'Dashboard', 'Catalog', 'Workloads', 'Network Access' (which is expanded), 'Services' (which is selected and highlighted in blue), 'Configuration', 'Platform', 'Manage', and 'Command Line Tools'. To the right of the menu, under 'Network Access', there is a table titled 'Items' with one column 'NAMESPACE' containing entries: 'kube-system', 'kube-system', 'kube-system', and 'default'.

ITEMS	NAMESPACE
1	kube-system
2	kube-system
3	kube-system
4	default



IBM Cloud Private - Mozilla Firefox

IBM Cloud Private

https://10.0.0.1:8443/console/access/services

admin

IBM Cloud Private

Services

All namespaces

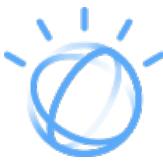
NAME	NAMESPACE	CREATION TIME	ACTION
<a href="#">elasticsearch</a>	kube-system	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">elasticsearch-data</a>	kube-system	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">elasticsearch-discovery</a>	kube-system	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">heapster</a>	kube-system	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">helm-api</a>	kube-system	Jan 4th 2018 at 9:59 AM	⋮
<a href="#">helmrepo</a>	kube-system	Jan 4th 2018 at 9:59 AM	⋮
<a href="#">image-manager</a>	kube-system	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">kube-dns</a>	kube-system	Jan 4th 2018 at 9:53 AM	⋮
<a href="#">kubernetes</a>	default	Jan 4th 2018 at 9:52 AM	⋮
<a href="#">labdb2-ibm-db2oltp-dev</a>	default	Feb 6th 2018 at 10:00 AM	⋮
<a href="#">logging-kibana</a>	kube-system	Feb 16th 2018 at 12:41 AM	⋮
<a href="#">logstash</a>	kube-system	Jan 4th 2018 at 9:57 AM	⋮
<a href="#">loyalty-level-service</a>	default	Feb 12th 2018 at 12:34 PM	⋮
<a href="#">metering-dm</a>	kube-system	Jan 4th 2018 at 9:57 AM	⋮

You'll notice **labdb2-ibm-db2oltp-dev** is listed again. Click on the **labdb2-ibm-db2oltp-dev** link.

O: db2

Create Service +

NAME	NAMESPACE	CREATION TIME	ACTION
<a href="#">labdb2-ibm-db2oltp-dev</a>	default	Feb 6th 2018 at 10:00 AM	⋮



## labdb2-ibm-db2oltp-dev

### Overview

Service details	
Type	Detail
Name	labdb2-ibm-db2oltp-dev
Namespace	default
Creation time	Feb 6th 2018 at 10:00 AM
Type	NodePort
Labels	app=labdb2-ibm-db2oltp-dev,chart=ibm-db2oltp-dev-1.1.1,heritage=Tiller,release=labdb2
Selector	app=labdb2-ibm-db2oltp-dev
IP	10.0.0.14
Port	ibm-db2oltp-dev 50000/TCP; ibm-db2oltp-dev-text 55000/TCP
Node port	<u>ibm-db2oltp-dev 30042/TCP</u> ← <u>ibm-db2oltp-dev-text 32070/TCP</u>
Session affinity	None

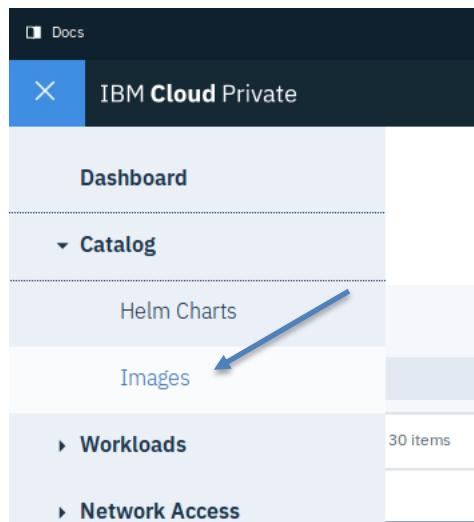
This data indicates that DB2 is exposed within IBM Cloud Private and Kubernetes to other services over port 50000 (the **Port** value) and that it is exposed *externally* at port 30042 (the **Node Port** value). By default, applications and services are not exposed outside of IBM Cloud Private or Kubernetes. They can be exposed to other services internally by specifying a port and externally by exposing a NodePort. IBM Cloud Private and Kubernetes then knows how to route any traffic received on port 30042 to the DB2 container's port 50000.

Back in the Service list you should also see entries for *loyalty-level-service*, *notification-service*, *portfolio-service*, *stock-quote-service*, and *trader-service*.



6. Go back to the Menu , expand **Catalog**, and select **Images**.



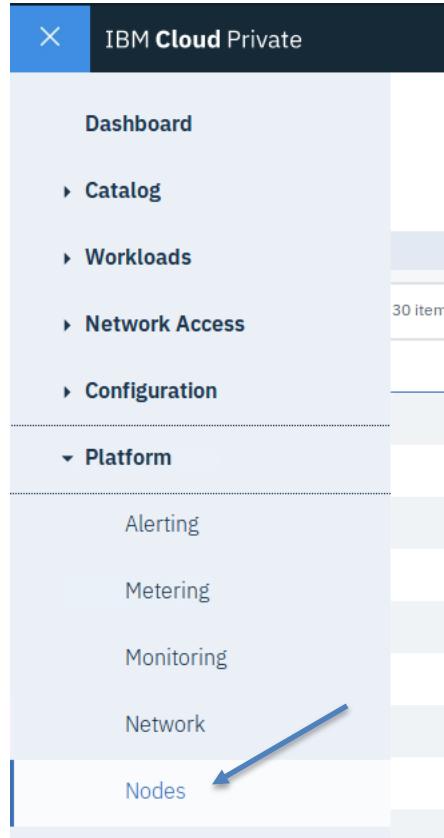


The screenshot shows a Firefox browser window displaying the IBM Cloud Private Docker Registry at <https://10.0.0.1:8443/console/images>. The page title is 'IBM Cloud Private - Mozilla Firefox'. The main content area is titled 'Images' and contains a table listing six Docker images:

NAME	OWNER	SCOPE
<a href="#">default/loyalty-level</a>	default	namespace
<a href="#">default/messaging</a>	default	namespace
<a href="#">default/notification-twitter</a>	default	namespace
<a href="#">default/portfolio</a>	default	namespace
<a href="#">default/stock-quote</a>	default	namespace
<a href="#">default/trader</a>	default	namespace

IBM Cloud Private ships with its own Docker Registry. This panel lets you view and interact with the Docker images already in the registry. Here you can see there are six images corresponding to the six microservices which comprise the StockTrader application. Clicking on an image name lets you see the different versions available for a given image along with some metadata about that image.

7. Go back to the Menu  expand **Platform**, and select **Nodes**.



The Nodes page shows all nodes in this Kubernetes cluster, the role they play, their architecture (ICP runs on x86, Power Linux, and zLinux), as well as its status to receive additional deployments.

## Nodes

NAME	ROLE	ARCHITECTURE	STATUS	SCHEDULABLE	CREATION TIME
10.0.0.1	proxy, management, master	amd64	Active	Schedulable	Jan 4th 2018 at 9:52 AM

Since this VM contains all the IBM Cloud Private/Kubernetes roles you see only one node listed at the bottom of the page. If we separated each role into its own virtual machine you would see multiple nodes listed in the table of nodes. If you click on **10.0.0.1** you are taken to the live statistics and currently running workloads on that particular node.



**Node details**

Type	Detail
Hostname	10.0.0.1
Unschedulable	Schedulable
Status	Active
Address	10.0.0.1
Labels	beta.kubernetes.io/arch=amd64,beta.kubernetes.io/os=linux,gpu/media=true,kubernetes.io/hostname=10.0.0.1,management=true,proxy=true,role=master
CPU	8
Memory	15.67 GiB
alpha.kubernetes.io/mvidia-GPU	0
CPU Request	2 (20%)
CPU Limits	5 (50%)
Memory Request	1792Mi (11%)
Memory Limits	16890Mi (105%)
GPU Limits	0 (0%)

**Pods**

NAME	NAME SPACE	STATUS	HOST IP	READY	START TIME	ACTION	
auth-pkikey-7hew	kube-system	Running	10.0.0.1	1/1	Jan 27 2018 at 10:10 AM	...	
auth-idp-7kwy	kube-system	Running	10.0.0.1	10.0.0.1	3/3	2018 at 10:10 AM	...
auth-psp-7t7wv	kube-system	Running	10.0.0.1	10.0.0.1	1/1	2018 at 10:10 AM	...
auth-pdo-7xh2	kube-system	Running	10.0.0.1	10.1.64.75	1/1	2018 at 10:10 AM	...
calico-node-7md64-6arw	kube-system	Running	10.0.0.1	10.0.0.1	2/2	Jan 27 2018 at 12:59 PM	...
calico-policy-controller-7qkqj-7qkqj	kube-system	Failed	-	-	0/1	Jan 27 2018 at 1:00 PM	...
calico-policy-controller-7zq5s-7zq5s	kube-system	Running	10.0.0.1	10.0.0.1	1/1	Jan 27 2018 at 10:11 AM	...
calico-catalog-server-7qkqj	kube-system	Running	10.0.0.1	10.0.0.1	1/1	Jan 27 2018 at 10:10 AM	...
calico-catalog-controller-7qkqj-7qkqj	kube-system	Failed	-	-	0/1	Jan 27 2018 at 9:58 AM	...
calico-catalog-7qkqj-7qkqj	kube-system	Running	10.0.0.1	10.1.64.121	1/1	2018 at 10:10 AM	...
calico-ui-7hber	kube-system	Running	10.0.0.1	10.0.0.1	1/1	2018 at 10:10 AM	...
cloudbeaver-db-7v7tq-cally	kube-system	Succeeded	10.0.0.1	10.1.64.87	0/1	Jan 4th 2018 at 9:35 AM	...
configure-calico-mesh-7mhs	kube-system	Succeeded	10.0.0.1	10.0.0.1	0/1	Jan 4th 2018 at 9:32 AM	...
deis-lb-7http-backend-7777-7777	kube-system	Running	10.0.0.1	10.1.64.108	1/1	2018 at 10:11 AM	...
elasticsearch-7777-7777	kube-system	Failed	-	-	0/1	Jan 4th 2018 at 9:27 AM	...
elasticsearch-client-7777-7777	kube-system	Failed	-	-	0/2	Jan 4th 2018 at 9:27 AM	...
elasticsearch-client-7777-7777	kube-system	Running	10.0.0.1	10.1.64.90	2/2	Jan 22nd 2018 at 10:10 AM	...
elasticsearch-data-0	kube-system	Running	10.0.0.1	10.1.64.123	1/1	2018 at 10:11 AM	...
elasticsearch-master-7777-7777	kube-system	Running	10.0.0.1	10.1.64.127	1/1	2018 at 10:11 AM	...

By default, 20 pods are shown per page; you can use the arrows at the top of the Pods section to see the later pages. If you click on a pod name, **portfolio-647fcc8fcd-2l7pv** for example (the generated suffix after **portfolio** may be different in your environment), you can see the details for that pod.



The screenshot shows a Firefox browser window titled "IBM Cloud Private - Mozilla Firefox". The URL is <https://10.0.0.1:8443/console/platform/nodes/10>. The page displays the "IBM Cloud Private" interface with a sidebar containing icons for Docs, Create resource, and Support. The main content area shows the path "Nodes / 10.0.0.1 / portfolio-647fcc8fcd-2l7pv /". Below this, there are four tabs: Overview (selected), Containers, Events, and Logs. The "Overview" section is titled "Pod details" and contains a table with the following data:

Type	Detail
Name	portfolio-647fcc8fcd-2l7pv
Namespace	default
Start time	Feb 12th 2018 at 12:30 PM
Labels	app=portfolio,pod-template-hash=2039774978,solution=stock-trader
PodSecurityPolicy applied	default
Node	10.0.0.1
IP	10.1.64.126
Status	Running

At the top of the pod details screen you will see four tabs with extra information: Overview, Containers, Events, and Logs. The **Overview** tab is shown above.

The **Containers** tab shows all the running containers in this pod. For the portfolio pod, there is only one container running.

The screenshot shows the "Containers" tab for the "portfolio-647fcc8fcd-2l7pv" pod. The table lists one container:

NAME	IMAGE	PORT	STATE	RESTART COUNT
portfolio	mycluster.icp:8500/default/portfolio:latest	9080/TCP,9443/TCP	Running	1



Clicking on the **portfolio** link shows details about that Docker container.

Nodes / 10.0.0.1 / portfolio-647fcc8fcfd-2l7pv / Containers / portfolio / portfolio

Overview

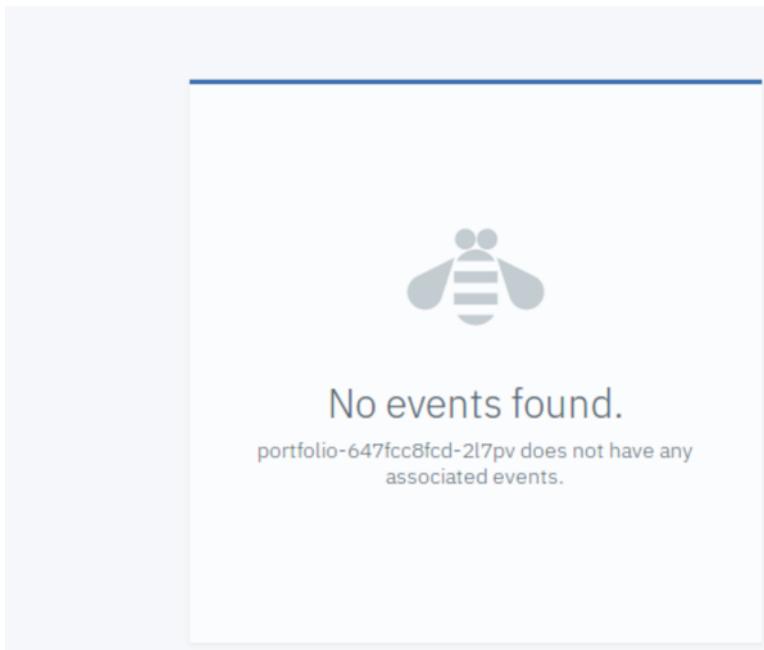
Container details	
Type	Detail
Container ID	docker://9a5195b0d12f28161afb88ffba187b4dc7e3449fc86ac483be9632e6136d98e5
Image	mycluster.icp:8500/default/portfolio:latest
Image ID	docker-pullable://mycluster.icp:8500/default/portfolio@sha256:5c9ca879cc338e731d590135317f638c6cf68f4e41cbbe7c1ffbc02c2ee687a6
Port	9080/TCP,9443/TCP
Command	-
Environment variables	JDBC_HOST={secretKeyRef:{name=db2,key=host}},JDBC_PORT={secretKeyRef:{name=db2,key=port}},JDBC_DB={secretKeyRef:{name=db2,key=db}},JDBC_ID={secretKeyRef:{name=db2,key=id}},JDBC_PASSWORD={secretKeyRef:{name=db2,key=pwd}},JWT_AUDIENCE={secretKeyRef:{name=jwt,key=audience}},JWT_ISSUER={secretKeyRef:{name=jwt,key=issuer}}
Resource	-

Back on the pod page, the **Events** tab is useful when debugging deployment problems for a given pod. In our case, there were no problems, so it says “No events found”.



Nodes / 10.0.0.1 / portfolio-647fcc8fcd-2l7pv /  
portfolio-647fcc8fcd-2l7pv

Overview Containers Events **Logs**



Finally, the **Logs** tab shows you the logs emitted by the container. For Liberty containers, you'll see messages written via Java's `System.out.println()` or methods of `java.util.logging.Logger` (depending on the `consoleLogLevel` set in the `logging` stanza in your microservice's `server.xml`). This is useful for debugging any application, middleware, or container configuration problems.



Nodes / 10.0.0.1 / portfolio-647fcc8fcfcd-2l7pv /

## portfolio-647fcc8fcfcd-2l7pv

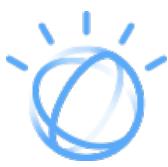
Overview Containers Events Logs

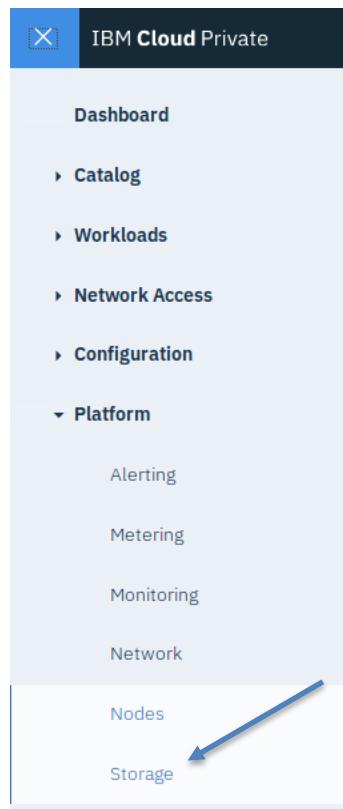
Search

portfolio ▾

```
[INFO ] SRVE9103I: A configuration file for a web server plugin was aut
[INFO ] Setting the server's publish address to be /
[INFO ] SRVE0242I: [Portfolio] [/portfolio] [com.ibm.hybrid.cloud.sample]
[INFO ] J2CA8050I: An authentication alias should be used instead of de
[INFO ] CWRLS0010I: Performing recovery processing for local WebSphere
[INFO ] CWRLS0007I: No existing recovery log files found in /opt/ibm/wl
[INFO ] CWRLS0006I: Creating new recovery log file /opt/ibm/wlp/output/
[INFO ] CWRLS0006I: Creating new recovery log file /opt/ibm/wlp/output/
[INFO ] CWRLS0007I: No existing recovery log files found in /opt/ibm/wl
[INFO ] CWRLS0006I: Creating new recovery log file /opt/ibm/wlp/output/
[INFO ] CWRLS0006I: Creating new recovery log file /opt/ibm/wlp/output/
[INFO ] CWRLS0012I: All persistent services have been directed to perf
[INFO ] WTRN0135I: Transaction service recovering no transactions.
[INFO ] DSRA8203I: Database product name : DB2/LINUXX8664
[INFO ] DSRA8205I: JDBC driver name : IBM Data Server Driver for JDBC
[INFO ] DSRA8204I: Database product version : SQL11012
[INFO ] DSRA8206I: JDBC driver version : 4.22.29
```

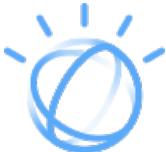
8. Go back to the Menu  expand **Platform**, and select **Storage**.





Storage								Create resource	Support	
PersistentVolume		PersistentVolumeClaim								
Name	Type	Capacity	Access Mode	Reclaim Policy	Status	Claim	Creation Time	Action		
cloudant-10.0.0.1		2Gi	RWO	Delete	Bound	kube-system/icp-ds-icp-ds-0	Jan 4th 2018 at 9:53 AM	⋮		
db2vol01	Hostpath	5Gi	RWO	Retain	Bound	default/labdb2-ibm-db2oltp-dev-data-stor	Feb 6th 2018 at 9:59 AM	⋮		
image-manager-10.0.0.1		20Gi	RWO	Retain	Bound	kube-system/image-manager-image-manager-0	Jan 4th 2018 at 9:57 AM	⋮		
logging-es-pv-10.0.0.1		20Gi	RWO	Delete	Bound	kube-system/elasticsearch-data-elasticsearch-data-0	Jan 4th 2018 at 9:57 AM	⋮		
mqvol1	Hostpath	2Gi	RWO	Retain	Bound	default/mqlab-ibm-mq-data-mqlab-ibm-mq-0	Feb 6th 2018 at 1:12 PM	⋮		
redisvol01	Hostpath	8Gi	RWO	Retain	Released	default/redislab-redis	Feb 6th 2018 at 10:38 AM	⋮		

On this page, you can review the existing PersistentVolumes used by pods. These volumes allow data to exist throughout pod deletion and creation. You can also create new PersistentVolumes on this page. **Note:** PersistentVolumes should be created with a highly available file system. For this lab, we are using an NFS server but you could use iSCSI, GlusterFS, or a cloud-provider storage solution.



## db2vol01

### Overview

PersistentVolume details	
Type	Detail
Name	db2vol01
Type	Hostpath
Labels	-
Status	Bound
Capacity	5Gi
Access modes	RWO
Claim	default/labdb2-ibm-db2oltp-dev-data-stor
Reclaim policy	Retain
Creation time	Feb 6th 2018 at 9:59 AM

A PersistentVolume is claimed by a pod via a **PersistentVolumeClaim**. A PersistentVolumeClaim is an implementation of claim check pattern for storage. When a pod requires persistent storage it creates a claim against a PersistentVolume to hold that volume exclusively. When the pod finishes using a PersistentVolume (when a pod is deleted for example), the PersistentVolumeClaim is released and the PersistentVolume is made available. You can view the existing claims by clicking the **PersistentVolumeClaim** tab.



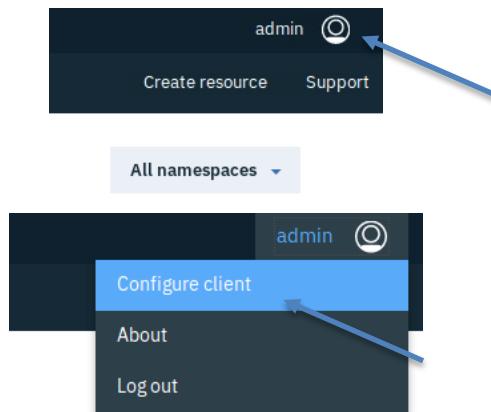
Storage								All namespaces <span>▼</span>
PersistentVolume		PersistentVolumeClaim						
<input type="text"/> Search items								<span>Create PersistentVolumeClaim</span> <span>+</span>
NAME <span>▲</span>	NAMESPACE	STATUS	PERSISTENTVOLUME	REQUESTS	ACCESS MODE	CREATION TIME	ACTION	
<a href="#">elasticsearch-data-elasticsearch-data-0</a>	kube-system	Bound	logging-es-pv-10.0.0.1	20Gi	RWO	Jan 4th 2018 at 9:57 AM	<span>⋮</span>	
<a href="#">icp-ds-icp-ds-0</a>	kube-system	Bound	cloudant-10.0.0.1	2Gi	RWO	Jan 4th 2018 at 9:53 AM	<span>⋮</span>	
<a href="#">image-manager-image-manager-0</a>	kube-system	Bound	image-manager-10.0.0.1	20Gi	RWO	Jan 4th 2018 at 9:57 AM	<span>⋮</span>	
<a href="#">labdb2-ibm-db2oltp-dev-data-stor</a>	default	Bound	db2vol01	5Gi	RWO	Feb 6th 2018 at 10:00 AM	<span>⋮</span>	
<a href="#">mqlab-ibm-mq-data-mqlab-ibm-mq-0</a>	default	Bound	mqvol1	2Gi	RWO	Feb 6th 2018 at 1:12 PM	<span>⋮</span>	



## 4. Using the Kubernetes CLI

In this section, you will utilize the Kubernetes command line interface, `kubectl`, to view information about the IBM Cloud Private environment, and view information about StockTrader.

1. Before you can use the CLI you need to configure the command client with some connection information and credentials. You do this by clicking the username, **admin**, in the upper right corner of the web console and selecting **Configure Client**.



2. In the pop up box that appears, click on the blue icon to the right of the commands to copy them to the clipboard.

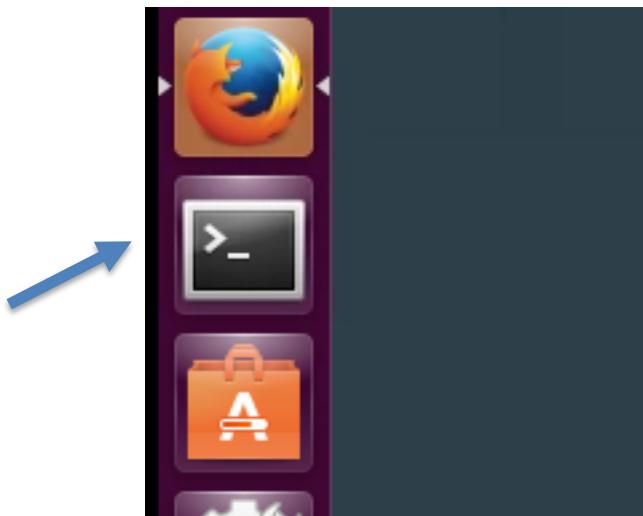
The image shows a modal dialog box titled "Configure kubectl". It contains the following text:  
Before you run commands in the kubectl command line interface for this cluster, you must configure the client.  
**Prerequisites:**  
Install the kubectl CLI: `kubectl`  
**To configure the CLI, paste the displayed configuration commands into your terminal window and run them.:**  

```
kubectl config set-cluster mycluster.icp --server=https://10.0.0.1:8001 --inse
kubectl config set-context mycluster.icp-context --cluster=mycluster.icp
kubectl config set-credentials admin --token=eyJhbGciOiJSUzI1NiJ9.eyJzdW
kubectl config set-context mycluster.icp-context --user=admin --namespace=
kubectl config use-context mycluster.icp-context
```

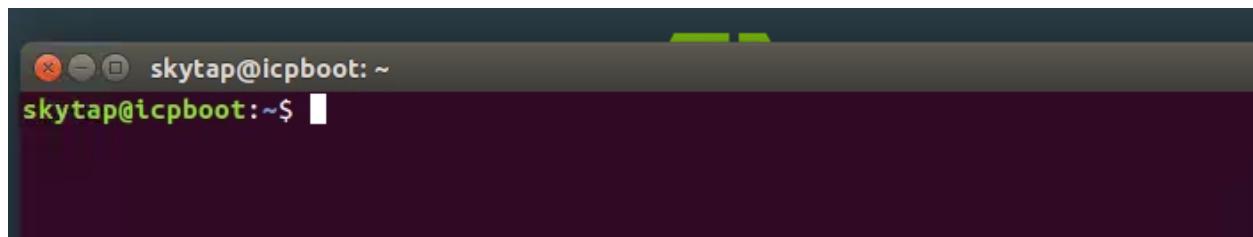
A blue arrow points from the blue icon in the "Configure client" dropdown above to the copy icon in this dialog.



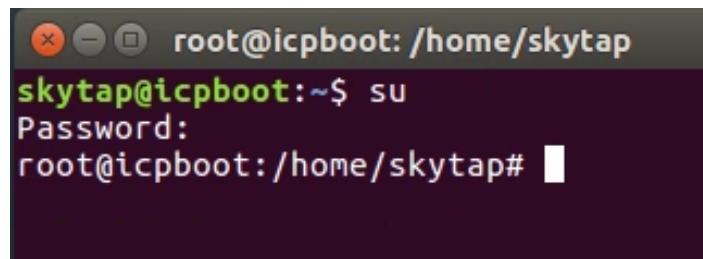
- Now you need to open a terminal by clicking the Terminal icon in the sidebar on the left side of the screen.



You should now see the terminal appear in front of Firefox:



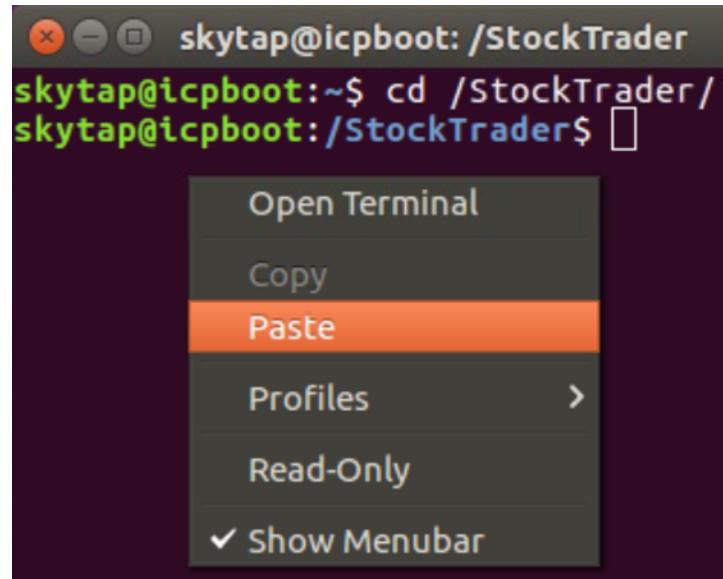
We need to switch to the root user and set up our command line. Type **su** and enter **A1rb0rn3** as the password.



Now enter the StockTrader directory by entering **cd /StockTrader**

- Right click in the terminal window and select **Paste**. Note that in this Skytap VM, choosing Paste from the right-click menu works better than keyboard shortcuts like Ctrl-V.





This configures `kubectl` to talk to our IBM Cloud Private instance. The last line in the console should read ‘Switched to context “mycluster.icp-context”’.

```
Switched to context "mycluster.icp-context".  
skytap@icpboot:/StockTrader$ █
```

5. First, find all the deployments in IBM Cloud Private. A deployment is a high-level abstraction which manages pods. As mentioned earlier, deployment is equivalent to the Workload/Deployments in the IBM Cloud Private web interface. You’ll use deployments later in the lab. You can get the list of current deployments and their status by running `kubectl get deployments`

```
skytap@icpboot:/StockTrader$ kubectl get deployments  
NAME          DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE  
labdb2-ibm-db2oltp-dev   1         1         1           1          9d  
loyalty-level    1         1         1           1          3d  
messaging       1         1         1           1          8h  
notification-twitter  1         1         1           1          7h  
portfolio        1         1         1           1          3d  
redislab2-redis   1         1         1           1          9d  
stock-quote      1         1         1           1          3d  
trader          1         1         1           1          3d  
skytap@icpboot:/StockTrader$ █
```

You will recognize these deployments as the StockTrader application. If you want more information about these deployments, such as what containers and Docker images are associated with a given deployment you can run `kubectl get deployments -o wide`



(Remember, if you copy from this document, make sure you select the Skytap clipboard menu item  and paste the command so the VM adds that text to its clipboard)

NAME	DESIRED	CURRENT	UP-TO-DATE	AVAILABLE	AGE	CONTAINERS	IMAGES	SELECTOR
labdb2-lbm-db2oltp-dev	1	1	1	1	10d	labdb2-lbm-db2oltp-dev	na.cumulusrepo.com/hclcp_dev/db2server_dcc:11.1.2.2b mycluster.icp:8500/default/loyalty-level:latest	app=labdb2-lbm-db2oltp-dev app=loyalty-level,solution=s
loyalty-level						loyalty-level		
stock-trader,version=v1								
messaging	1	1	1	1	1d	messaging	mycluster.icp:8500/default/messaging:latest	app=messaging,solution=s
k-trader								
notification-twittter	1	1	1	1	1d	notification-twittter	mycluster.icp:8500/default/notification-twittter:latest	app=notification,solution=s
stock-trader,version=twittter								
portfolio	1	1	1	1	4d	portfolio	mycluster.icp:8500/default/portfolio:latest	app=portfolio,solution=s
x-trader								
redisLab2-redis	1	1	1	1	10d	redisLab2-redis	bitnami/redis:4.0.7-r0 mycluster.icp:8500/default/stock-quote:latest	app=redisLab2-redis app=stock-quote,solution=s
stock-quote	1	1	1	1	4d	stock-quote		
stock-trader								
trader	1	1	1	1	4d	trader	mycluster.icp:8500/default/trader:latest	app=trader,solution=stock-t
trader,version=v1								

- For even more information about a deployment you can run `kubectl describe deployment <deploymentName>`. Try it for the `stock-quote` deployment by entering `kubectl describe deployment stock-quote`

In the returned data, you should recognize some of the same data from IBM Cloud Private's Workloads > Deployments web interface.

```
skytap@icpboot:/StockTrader
skytap@icpboot:/StockTrader$ kubectl describe deployment stock-quote
Name:           stock-quote
Namespace:      default
CreationTimestamp: Mon, 12 Feb 2018 12:33:05 -0800
Labels:          app=stock-quote
                 solution=stock-trader
Annotations:    deployment.kubernetes.io/revision=1
Selector:        app=stock-quote,solution=stock-trader
Replicas:        1 desired | 1 updated | 1 total | 1 available | 0 unavailable
StrategyType:   RollingUpdate
MinReadySeconds: 0
RollingUpdateStrategy: 1 max unavailable, 1 max surge
Pod Template:
  Labels:  app=stock-quote
           solution=stock-trader
  Containers:
    stock-quote:
      Image:  mycluster.icp:8500/default/stock-quote:latest
      Ports:  9080/TCP, 9443/TCP
      Environment:
        REDIS_URL:      <set to the key 'url' in secret 'redis'>      Optional: false
        QUANDL_KEY:     <set to the key 'quandl-key' in secret 'redis'>  Optional: false
        JWT_AUDIENCE:   <set to the key 'audience' in secret 'jwt'>    Optional: false
        JWT_ISSUER:     <set to the key 'issuer' in secret 'jwt'>      Optional: false
      Mounts:         <none>
      Volumes:        <none>
  Conditions:
    Type      Status  Reason
    ----      ----   -----
    Available  True    MinimumReplicasAvailable
OldReplicaSets: <none>
NewReplicaSet:  stock-quote-d7d8c4cf5 (1/1 replicas created)
Events:         <none>
skytap@icpboot:/StockTrader$
```

- To get the list of pods in IBM Cloud Private type: `kubectl get pods`



```

skytap@icpboot:/StockTrader$ kubectl get pods
NAME                               READY   STATUS    RESTARTS   AGE
labdb2-ibm-db2oltp-dev-6dfcb56b8d-r6dg9   1/1     Running   1          9d
loyalty-level-789465954c-gcmkq      1/1     Running   1          3d
messaging-64cf9848ff-wvpg8        1/1     Running   0          9h
mqlab-ibm-mq-0                   1/1     Running   1          9d
notification-twitter-79f4b9f465-h5g6x   1/1     Running   0          8h
portfolio-647fcc8fcfd-2l7pv       1/1     Running   1          3d
redislab2-redis-c874b98d9-5q6t6   1/1     Running   1          9d
stock-quote-d7d8c4cf5-5zdwn      1/1     Running   1          3d
trader-5c75688d9-92brf         1/1     Running   1          3d
skytap@icpboot:/StockTrader$ 

```

You will notice that this list of pods is shorter than the list reported in the web interface. This is because `kubectl` filters out the Kubernetes system pods by default (you can see all the pods across all namespaces, like the web interface shows by default, by adding the `--all-namespaces` flag, as in `kubectl get pods --all-namespaces`). You will also recognize some of the same pods for StockTrader as from the IBM Cloud Private web interface. If you want the location where the pods are running you can run `kubectl get pods -o wide`

```

skytap@icpboot:/StockTrader$ kubectl get pods -o wide
NAME                               READY   STATUS    RESTARTS   AGE   IP           NODE
labdb2-ibm-db2oltp-dev-6dfcb56b8d-r6dg9   1/1     Running   1          9d   10.1.64.104   10.0.0.1
loyalty-level-789465954c-gcmkq      1/1     Running   1          3d   10.1.64.72    10.0.0.1
messaging-64cf9848ff-wvpg8        1/1     Running   0          9h   10.1.64.99    10.0.0.1
mqlab-ibm-mq-0                   1/1     Running   1          9d   10.1.64.124   10.0.0.1
notification-twitter-79f4b9f465-h5g6x   1/1     Running   0          8h   10.1.64.111   10.0.0.1
portfolio-647fcc8fcfd-2l7pv       1/1     Running   1          3d   10.1.64.126   10.0.0.1
redislab2-redis-c874b98d9-5q6t6   1/1     Running   1          9d   10.1.64.67    10.0.0.1
stock-quote-d7d8c4cf5-5zdwn      1/1     Running   1          3d   10.1.64.113   10.0.0.1
trader-5c75688d9-92brf         1/1     Running   1          3d   10.1.64.115   10.0.0.1
skytap@icpboot:/StockTrader$ 

```

- If you need more detail about a pod you can run `kubectl describe pod <podName>`. Try it for the `stock-quote` pod by running the following command (note the generated suffix after `stock-quote` might be different in your environment):

```
kubectl describe pod stock-quote-d7d8c4cf5-5zdwn
```



```

skytap@icpboot:/StockTrader$ kubectl describe pod stock-quote-d7d8c4cf5-5zdw
Name:           stock-quote-d7d8c4cf5-5zdw
Namespace:      default
Node:          10.0.0.1/10.0.0.1
Start Time:    Mon, 12 Feb 2018 12:33:05 -0800
Labels:         app=stock-quote
                pod-template-hash=838470791
                solution=stock-trader
Annotations:   kubernetes.io/created-by={"kind":"SerializedReference","apiVersion":"v1","reference":{"kind":"ReplicaSet","namespace":"default","name":"stock-quote-d7d8c4cf5","uid":"edcf47cc-1033-11e8-9bc1-005056379c..."}},kubernetes.io/psp=default
Status:        Running
IP:            10.1.64.113
Controlled By: ReplicaSet/stock-quote-d7d8c4cf5
Containers:
  stock-quote:
    Container ID:  docker://234f662014b8e7bcd8a300f5900d9137cb19a45933d868f424f2ebb142c19371
    Image:         mycluster.icp:8500/default/stock-quote:latest
    Image ID:     docker-pullable://mycluster.icp:8500/default/stock-quote@sha256:cf3e59af45a065e7cb89a52ac6123bc3d00b7ce3c6e08c3ccfff1dc5aa304f92
    Ports:        9080/TCP, 9443/TCP
    State:        Running
      Started:   Thu, 15 Feb 2018 23:31:55 -0800
    Last State:  Terminated
      Reason:    Error
      Exit Code: 137
      Started:   Mon, 12 Feb 2018 12:33:07 -0800
      Finished:  Tue, 13 Feb 2018 14:07:18 -0800
    Ready:       True
    Restart Count: 1
    Environment:
      REDIS_URL: <set to the key 'url' in secret 'redis'>          Optional: false
      QUANDL_KEY: <set to the key 'quandl-key' in secret 'redis'>    Optional: false
      JWT_AUDIENCE: <set to the key 'audience' in secret 'jwt'>      Optional: false
      JWT_ISSUER:  <set to the key 'issuer' in secret 'jwt'>        Optional: false

```

This provides a lot of container and runtime data for this particular pod. This is useful when debugging problems with pod deployments. Some of this data should look familiar from the deployment information gathered earlier. This pod utilized that data when instantiating itself.

9. You can also gather the node information by running `kubectl get nodes` and `kubectl describe node <nodeName>`

```

skytap@icpboot:/StockTrader$ kubectl get nodes
NAME      STATUS    ROLES   AGE      VERSION
10.0.0.1  Ready     <none>  42d      v1.8.3+icp+ee
skytap@icpboot:/StockTrader$ █

```

The `kubectl describe node` command can be rather verbose so you must scroll up in the terminal to see everything. The data returned is very similar to the graphs you saw in IBM Cloud Private's Node page in the web interface.



```

skytap@icpboot:/StockTrader$ kubectl describe node 10.0.0.1
Name:           10.0.0.1
Roles:          <none>
Labels:         beta.kubernetes.io/arch=amd64
                beta.kubernetes.io/os=linux
                gpu/nvidia=NA
                kubernetes.io/hostname=10.0.0.1
                management=true
                proxy=true
                role=master
Annotations:   alpha.kubernetes.io/provided-node-ip=10.0.0.1
                node.alpha.kubernetes.io/ttl=0
                volumes.kubernetes.io/controller-managed-attach-detach=true
Taints:         <none>
CreationTimestamp: Thu, 04 Jan 2018 09:52:21 -0800
Conditions:
  Type      Status  LastHeartbeatTime          LastTransitionTime
  Reason    Message
  ----     -----
  OutOfDisk False   Fri, 16 Feb 2018 09:38:37 -0800  Thu, 04 Jan 2018 09:52:21
  -0800   KubeletHasSufficientDisk  kubelet has sufficient disk space available
  MemoryPressure False   Fri, 16 Feb 2018 09:38:37 -0800  Fri, 16 Feb 2018 06:58:43
  -0800   KubeletHasSufficientMemory kubelet has sufficient memory available
  DiskPressure False   Fri, 16 Feb 2018 09:38:37 -0800  Fri, 16 Feb 2018 06:58:43
  -0800   KubeletHasNoDiskPressure kubelet has no disk pressure
  Ready      True    Fri, 16 Feb 2018 09:38:37 -0800  Fri, 16 Feb 2018 06:58:43
  -0800   KubeletReady            kubelet is posting ready status. AppArmor enabled
Addresses:
  InternalIP: 10.0.0.1
  Hostname:   10.0.0.1
Capacity:
  cpu:        8
  memory:    16431908Ki
  pods:       110

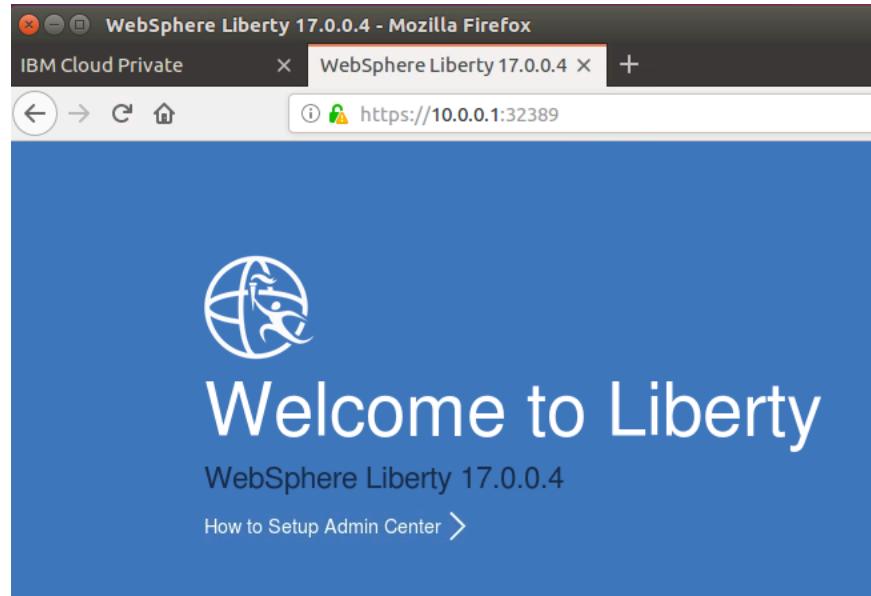
```

10. What if you've just deployed StockTrader to IBM Cloud Private and need to know which external port you should use when accessing StockTrader's web interface? You can determine the port by running `kubectl get services`

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
kubernetes	ClusterIP	10.0.0.1	<none>	443/TCP	42d
labdb2-ibm-db2oltp-dev	NodePort	10.0.0.14	<none>	50000:30042/TCP,55000:32070/TCP	9d
loyalty-level-service	NodePort	10.0.0.95	<none>	9080:31181/TCP,9443:32143/TCP	3d
mqlab-ibm-mq	NodePort	10.0.0.205	<none>	1414:30016/TCP,9443:32343/TCP	9d
notification-service	NodePort	10.0.0.231	<none>	9080:30043/TCP,9443:32046/TCP	8h
portfolio-service	NodePort	10.0.0.186	<none>	9080:31066/TCP,9443:32709/TCP	3d
redislab2-redis	NodePort	10.0.0.151	<none>	6379:31803/TCP	9d
stock-quote-service	NodePort	10.0.0.169	<none>	9080:30302/TCP,9443:30826/TCP	3d
trader-service	NodePort	10.0.0.152	<none>	9080:32388/TCP,9443:32389/TCP	3d

We know that the *trader* microservice provides the user interface so we check the table for *trader-service*. Here you see that *trader-service*'s port 9443 (Liberty's default HTTPS port) is exposed to the outside world at port **32389**. If you go back to Firefox and enter <https://10.0.0.1:32389> you should see the "Welcome to Liberty" splash page.





If you add **/trader** to the end of the URL you should be redirected to the StockTrader user interface.

A screenshot of a Mozilla Firefox browser window titled "Stock Portfolio - Mozilla Firefox". The address bar shows "Stock Portfolio" and the URL "10.0.0.1:31110/trader/summary". The page features a colorful background with US dollar bills and various investment terms like "STOCKS", "BONDS", "MUTUAL FUNDS", and "401(k)s". Below the background, there is a list of options:

- Create a new portfolio
- Retrieve selected portfolio
- Update selected portfolio (add stock)
- Delete selected portfolio

A table displays two portfolios:

	Owner	Total	Loyalty Level
<input checked="" type="radio"/>	EM	\$5,688.93	Basic
<input type="radio"/>	EM1	\$2,158,753.68	Platinum



## 5. Scaling StockTrader

Scaling deployments in IBM Cloud Private can occur in a few different places: the IBM Cloud Private web interface, the `kubectl` command line, or the Kubernetes management console (not shown in this lab). Within those places there are two different methods of scaling up and down. First, you can directly tell IBM Cloud Private and Kubernetes to scale up or down the deployment. Alternatively, if you find that you always have to change the number of replicas for a given service you can provide an updated deployment YAML file with a new `replicas` value to IBM Cloud Private and Kubernetes. This allows you to version control your configuration in an external source code repository and track changes which occur over time. We will focus on scaling directly via the command line in this lab.

1. Now let's scale up the number of instances for the *trader* microservice. Back in the terminal enter the command `kubectl get deployments` again.

NAME	DESIRED	CURRENT	UP-TO-DATE	AVAILABLE	AGE
labdb2-ibm-db2oltp-dev	1	1	1	1	11d
loyalty-level	1	1	1	1	5d
messaging	1	1	1	1	2d
notification-twitter	1	1	1	1	1d
portfolio	1	1	1	1	9h
redislab3-redis	1	1	1	1	1d
stock-quote	1	1	1	1	5d
trader	1	1	1	1	9h

Notice that the *trader* service currently expects and has a single container supporting it. Let's try scaling up *trader* by running the command

```
kubectl scale --replicas=3 deployment trader
```

```
skytap@icpboot:/StockTrader$ kubectl scale --replicas=3 deployment trader
deployment "trader" scaled
```

If you re-run `kubectl get deployments` you should now see there are three containers as part of the *trader* deployment.

NAME	DESIRED	CURRENT	UP-TO-DATE	AVAILABLE	AGE
labdb2-ibm-db2oltp-dev	1	1	1	1	11d
loyalty-level	1	1	1	1	5d
messaging	1	1	1	1	2d
notification-twitter	1	1	1	1	1d
portfolio	1	1	1	1	9h
redislab3-redis	1	1	1	1	1d
stock-quote	1	1	1	1	5d
trader	3	3	3	3	9h



Also, if you run `kubectl get pods` you should now see three separate *trader* pods.

NAME	READY	STATUS	RESTARTS	AGE
labdb2-ibm-db2oltp-dev-6dfcb56b8d-r6dg9	1/1	Running	1	11d
loyalty-level-789465954c-gcmkq	1/1	Running	1	5d
messaging-64cf9848ff-wvpg8	1/1	Running	0	2d
mqlab-ibm-mq-0	1/1	Running	1	11d
notification-twitter-79f4b9f465-h5g6x	1/1	Running	0	1d
portfolio-647fcc8fcfd-sqxtm	1/1	Running	0	9h
redislab3-redis-7887cb7c46-qqqkp	1/1	Running	6	1d
stock-quote-d7d8c4cf5-vw2cl	1/1	Running	0	1d
trader-5c75688d9-8mjpd	1/1	Running	0	9h
trader-5c75688d9-dpvqd	1/1	Running	0	3m
trader-5c75688d9-tbnx9	1/1	Running	0	3m

2. To scale down the number of trader pods you can run

```
kubectl scale --replicas=1 deployment/trader
```

```
skytap@icpboot:/StockTrader$ kubectl scale --replicas=1 deployment trader
deployment "trader" scaled
```

And if you re-run `kubectl get deployments` and `kubectl get pods` you see the new values for *trader*.

skytap@icpboot:/StockTrader\$ kubectl get deployments					
NAME	DESIRED	CURRENT	UP-TO-DATE	AVAILABLE	AGE
labdb2-ibm-db2oltp-dev	1	1	1	1	11d
loyalty-level	1	1	1	1	5d
messaging	1	1	1	1	2d
notification-twitter	1	1	1	1	1d
portfolio	1	1	1	1	9h
redislab3-redis	1	1	1	1	1d
stock-quote	1	1	1	1	5d
trader	1	1	1	1	9h

skytap@icpboot:/StockTrader\$ kubectl get pods					
NAME	READY	STATUS	RESTARTS	AGE	
labdb2-ibm-db2oltp-dev-6dfcb56b8d-r6dg9	1/1	Running	1	11d	
loyalty-level-789465954c-gcmkq	1/1	Running	1	5d	
messaging-64cf9848ff-wvpg8	1/1	Running	0	2d	
mqlab-ibm-mq-0	1/1	Running	1	11d	
notification-twitter-79f4b9f465-h5g6x	1/1	Running	0	1d	
portfolio-647fcc8fcfd-sqxtm	1/1	Running	0	9h	
redislab3-redis-7887cb7c46-qqqkp	1/1	Running	6	1d	
stock-quote-d7d8c4cf5-vw2cl	1/1	Running	0	1d	
trader-5c75688d9-8mjpd	1/1	Running	0	9h	



3. You can also scale up and down by editing the deployment YAML file for a given deployment and sending the updated value to IBM Cloud Private. To scale up the *stock-quote* service, in the terminal enter `nano stock-quote/manifests/deploy.yaml`

```
skytap@icpboot:/StockTrader$ nano stock-quote/manifests/deploy.yaml
```

In the editor look for the line `replicas: 1` under the `spec` header.

```
#Deploy the pod
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
  name: stock-quote
# namespace: stock-trader
spec:
  replicas: 1
  template:
    metadata:
      labels:
        app: stock-quote
        solution: stock-trader
```

Change the `1` to `3` then save and exit the file by pressing and releasing `Ctrl+O`, then press `Enter`. Finally press `Ctrl+X` to exit the editor. Note you must have done the “`su`” command described earlier, or you won’t have authority to save the file.

```
#Deploy the pod
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
  name: stock-quote
# namespace: stock-trader
spec:
  replicas: 3
  template:
    metadata:
      labels:
        app: stock-quote
        solution: stock-trader
```



4. Now scale out stock quote by typing

```
kubectl apply -f stock-quote/manifests/deploy.yaml --record
```

```
skytap@icpboot:/StockTrader$ kubectl apply -f stock-quote/manifests/deploy.yaml --record
Warning: kubectl apply should be used on resource created by either kubectl create --save-config or kubectl apply
deployment "stock-quote" configured
Warning: kubectl apply should be used on resource created by either kubectl create --save-config or kubectl apply
service "stock-quote-service" configured
Warning: kubectl apply should be used on resource created by either kubectl create --save-config or kubectl apply
ingress "stock-quote-ingress" configured
```

You can ignore the warnings. Any time you take an action against a deployment that action is saved as part of the deployment's history. The `--record` flag saves the triggering command into that history for future reference.

If you run `kubectl get deployments` you'll see that stock-quote has scaled up to three.

```
skytap@icpboot:/StockTrader$ kubectl get deployments
NAME        DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
labdb2-ibm-db2oltp-dev   1         1         1           1          11d
loyalty-level      1         1         1           1          5d
messaging          1         1         1           1          2d
notification-twitter 1         1         1           1          2d
portfolio          1         1         1           1          10h
redislab3-redis    1         1         1           1          1d
stock-quote         3         3         3           3          5d
trader              1         1         1           1          10h
```

5. Now let's review recorded history. Run the command

```
kubectl rollout history deployment/stock-quote
```

```
skytap@icpboot:/StockTrader$ kubectl rollout history deployment/stock-quote
deployments "stock-quote"
REVISION  CHANGE-CAUSE
1          kubectl apply --filename=stock-quote/manifests/deploy.yaml --record=true
```

Notice there is only one change to this deployment, the scale out we just performed. If we performed another scale out we could tell IBM Cloud Private to revert the deployment to an earlier state in case an operation fails. This roll back is controlled by the `kubectl rollout undo` command.



If you want to return to one replica, repeat Steps 3 and 4 above replacing the replica value of 3 with **1**.

The deploy.yaml file allows you to version control your deployment configuration. You could make this part of a DevOps pipeline so any changes, once proven correct through a pipeline deployment, would eventually reach production. It lets you treat your deployments as another governable artifact.

You've now seen how to adjust the scaling of a microservice in a Kubernetes environment such as IBM Cloud Private. For high availability reasons, in production environments, it is recommended to have at least two replicas running of each microservice, so that if one goes down for any reason, the other can continue processing requests until Kubernetes automatically restarts the failed pod (which it does quite quickly, once the pod's process (such as a Liberty JVM) has exited/abended, or a health check has failed). You can also use this scaling feature to increase the number of concurrent requests that your microservice can handle before slowing down to an unacceptable level of performance.



## 6. Deploying Your Own Instance of MQ Messaging Service

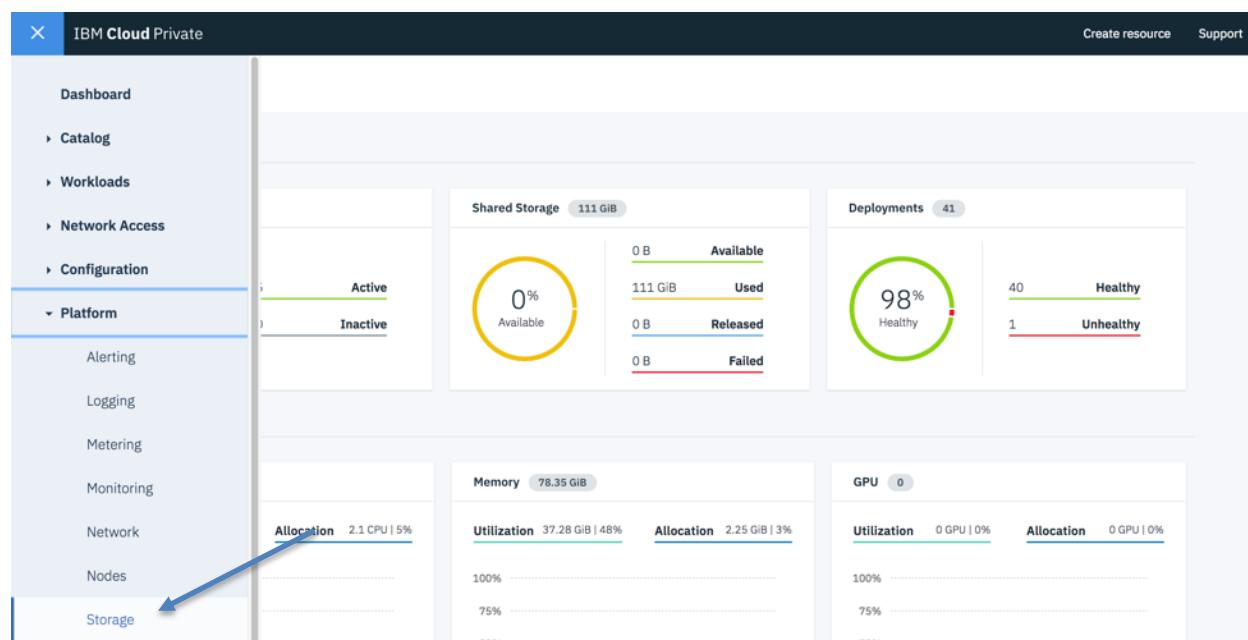
**NOTE: This is an optional section. If you want to skip to section 7 where you will edit code and deploy new microservice, feel free to come back to this later.**

To have you experience the value of Helm Charts, this section will involve you installing and configuring MQ. While this traditionally took hours to install, with a containerized service deployed through Helm Charts, it really only takes minutes.

### Create Persistent Volume

To deploy IBM MQ-Dev, you need to create a persistent volume that uses the “ReadWriteOnce” (RWO) access mode. You can create the storage volume from the UI, and should ideally be created before the deployment. However, you could create it after the deployment as well...Kubernetes will pause the deployment until it can find a matching persistent volume.

To create the volume, log into IBM Cloud Private, and use the upper left menu to navigate to the Storage page by selecting **Platform > Storage**



The screenshot shows the IBM Cloud Private dashboard. On the left, there is a navigation sidebar with the following items:

- Dashboard
- Catalog
- Workloads
- Network Access
- Configuration
- Platform (selected)
- Alerting
- Logging
- Metering
- Monitoring
- Network
- Nodes
- Storage (selected)

A blue arrow points from the "Storage" item in the sidebar to the "Storage" link in the main content area. The main content area displays several metrics and status indicators:

- Shared Storage**: 111 GiB
  - 0 B Available (yellow circle)
  - 111 GiB Used (green bar)
  - 0 B Released (blue bar)
  - 0 B Failed (red bar)
- Deployments**: 41
  - 98% Healthy (green circle)
  - 1 Unhealthy (red bar)
- Memory**: 78.35 GiB
  - Utilization: 37.28 GiB | 48%
  - Allocation: 2.25 GiB | 3%
- GPU**: 0
  - Utilization: 0 GPU | 0%
  - Allocation: 0 GPU | 0%

Once on the storage page, click **Create PersistentVolume**



**PERSISTENTVOLUME**  
Create PersistentVolume

**General**

Name: gregvol6

**PERSISTENTVOLUME**  
Create PersistentVolume

**General**

Capacity: 2 Gi

Access mode: Read write once

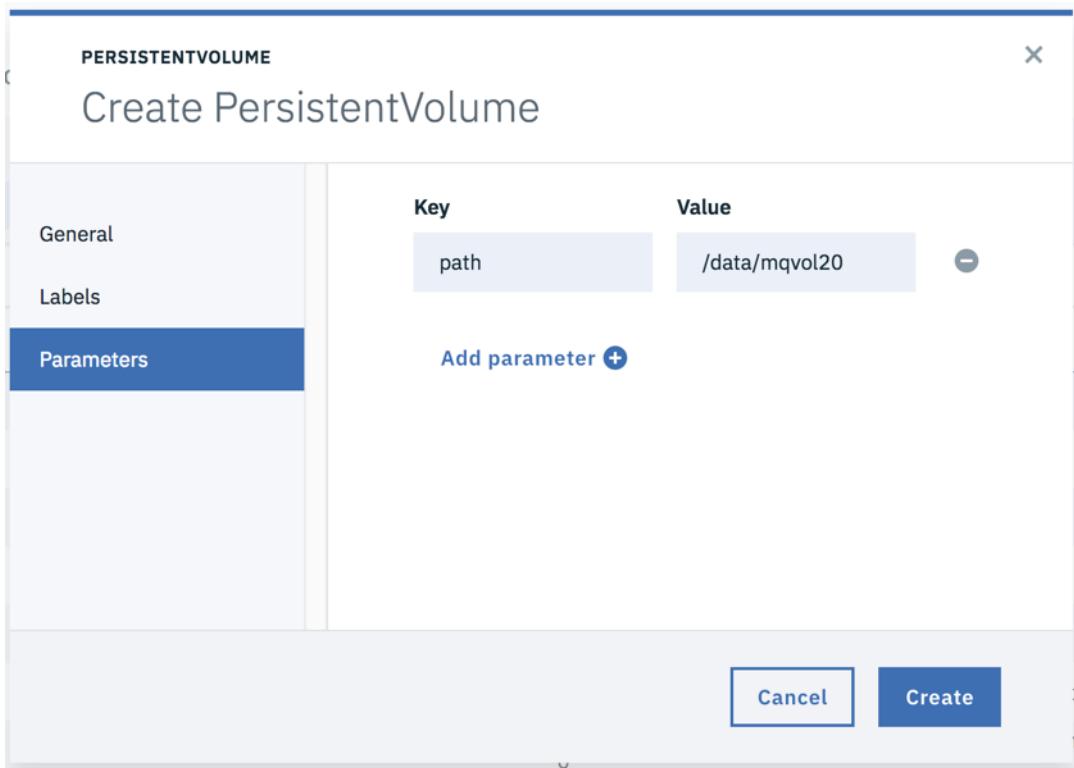
Reclaim policy: Retain

Storage type: Host path

In this example, name: **mqvol20** I created a Capacity: **2GB** Storage Type: **Host Path** with **“Read Write Once”** access mode.

Click the **Parameters** tab, and then enter **path**, and **/data/mqvol20**.





Click **Create**.

The value of using a persistent volume is that even though this recipe only deploys a single MQ queue manager, you can still achieve a level of availability in that if the queue manager pod or the node itself were to fail, IBM Cloud Private automatically re-schedules the queue manager to another node.

[Get to the MQ Helm Chart](#)

Next, install MQ itself.

For this example, we will use the catalog. However, if you want to use the command line, you can directly access the helm charts here: <https://github.com/IBM/charts>. Either path is fine, and as we both know, if you love kubectl and helm commands, then using the helm charts directly is a great option (you can [get helm command line here](#))

For the UI path, open IBM Cloud Private, and navigate to the catalog.



The screenshot shows the IBM Cloud Private dashboard. On the left, there's a sidebar with various sections like 'Catalog', 'Images', 'Workloads', 'Network Access', 'Configuration', 'Platform', 'Manage', and 'Command Line Tools'. Under 'Catalog', a pink arrow points to the 'Helm Charts' link. The main area has several cards: 'Shared Storage' (57 GiB), 'Deployments' (21 total, 100% healthy), 'Memory' (15.67 GiB utilization 12.26 GiB, allocation 1.75 GiB), and 'GPU' (0 utilization, 0 allocation). At the bottom left is a URL: <https://10.0.0.1:8443/catalog>.

The catalog lists all the content you can install into IBM Cloud Private. Notice some are marked **community** and some are marked **ibm-charts** .

Enter **mq** in the search to find MQ.

The screenshot shows the Catalog page with a search bar containing 'mq'. Below it, there's a heading 'Helm charts' with a sub-instruction 'Deploy your applications and install software packages'. It lists several charts:

- rabbitmq**: Open source message broker software that implements the Advanced Message Queuing. Labeled 'Community'.
- rabbitmq-ha**: Highly available RabbitMQ cluster, the open source message broker software that. Labeled 'Community'.
- ibm-mqadvanced-server-dev**: IBM MQ queue manager. Labeled 'ibm-charts'.
- ibm-rabbitmq-dev**: Open source message broker software that implements the Advanced Message Queuing. Labeled 'ibm-charts'.



## Click on **ibm-mqadvanced-server-dev**

From this details view, select the “Configure” button at the bottom, then go to the next step.

The screenshot shows the IBM Cloud Private interface with the following details:

- IBM MQ queue manager**: The chart name.
- ibm-charts**: The category.
- View Licenses**: License information.
- VERSION**: 1.1.0
- PUBLISHED**: Jan 2nd 2018
- TYPE**: Helm Chart

**IBM MQ**: The description states: "IBM® MQ is messaging middleware that simplifies and accelerates the integration of diverse applications and business data across multiple platforms. It uses message queues to facilitate the exchanges of information and offers a single messaging solution for cloud, mobile, Internet of Things (IoT) and on-premises environments."

### Introduction

This chart deploys a single IBM MQ Advanced for Developers server (queue manager) into an IBM Cloud private or other Kubernetes environment.

### Prerequisites

Kubernetes 1.6 or greater, with beta APIs enabled

If persistence is enabled (see [configuration](#)), then you either need to create a PersistentVolume, or specify a Storage Class if classes are defined in your cluster.,

### Installing the Chart

To install the chart with the release name `foo`:

```
helm install --name foo stable/ibm-mqadvanced-server-dev --set license=accept
```

This command accepts the [IBM MQ Advanced for Developers license](#) and deploys an MQ Advanced for Developers server on the Kubernetes cluster. The [configuration](#) section lists the parameters that can be configured during installation.

**Tip:** See all the resources deployed by the chart using `kubectl get all -l release=foo`

**Configure**

There are quite a few settings in the MQ install, but I'll just highlight the ones you need to worry about.



## Install Options 1 of 2

Configuration  
IBM MQ queue manager Edit these parameters for configuration

Release name [i](#)  
mq-greg-lab

Target namespace [i](#)  
default

I have read and agreed to the [license agreements](#)

In this first section you need to give your deployment a name **mq-myname-lab**, select **default** namespace, then accept the license, otherwise the deployment will fail.

## Install Options 2 of 2:

Service

Service name [i](#)  
qmgr

Service type [i](#)  
NodePort

Resources

CPU limit [i](#)  
500m

Memory limit [i](#)  
512Mi

CPU request [i](#)  
500m

Memory request [i](#)  
512Mi

Queue manager

Queue manager name [i](#)  
trader

Admin password [i](#)  
\*\*\*\*\*

App password [i](#)  
Enter value

Cancel Install



There are 4 fields you should consider in this last section.

#### **dataPVC.size**

Enter 2Gi. This is where you can customize how large you want your storage to be, but remember, it can't be bigger than the persistent volume you created earlier.

#### **service.type**

Select **NodePort**. If you keep it ‘ClusterIP’, then only apps running inside the IBM Cloud Private cluster will be able to access the MQ service. However, if you change it to ‘NodePort’, then you will be able to call the MQ service from the web browser.

#### **queueManager.name**

Enter **trader**, which is the name of the queue manager that your app will use.

#### **queueManager.dev.adminPassword**

Enter **admin** for the admin password.

### [Deploy the MQ Helm Chart](#)

Once you are ready (you have accepted the license, created your persistent volume, and filled in all the advanced installation details) click **Install** and you are installing!

Depending on compute and storage speeds, it may take a few minutes to install since it needs to create default queues, and start the management UI.

To monitor the progress, select **View Helm Releases**, then scroll to **StatefulSet**. You'll see the pod running, select it and you can view logs.



The screenshot shows the Kubernetes UI for a StatefulSet named "mq-greg-lab-ibm-mq". On the left, the "Overview" tab is selected, displaying "StatefulSet details". It lists the following information:

Type	Detail
Name	mq-greg-lab-ibm-mq
Namespace	default
Images	ibmcom/mq:9;
Selector	app= mq-greg-lab-ibm-mq
Labels	app= mq-greg-lab-ibm-mq, chart= ibm-mqadvanced-server-dev-1.1.0, heritage= Tiller, release= mq-greg-lab
Service	qmgr
Desired replicas	1
Current replicas	1

On the right, the "Pods" tab is selected, showing a table with one item:

NAME	NAMESPACE	STATUS	HOST IP	POD IP	READY	START TIME	ACTION
mq-greg-lab-ibm-mq-0	default	Running	10.0.0.1	10.1.64.94	1/1	Feb 17th 2018 at 8:08 AM	⋮

From the UI, click on “Workloads”, select the MQ Stateful Set, locate the pod and select it, then select the Logs tab.

The screenshot shows the "Logs" tab for the pod "mq-greg-lab-ibm-mq-0". The logs output is as follows:

```

: * 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.
:
: * Enable and start a TCP/IP listener on port 1414
1 : ALTER LISTENER('SYSTEM.DEFAULT.LISTENER.TCP') TRPTYPE(TCP) PORT(1414) CONTROL(QMGR)
AMQ8021I: Request to start IBM MQ listener accepted.
AMQ8623I: IBM MQ listener changed.
2 : START LISTENER('SYSTEM.DEFAULT.LISTENER.TCP')
2 MQSC commands read.
All valid MQSC commands were processed.
No commands have a syntax error.
-----
Monitoring Queue Manager trader
QMNAME(trader) STATUS(Running)
IBM MQ Queue Manager trader is now fully running
Server mqweb started with process ID 367.

```

From the command line: find the pod name and monitor its log:

```
kubectl get pods
```

```
kubectl logs <podname> -f
```



## Start Using MQ

To open the MQ UI, you need to find what service MQ is listening through. To find which URLs to use, run the following to get the list of services:

```
kubectl get svc
```

Then once you identify the service name, run:

```
kubectl describe service <service Name>
```

Here is an example of what you will see:

```
Name: mqlab-ibm-mq
Namespace: default
Labels: app=mqlab-ibm-mq
chart=ibm-mqadvanced-server-dev-1.1.0
heritage=Tiller
release=mqlab
Annotations: <none>
Selector: app=mqlab-ibm-mq
Type: NodePort
IP: 10.0.0.205
Port: qmgr-server 1414/TCP
TargetPort: 1414/TCP
NodePort: qmgr-server 30016/TCP
Endpoints: 10.1.64.117:1414
Port: qmgr-web 9443/TCP
TargetPort: 9443/TCP
NodePort: qmgr-web 32343/TCP
Endpoints: 10.1.64.117:9443
Session Affinity: None
External Traffic Policy: Cluster
Events: <none>
```

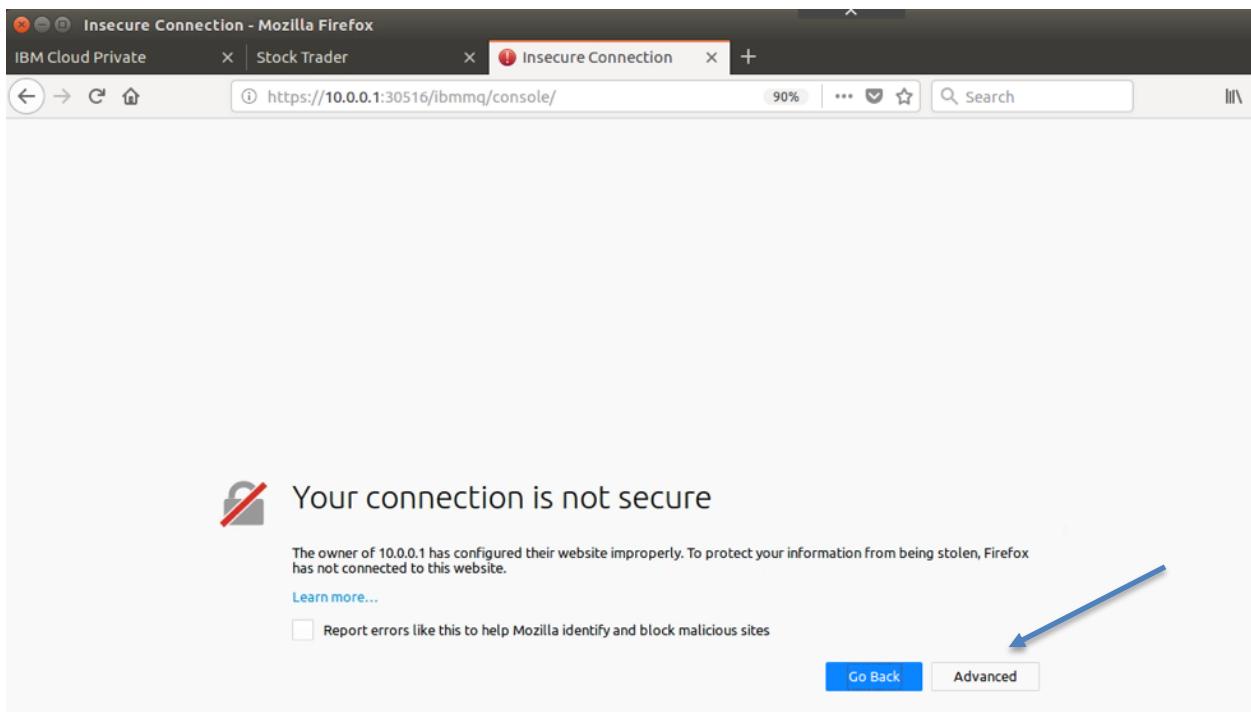
Notice there are 2 sets of ports. MQ uses 1414 for the API, and 9443 for the web UI. Make sure you use the correct NodePort when accessing the UI (in the above example, **32343**).

Paste this (with the correct node port) into a new browser tab:

<https://10.0.0.1:NodePort/ibmmq/console/>

You should get a “not secure” page, click **Advanced, Add Exception**, then **Confirm Security Exception**





Once you see the login on the console, you can start with the default userID and password you entered earlier: is **admin/admin**

**Queue Manager**

Name	Status
trader	Running

Total: 1 Selected: 0 Updated: 8:20:36 AM

**Channels on trader**

Name	Type	Overall channel status
DEV.ADMIN.SVRCONN	Server-connection	Inactive
DEV.APP.SVRCONN	Server-connection	Inactive

Total: 2 Selected: 0 Updated: 8:18:21 AM

**Queues on trader**

Name	Queue type	Queue depth
DEV.DEAD.LETTER.QUEUE	Local	0
DEV.QUEUE.1	Local	0
DEV.QUEUE.2	Local	0
DEV.QUEUE.3	Local	0

Total: 4 Selected: 0 Updated: 8:18:22 AM

**Topics on trader**

Name	Topic String
DEV.BASE.TOPIC	dev/

Total: 1 Selected: 0 Updated: 8:18:20 AM

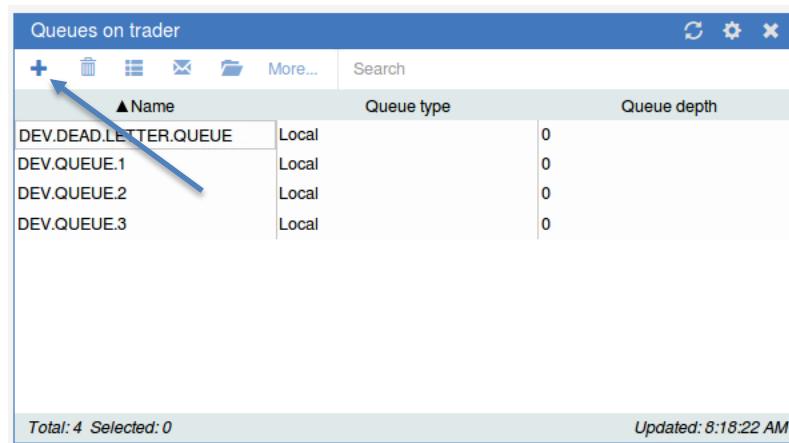


To start using MQ from an application, you will want to use the application user ID, not the admin user ID. The application user ID is “app” (with no default password). [Click here to learn more and see examples.](#)

## Configuring MQ

Once MQ is running, we need to create the message queue that the app expected.

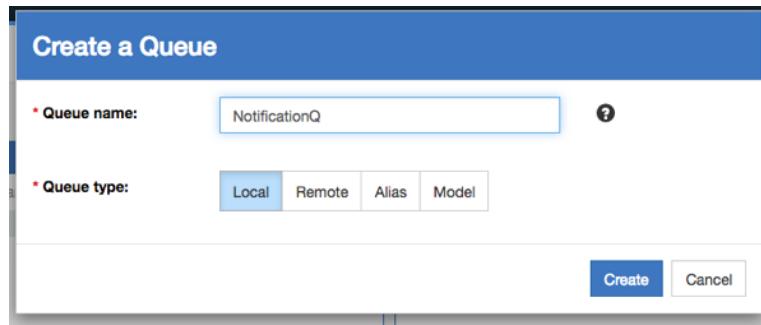
Select the + icon



The screenshot shows a window titled "Queues on trader". The toolbar at the top includes icons for creating (+), deleting (-), sorting (grid), filtering (magnifying glass), and more (More...). A search bar is also present. Below the toolbar is a table with three columns: Name, Queue type, and Queue depth. The table contains four rows of data. At the bottom of the window, it says "Total: 4 Selected: 0" and "Updated: 8:18:22 AM". A blue arrow points to the "+" icon in the toolbar.

Name	Queue type	Queue depth
DEV.DEAD.LETTER.QUEUE	Local	0
DEV.QUEUE.1	Local	0
DEV.QUEUE.2	Local	0
DEV.QUEUE.3	Local	0

Create a queue called, **NotificationQ**



The screenshot shows a modal dialog box titled "Create a Queue". It has two main input fields: "Queue name:" with the value "NotificationQ" and "Queue type:" with the value "Local" selected. There are other options "Remote", "Alias", and "Model" available. At the bottom right are "Create" and "Cancel" buttons.

Next, we authorize the app user ID ‘app’ to the queue. The MQ instructions says NOT to use the default admin ID, but to use the default application ID, ‘app’. To do that, select **NotificationQ**, the **More...** menu, then **Manage Authority Records**.



Queues on trader		
		More... Search
▲ Name		Queue depth
DEV.DEAD.LETTER.QUEUE		0
DEV.QUEUE.1		0
DEV.QUEUE.2	Local	0
DEV.QUEUE.3	Local	0
NotificationQ	Local	0

Total: 5 Selected: 1 Updated: 8:22:16 AM

Click the plus button, and enter **app**

### Create Authorities

\* Entity name:  ?

\* Entity type:  User  Group

Create Cancel

You will then see the group mqclient in the list. Select **mqclient** and select all the check boxes on the right.



Authority records for 'NotificationQ' on stocktrader

Entity name	Entity type
mqclient	Group
mqm	Group

Total: 2 Selected: 1 Updated: 12:34:14 PM

**Administration**

 Change  
 Clear  
 Delete  
 Display

**Context**

 Pass all context  
 Pass identity context  
 Set all context  
 Set identity context

**MQI**

 Browse  
 Inquire  
 Get  
 Put  
 Set

You have unsaved changes Check all Uncheck all Save Close

Finally, click **Save** then **Close**.

## Create Secrets

We have a recipe describing why secrets are so useful, and you can read it here (in a nutshell they make your application portable by letting you define custom, cloud-specific information regarding how the app can use each service):

<https://developer.ibm.com/recipes/tutorials/use-kubernetes-secrets-to-make-your-app-portable-across-clouds/>

## Switch to use YOUR MQ service

In this section you will use Kubernetes Secrets to switch from using the MQ service we deployed to the MQ service you just deployed. As we mentioned earlier, our Stock Trader microservices use Kubernetes secrets to “learn” how to connect to services. This allows the cloud admin to “pivot” from using different versions of the services, even to pivot to use services not even running in IBM Cloud Private.

In this case, you’ll want to delete the existing Kubernetes secret for MQ:

```
kubectl delete secret mq
```

Then, find your MQ service name



```
kubectl get svc
```

Then viewed the properties

```
kubectl describe service your-mq-service-name
```

Now **create** the secret that lists your MQ instance:

```
kubectl create secret generic mq --from-literal=id=app --from-literal=pwd= --from-literal=host=<your-mq-service-name> --from-literal=port=1414 --from-literal=channel=DEV.APP.SVRCONN --from-literal=queue-manager=trader --from-literal=queue=NotificationQ
```

Finally, for the Stock Trader application to use your new MQ service, you should delete the **loyalty-level** and **messaging** pods. Kubernetes will immediately replace them and as a result the new pods will pick up the new secret.

**NOTE: If you want to go back to the MQ service we created earlier, just delete your secret and run this command:**

```
kubectl create secret generic mq --from-literal=id=app --from-literal=pwd= --from-literal=host=mqlab-ibm-mq --from-literal=port=1414 --from-literal=channel=DEV.APP.SVRCONN --from-literal=queue-manager=stocktrader --from-literal=queue=NotificationQ
```



## 7. Edit Code and Deploy a New Version of a StockTrader Micro-Service

Earlier you saw how a tweet gets sent out when a portfolio's loyalty level changes. As a reminder, here's an example tweet, showing the message that the version of notification-twitter in GitHub (and on the lab VM) produces:



### Update Code

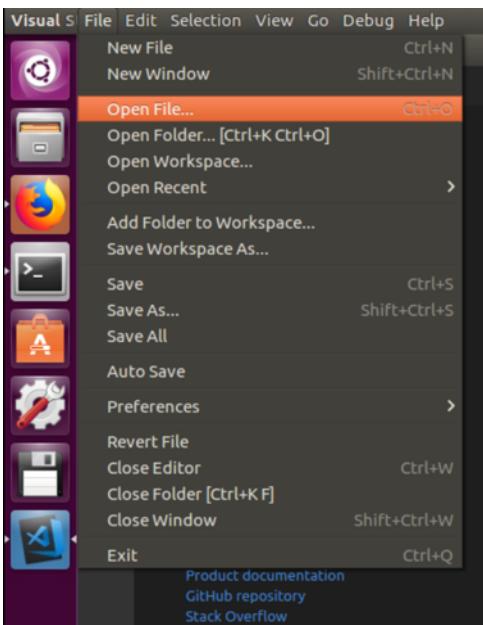
Let's go update that message, so we can see the process for how to build and deploy a new version of a microservice. First, open up the **VS Code** editor (<https://code.visualstudio.com>), which is pre-installed in the lab VM image, via the blue icon on the left palette:



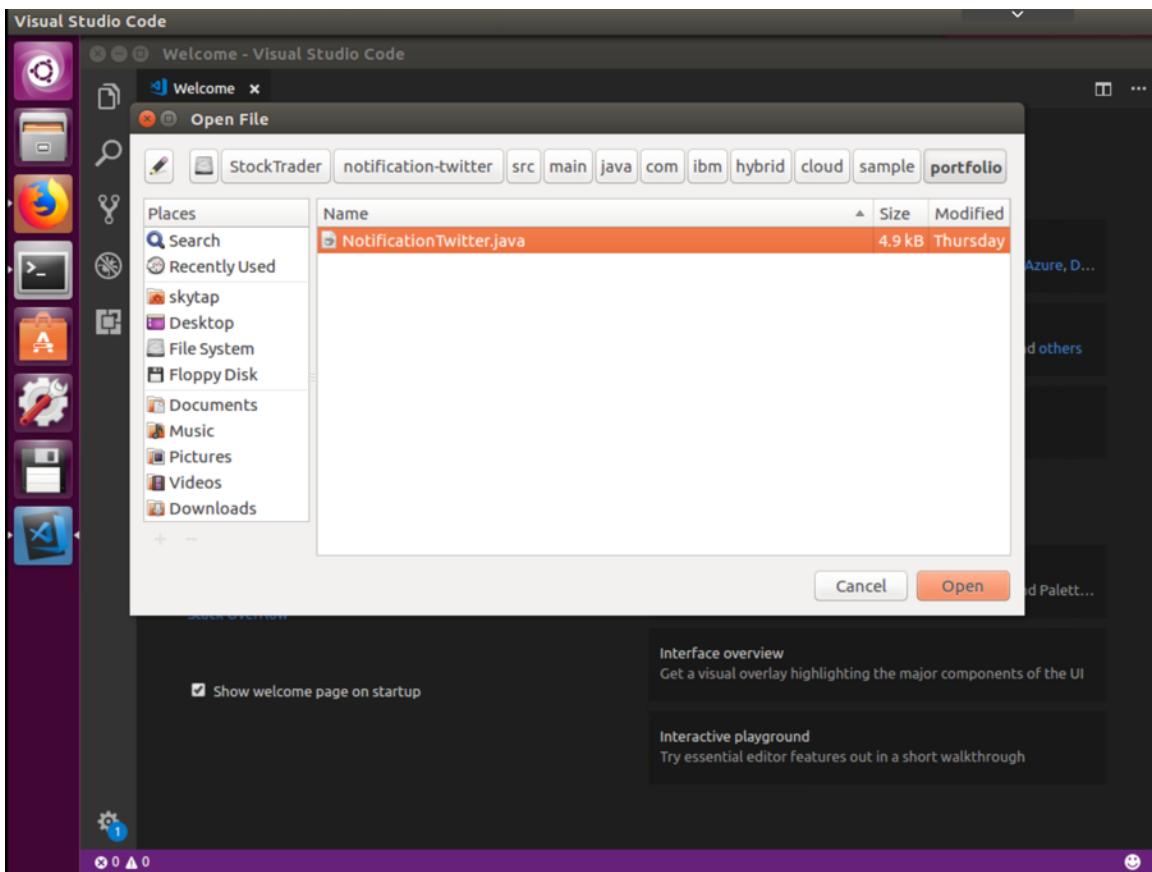
You could use another editor if you prefer, like **nano** or **vi**, but I recommend **VS Code** (with its Java language extension installed) since it understands Java and will provide code highlighting and instant reporting of syntax errors.

Choose **File->Open File...** from the menu bar at the top of the screen:





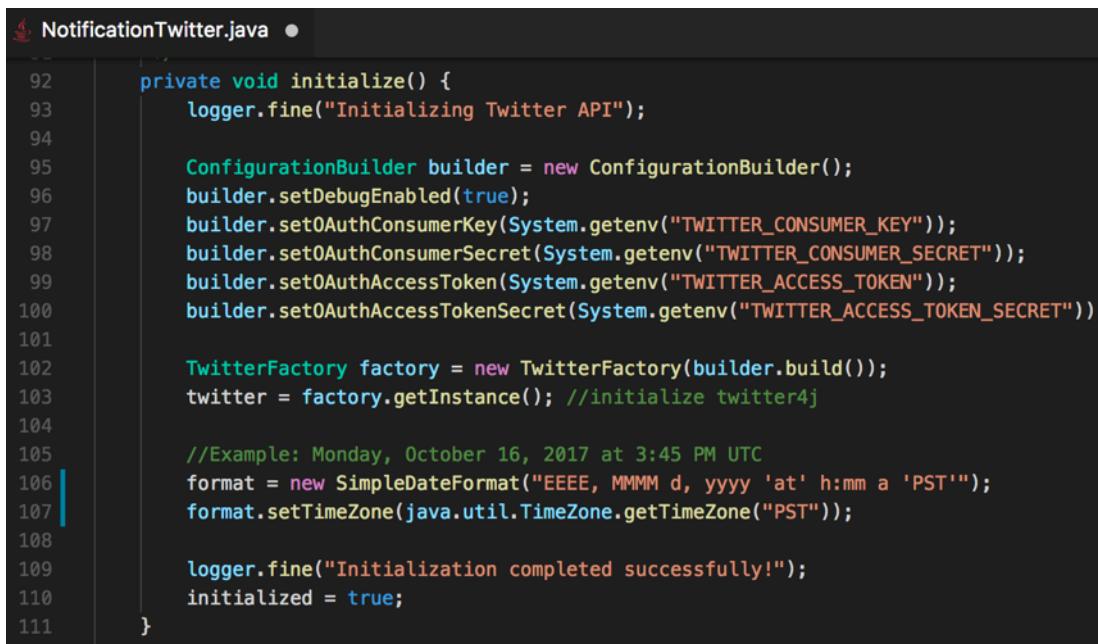
Navigate to /StockTrader/notification-twitter/src/main/java/com/ibm/hybrid/cloud/sample/portfolio/NotificationTwitter.java



Notice how the time stamp in the tweet is in the *UTC* (London) time zone? Since this conference takes place in the *US Pacific Standard Time* (PST) time zone, let's edit the code to send the tweet in PST instead. Go to line 106 (in the `initialize()` method) and let's make two changes. First, replace the "UTC" with "PST" in the `SimpleDateFormat` constructor. Then add a line right under that one which says:

```
format.setTimeZone(java.util.TimeZone.getTimeZone("PST"));
```

(you could use "America/Los\_Angeles" in place of "PST" if you desire). The `initialize()` method should now look like this:



```
NotificationTwitter.java ●

92     private void initialize() {
93         logger.fine("Initializing Twitter API");
94
95         ConfigurationBuilder builder = new ConfigurationBuilder();
96         builder.setDebugEnabled(true);
97         builder.setOAuthConsumerKey(System.getenv("TWITTER_CONSUMER_KEY"));
98         builder.setOAuthConsumerSecret(System.getenv("TWITTER_CONSUMER_SECRET"));
99         builder.setOAuthAccessToken(System.getenv("TWITTER_ACCESS_TOKEN"));
100        builder.setOAuthAccessTokenSecret(System.getenv("TWITTER_ACCESS_TOKEN_SECRET"));
101
102        TwitterFactory factory = new TwitterFactory(builder.build());
103        twitter = factory.getInstance(); //initialize twitter4j
104
105        //Example: Monday, October 16, 2017 at 3:45 PM UTC
106        format = new SimpleDateFormat("EEEE, MMMM d, yyyy 'at' h:mm a 'PST'");
107        format.setTimeZone(java.util.TimeZone.getTimeZone("PST"));
108
109        logger.fine("Initialization completed successfully!");
110        initialized = true;
111    }
```

Let's also include the hashtag for the conference. The Index conference is known by #IndexConf, so let's go add that to the tweet message, in line 120 (I split the line for readability). Then save the file. Here's what the new `tweet()` method looks like after that:



```

NotificationTwitter.java ●

113     /** Tweet a message to our @IBMStockTrader account.
114      * @throws TwitterException
115      */
116     private String tweet(String owner, String oldLoyalty, String loyalty) throws TwitterException {
117         if (!initialized) initialize();
118
119         Date now = new Date();
120         String message = "On "+format.format(now)+" "+owner+" changed status from "+oldLoyalty+
121             " to "+loyalty+". #IBMStockTrader #IndexConf";
122
123         logger.fine("Sending following tweet: "+message);
124         twitter.updateStatus(message);
125
126         logger.info("Message tweeted successfully!");
127         return message;
128     }

```

## Build the project

Now return to the Terminal window (where “su” has been run), switch to the /StockTrader/notification-twitter directory, and run “mvn package”.

```

skytap@icpboot:~$ cd /StockTrader/notification-twitter/
skytap@icpboot:/StockTrader/notification-twitter$ su
Password:
root@icpboot:/StockTrader/notification-twitter# mvn package

```

That command produces several screens of output. Once it completes, you should see output like the following. If so, then run “docker build -t notification-twitter .” (note the trailing dot, meaning current directory), as shown below:

```

[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 43.497 s
[INFO] Finished at: 2018-02-18T04:53:48-08:00
[INFO] Final Memory: 16M/144M
[INFO] -----
root@icpboot:/StockTrader/notification-twitter# docker build -t notification-twitter .

```

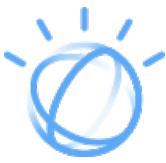
This make take a couple of minutes. When it completes, run “docker tag notification-twitter:latest mycluster.icp:8500/default/notification-twitter:latest”, followed by “docker push mycluster.icp:8500/default/notification-twitter:latest”.



```
root@icpboot:/StockTrader/notification-twitter
Successfully tagged notification-twitter:latest
root@icpboot:/StockTrader/notification-twitter# docker tag notification-twitter:latest
mycluster.icp:8500/default/notification-twitter:latest
root@icpboot:/StockTrader/notification-twitter# docker push mycluster.icp:8500/default/
notification-twitter:latest
The push refers to repository [mycluster.icp:8500/default/notification-twitter]
311480de49d0: Pushed
05ab2361008b: Pushed
7a42ed25cdab: Pushed
1fa497110f5d: Layer already exists
70ff20a97f51: Layer already exists
a0c9e4c8bfb4: Layer already exists
0165e4961a77: Layer already exists
a049d653e9fe: Layer already exists
49cc0168f595: Layer already exists
58860ebfe087: Layer already exists
2cdf1100a9ba: Layer already exists
babe8441459b: Layer already exists
c302aac9a989: Layer already exists
eb2b8fa110d3: Layer already exists
6f4ce6b88849: Layer already exists
92914665e7f6: Layer already exists
c98ef191df4b: Layer already exists
9c7183e0ea88: Layer already exists
ff986b10a018: Layer already exists
latest: digest: sha256:b6a9419935c34fe5cc4aae1c2dde4fe33daf2acf7723c7e18441e9dc6c7abaf0
size: 4288
root@icpboot:/StockTrader/notification-twitter# kubectl apply -f manifests/deploy.yaml
```

## Deploy to IBM Cloud Private

We now have the updated microservice in the Docker image registry. So we're ready to deploy the updates to IBM Cloud Private. First, let's undeploy the old version, via "kubectl delete -f manifests/deploy.yaml". Then do a "kubectl get pods" to confirm it's gone. Then you can do a "kubectl create -f manifests/deploy.yaml", and another "kubectl get pods" to confirm the new version is deployed and running.



```

root@icpboot:/StockTrader/notification-twitter
root@icpboot:/StockTrader/notification-twitter# kubectl delete -f manifests/deploy.yaml
deployment "notification-twitter" deleted
service "notification-service" deleted
ingress "notification-ingress" deleted
root@icpboot:/StockTrader/notification-twitter# kubectl get pods
NAME                               READY   STATUS    RESTARTS   AGE
labdb2-ibm-db2oltp-dev-6dfcb56b8d-r6dg9  1/1     Running   2          11d
loyalty-level-789465954c-gcmkq            1/1     Running   2          5d
messaging-64cf9848ff-wvpg8               1/1     Running   1          2d
mqlab-ibm-mq-0                          1/1     Running   2          11d
portfolio-647fcc8fcfd-sqxtm             1/1     Running   1          14h
redislab3-redis-7887cb7c46-qqqkp        1/1     Running   7          1d
stock-quote-d7d8c4cf5-vw2cl              1/1     Running   1          1d
trader-5c75688d9-8mjpd                 1/1     Running   1          14h
root@icpboot:/StockTrader/notification-twitter# kubectl create -f manifests/deploy.yaml
deployment "notification-twitter" created
service "notification-service" created
ingress "notification-ingress" created
root@icpboot:/StockTrader/notification-twitter# kubectl get pods
NAME                               READY   STATUS    RESTARTS   AGE
labdb2-ibm-db2oltp-dev-6dfcb56b8d-r6dg9  1/1     Running   2          11d
loyalty-level-789465954c-gcmkq            1/1     Running   2          5d
messaging-64cf9848ff-wvpg8               1/1     Running   1          2d
mqlab-ibm-mq-0                          1/1     Running   2          11d
notification-twitter-79f4b9f465-nhzcl      1/1     Running   0          13s
portfolio-647fcc8fcfd-sqxtm             1/1     Running   1          14h
redislab3-redis-7887cb7c46-qqqkp        1/1     Running   7          1d
stock-quote-d7d8c4cf5-vw2cl              1/1     Running   1          1d
trader-5c75688d9-8mjpd                 1/1     Running   1          14h
root@icpboot:/StockTrader/notification-twitter#

```

## Run the code

Now go add some stock to cause a change in loyalty level, and then take a look at the new tweet.



Congratulations, you've now seen the full edit->compile->deploy->run cycle for a microservice in IBM Cloud Private. But before we wrap up this section, let's do one more thing. Let's deploy a tool that will show the various microservice interactions that led from you clicking in the browser to the tweet getting sent, which is a fairly long call path.



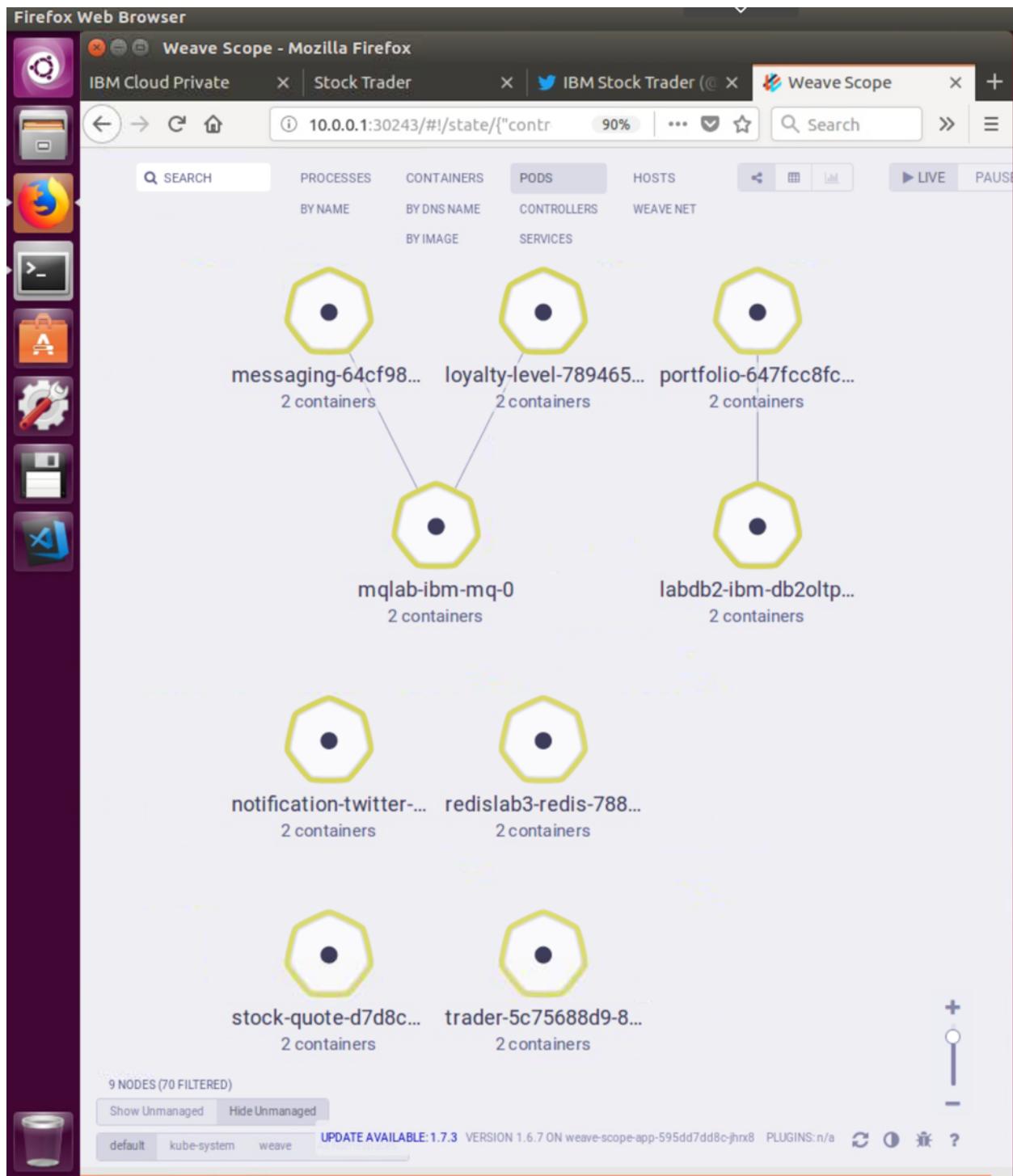
## Visualize the interactions

WeaveWorks has a cool tool (<https://www.weave.works/docs/net/latest/kubernetes/kube-addon/>) that plugs in to Kubernetes, that among other things provides dynamic discovery and visualization of interaction between the pods. For convenience, the lab VM has its deployment yaml already downloaded and in the /StockTrader directory. Just go there and run “`kubectl create -f weave.yaml`”. This will create a new “weave” namespace (rather than dumping everything in the “default” namespace, like where StockTrader is) and creates several resources in that namespace. We’ll have to use the “-n” flag to kubectl to tell it to target that new namespace. For example, you can run “`kubectl get pods -n weave`” to see the new pods it made available, and “`kubectl get services -n weave`” to see its service, which will tell you the node port that you need to enter in the browser to access its UI.

```
skytap@icpboot:/StockTrader$ ls
loyalty-level notification-twitter stock-quote weave.yaml
messaging      portfolio          trader
skytap@icpboot:/StockTrader$ kubectl create -f weave.yaml
namespace "weave" created
serviceaccount "weave-scope" created
clusterrole "weave-scope" created
clusterrolebinding "weave-scope" created
deployment "weave-scope-app" created
service "weave-scope-app" created
daemonset "weave-scope-agent" created
skytap@icpboot:/StockTrader$ kubectl get pods -n weave
NAME                  READY   STATUS    RESTARTS   AGE
weave-scope-agent-zrzlb   1/1    Running   0          30s
weave-scope-app-595dd7dd8c-jhrx8   1/1    Running   0          30s
skytap@icpboot:/StockTrader$ kubectl get services -n weave
NAME        TYPE        CLUSTER-IP      EXTERNAL-IP      PORT(S)        AGE
weave-scope-app   NodePort    10.0.0.186    <none>           80:30243/TCP   40s
```

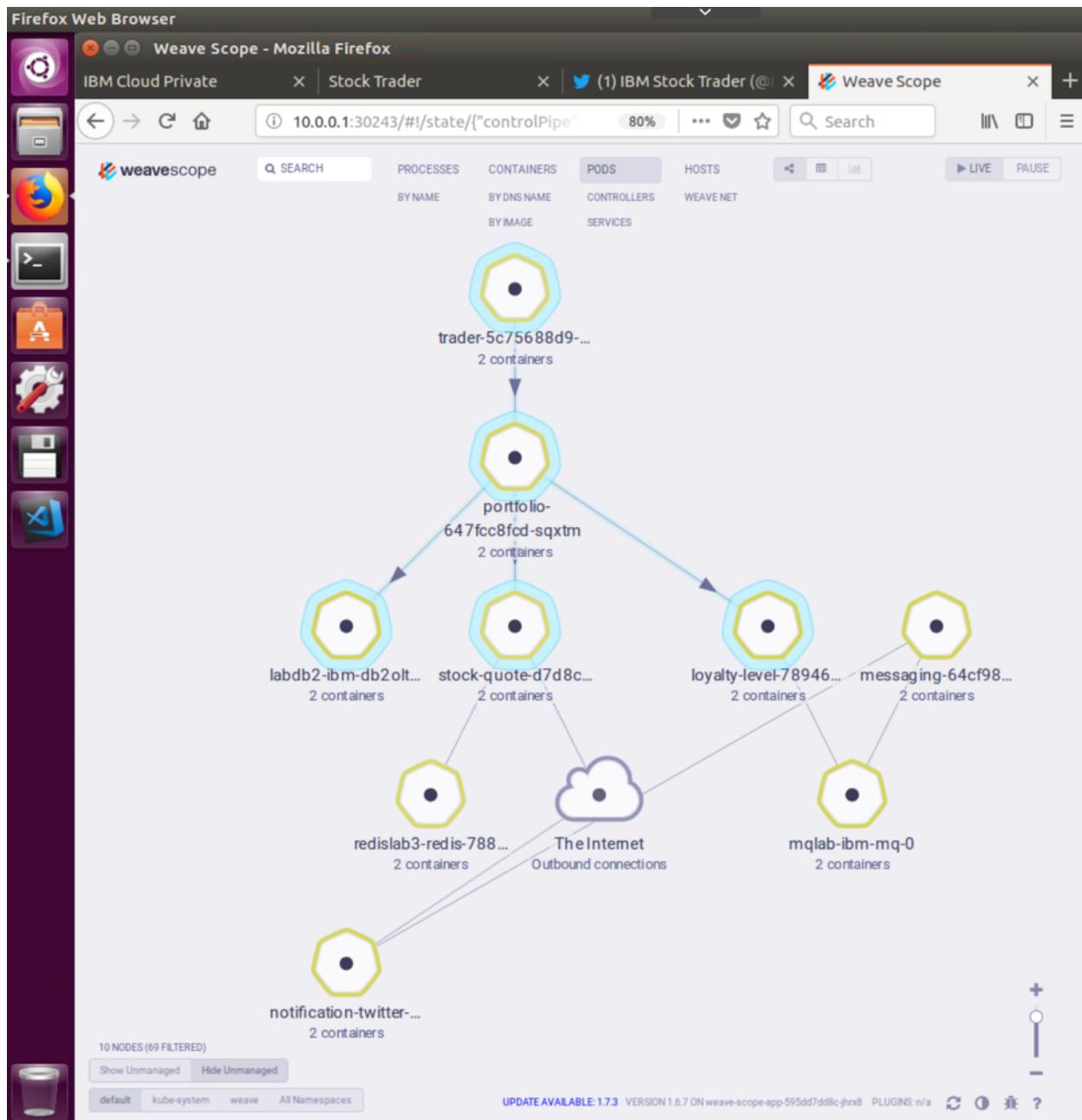
As you can see in this example, it got assigned a node port of 30243. So let’s go back to Firefox and hit <http://10.0.0.1:30243> and give it a try. At first it shows way too much, so let’s filter it down to just what we want, by clicking Pods in the top middle, and clicking on the Default namespace at the bottom left:





So we can see our pods, but with the app “at rest”, the only connections it could discover were the ones to DB2 and MQ (the non-http connections). So now let’s go use the Stock Trader app, making sure to cause a change in loyalty level. Then quickly return to this tab, since some of the http links between pods disappear after only a few seconds. If you hover over a pod, it will highlight and the links to and from it become directional arrows, such as when I hovered over the portfolio pod.





So other than being oriented top down rather than left to right, this dynamically discovered diagram does exactly match my PowerPoint slide shown at the very beginning of the lab, showing who calls whom, who uses the prereqs like DB2, MQ and Redis, and who reaches out to services on the internet (note the link from messaging to notification-twitter only appears to go through the internet – really, that's just a sloppy layout thing). Plugins to Kubernetes, like this Weave tool, can help you view and manage things at an application level, rather than dealing with machines, memory, networks, etc.



## 9. Conclusions

Congratulations! You have successfully managed and updated a microservice-based application running in IBM Cloud Private. You have deployed a helm chart from the catalog. You now know how to package and build a Docker image containing WebSphere Liberty and your application; and how to update existing application instances running in IBM Cloud Private. You have also explored the scaling and auto-recoverability features of IBM Cloud Private.

We hope you have enjoyed exploring IBM Cloud Private, and this little sample meant to showcase it. Please share any feedback you might have, on the lab instructions, the Stock Trader sample, Kubernetes, IBM Cloud Private, or anything else regarding your experience in this lab. Note that IBM also has an IBM Container Service, which is a hosted Kubernetes environment in the public IBM Cloud, and Stock Trader runs great there too. Thank you for attending, and for your interest in microservices, Kubernetes, and IBM Cloud Private!

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