Quick Lab: Create Highly Scalable Web Application Microservices with Node.js

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Introduction

This lab walks you through the steps required to create, build and run a cloud native Express.js microservice in less than 5 minutes.

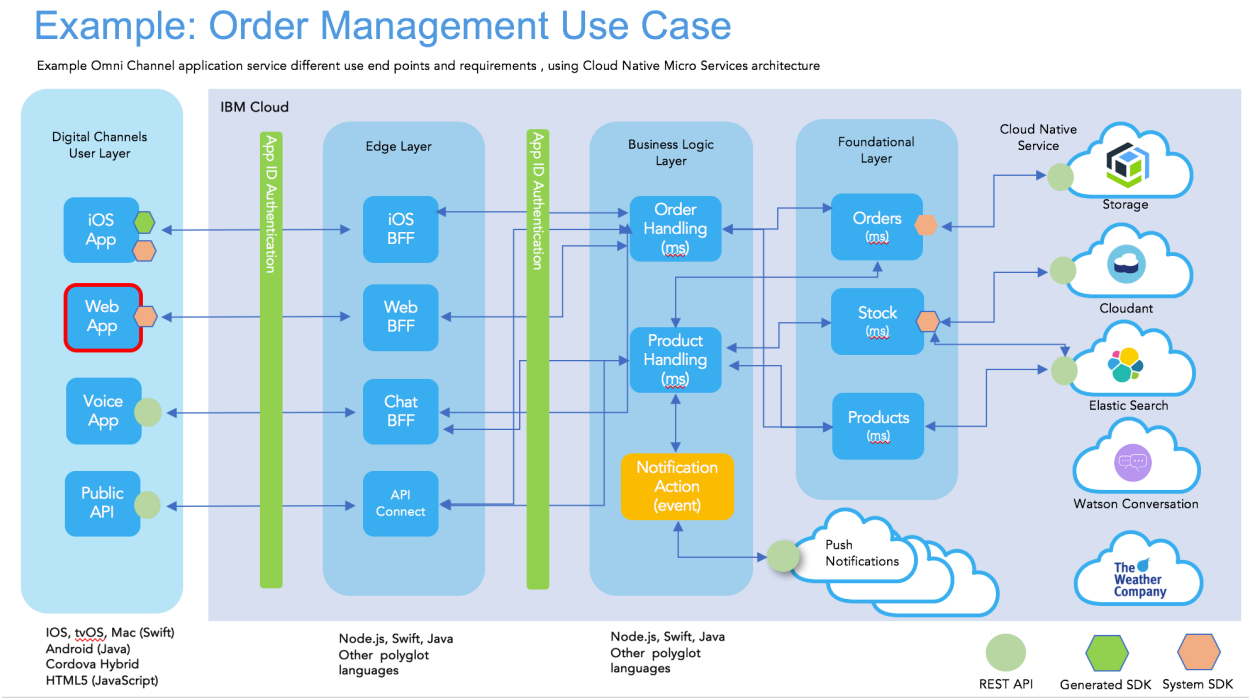
The microservice can either be built using either:

1. A web browser using the **IBM Cloud App Service**
   This offers a guided approach that enables you build cloud native apps in minutes. It eliminates the need to manually edit configuration files and allows you to easily add a select set of IBM Cloud Services to you project, provisioning those services as required. Moreover, you can easily attach a DevOps Toolchain to your project using the **IBM Cloud Continuous Delivery Service** that supports continuous integration and deployment to either a **Cloud Foundry** or **IBM Cloud Container Service** – a managed Kubernetes-based environment on the IBM Cloud. While the Cloud App Service is free, it simplifies the construction and deployment of cloud native apps by easily integrating with other paid IBM Cloud Services.

2. The command line using the **NodeServer CLI**
   This provides a local command line utility to create the Node.js cloud native application. This creates applications that are "Cloud Ready", including all the necessary configuration to create a DevOps pipeline to your project using Jenkins or the IBM Cloud Continuous Delivery Service, and for deployment to Cloud Foundry, Docker and Kubernetes technologies, such as those provided by IBM Cloud.

This lab allows you to use either approach. Note that using the **IBM Cloud App Service** requires you to have an account with IBM Cloud. You may use your existing account or create a new account (Section 2).

For this lab, we are going to focus on an example cloud native web application architecture. We are going to build one part of this architecture: a Foundational Layer Microservice that provides a REST API. For more information on a Reference Implementation for building a cloud native OmniChannel Application using a Microservices architecture refer to IBM Garage Method: https://github.com/ibm-cloud-architecture/refarch-cloudnative



At the conclusion of this lab, you will have completed the following steps:

1. Create a Express.js Microservice Application
2. Run the Express.js microservice, with full support for monitoring, request tracking, and liveness checking, and access it via the web browser.

Setting Up

Before starting this lab, please do the following:

1. Go to http://ibm.biz/startmylab

2. Select **Create Highly Scalable Web Application Microservices with Node.js** lab from the dropdown and click Ok
    1. You will be brought to the sign up page to register for an IBM Cloud Platform account. If you do not have an account, please register for one.
    2. This lab does not require you to have an IBM Cloud Platform account but it allows you to do some optional steps.

3. Clone the project for this lab:

    1. Click on the Launchpad (rocket logo) in the toolbar, search for "Terminal" and click on the icon.

    2. Clone the GitHub project containing the FoodTracker application we are going to extend:

    ```
    git clone
    http://github.com/seabaylea/NodeMicroservices
    ```

    3. A copy of these instructions are available included in the project. You can open the instructions using:

    ```
    open "NodeMicroservices/ NodeMicroservices.pdf"
    ```

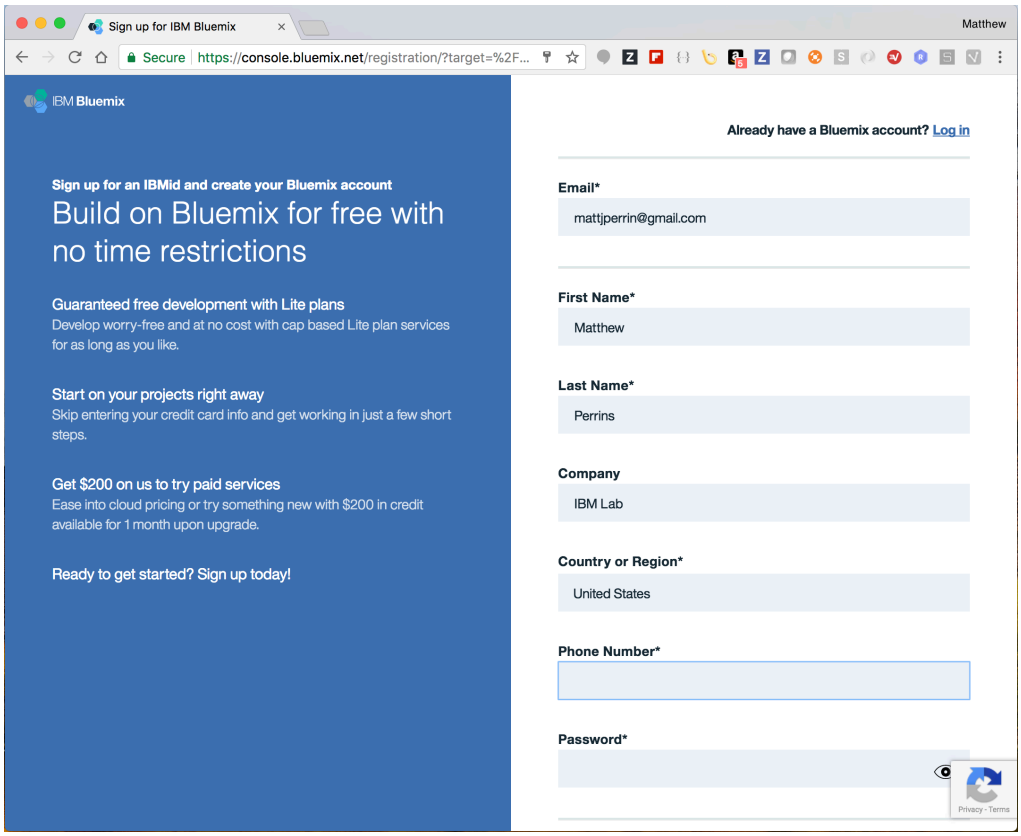
NEXT STEPS:
If you want to use the **IBM Cloud App Service**, proceed to Section 2 (Create an Account) or Section 3 (Create a Node.js Microservice on IBM Cloud)

If you want to use the **NodeServer CLI**, proceed to section 4 (Create a Node.js Microservice)

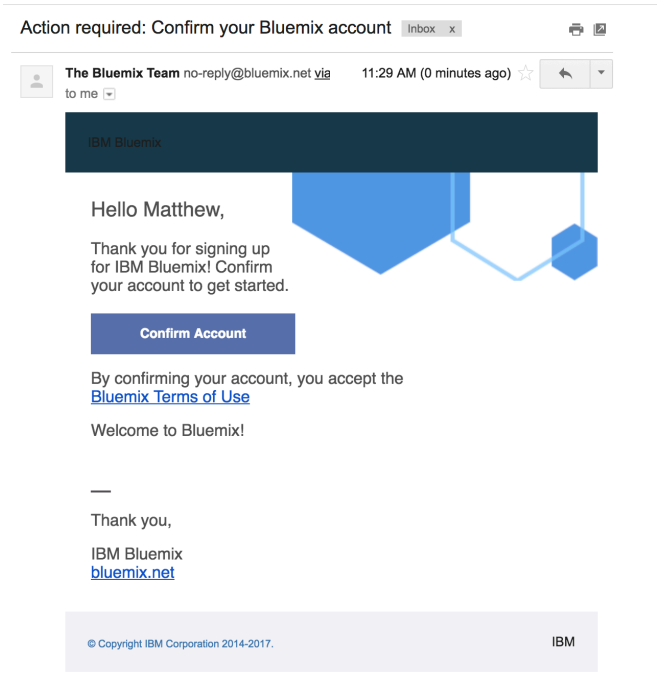
2. IBM Cloud App Service: Create an Account

If you **do** have an existing IBM Cloud account, skip to the next section.

- To run these lab instructions, you will need to create a trial account on the IBM Cloud. You can do this free of charge and all the instructions contained in this lab do not incur any additional costs.
- Create an IBM Cloud Trial account by navigating to this link. https://console.bluemix.net, and click on **Create a free Account.**
- Complete the Registration Form with your details and a valid email address.

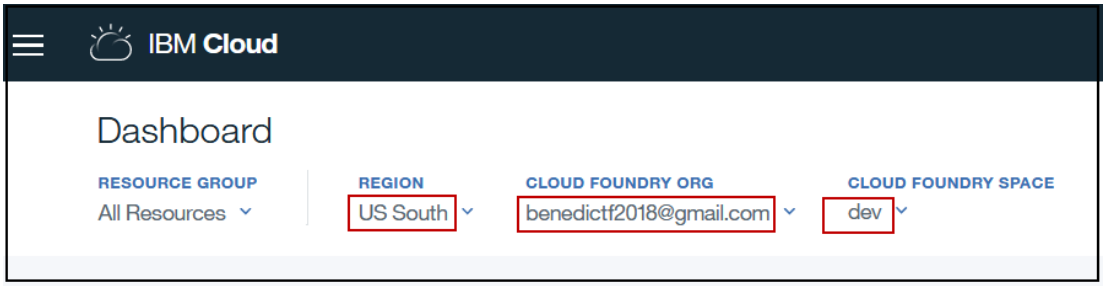


- Click on **Create Account.**
- Confirm your registration by accessing your email and clicking on **Confirm Account.**



- You can now log into IBM Cloud.
- Click on **Login** and enter your email and password
- You will finally see the Dashboard View, which will be empty as you have not created any services or apps at this point. Please note the **Region**, **Org** and **Space** settings.

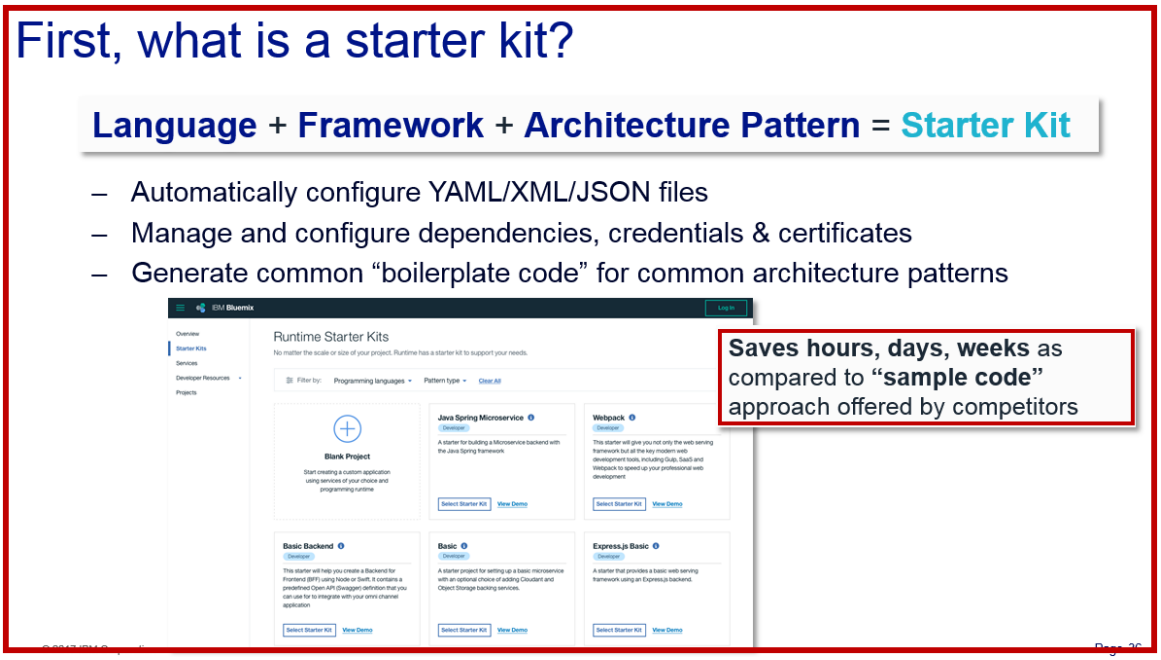
Typically this will be **US South**, the Org setting will be same as your email address and by default you are placed in a Space called **dev**, as shown below.



3. IBM Cloud App Service: Create a Node.js Microservice on IBM Cloud

In this section, you will use the IBM Cloud to create an Express.js microservice application using the IBM Cloud App Service from IBM.

1. Access the IBM Cloud App Service
2. Create from the Blank Project Starter Kit



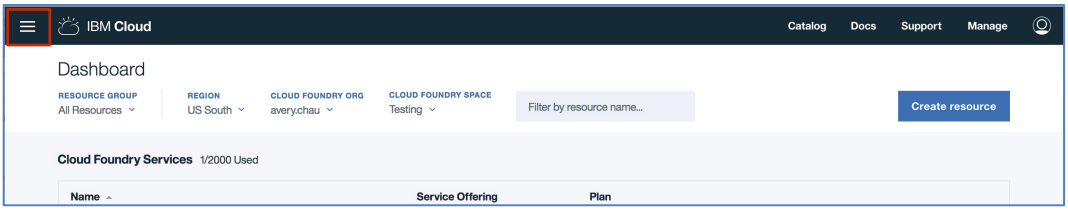
The IBM Cloud App Service jump-starts cloud native development by allowing a developer to create a project, pick an application starter kit and deploy a production-ready application within minutes to the IBM Cloud.

The platform's code generation technology creates a starter application in the developer's preferred language and framework, which can be tailored to their needs and use case. Any services that are required in support of the use case, are provisioned automatically.

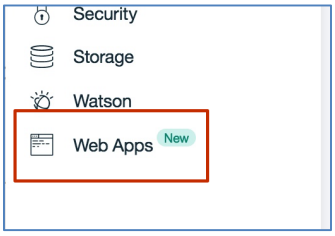
Developers can debug and test on their local workstation or in the cloud, and then use the DevOps Toolchain to collaborate with others to automate the delivery process.

3. Start by logging in to IBM Cloud: http://console.bluemix.net

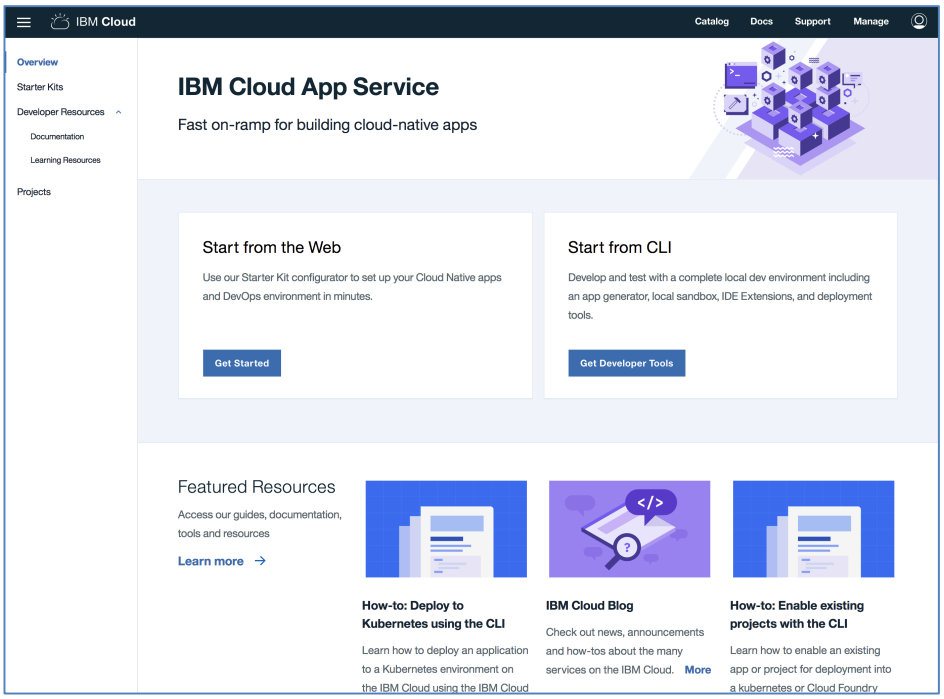
   While logged into the IBM Cloud, click on the **Navigation** menu in the header:



   Then click on **Web Apps** to access the **IBM Cloud App Service** cloud-native development experience on IBM Cloud.

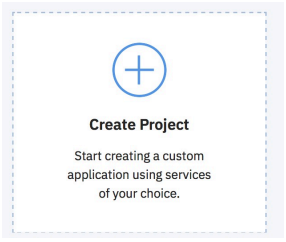


4. Take a few moments to explore the main Overview screen for the IBM Cloud App Service. From here you may access and discover hand-picked content related to cloud-native development including the **Resources**, **Community**, and **Starter Kits** sections. As explained IBM Cloud provides two approaches to building cloud native apps – a web-based and a CLI-based approach. This Lab will use the IBM Cloud App Service, which provides a web console.



5. Navigate to the **Starter Kits** menu on the left-hand side. You will see a range of starter kits that are designed to provide production code starting point for a variety of common cloud-native development use cases. They include patterns and technology framework stacks for key programming languages that are commonly used by developers. Have a look through the list of starter kits for other types of projects you may have in the future.

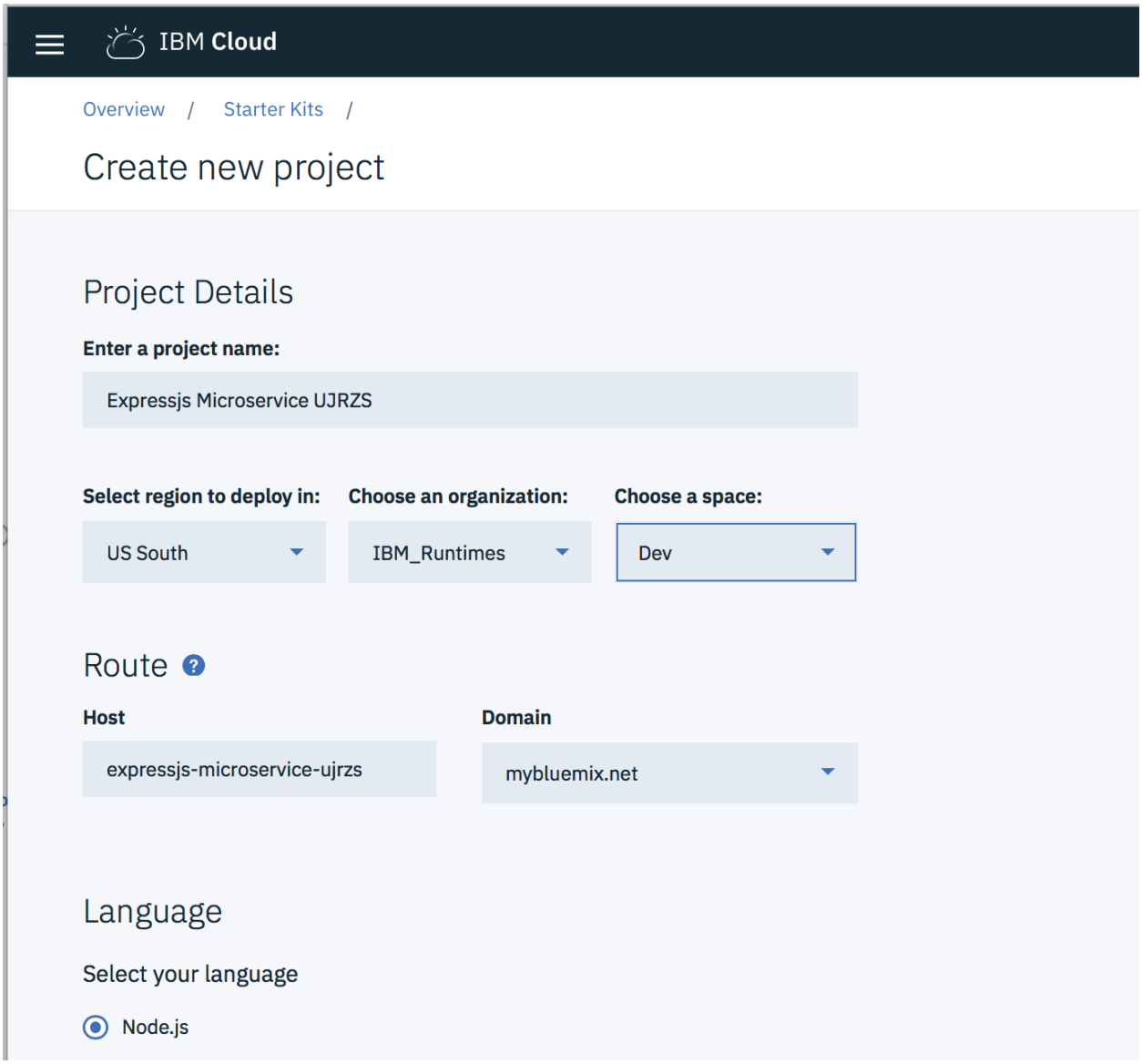
6. Scroll down the list and click on the tile labelled **Create Project** to create a custom project.



7. Within the Create New Project view, enter a project name of NodeMicroservice. Once you've completed the form, click on the **Create Project** button.

8. Select a Language of **Node.js**, and click the "**Add file**" button to add a OpenAPI (aka Swagger) document. Select the "petstore.yaml" file from the NodeMicroservices directory.

NOTE: Please ensure that you select **US South** as the Region.

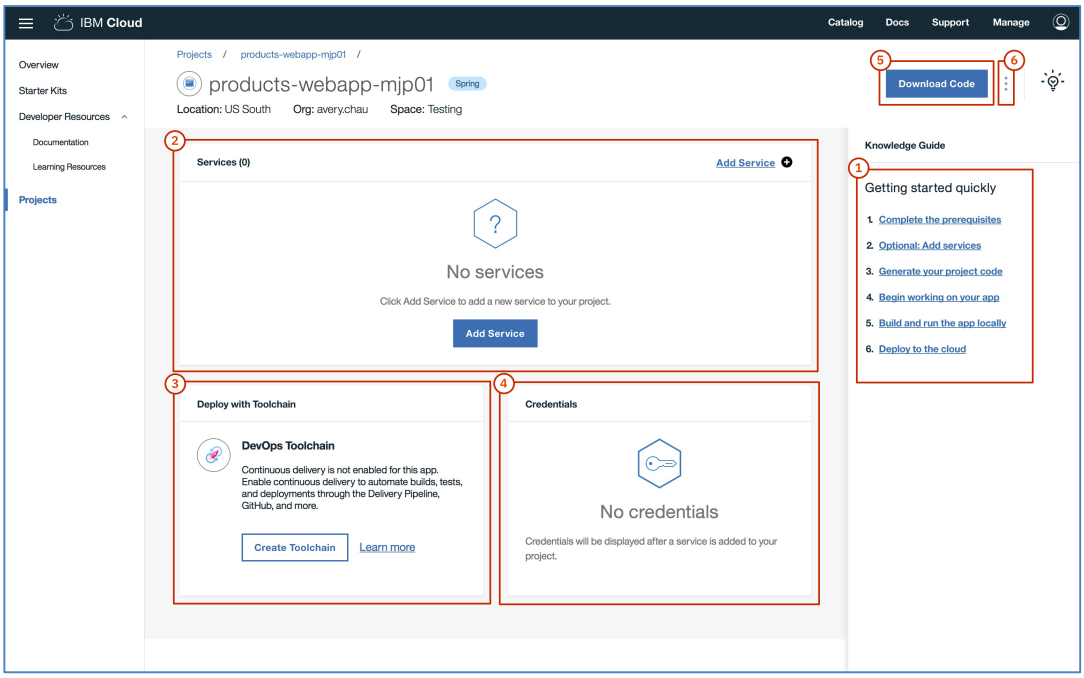


9. Click "**Create Project**" to create the project.

10. The App Configuration/Details view is now displayed. This view is used to manage various aspects of an app:

    1. The right-hand side (1) offers a Getting Started Quickly guide.
    2. The main body has an area where you can create new and associate existing services to the app (2)

3. The bottom of the screen offers an area where you may configure a DevOps toolchain (3)
4. The bottom of the screen also offers an area where you may access credentials to any services that you have added to this app (4)
5. At the top of the screen, it is possible to download the code (5) to the app without any DevOps configuration.
6. Using the menu in the top right (6), you can also rename of the project or delete it.



7. Click “Download Code” to download the project to your local machine.

11. Open a Terminal window to access the command line:
    Click on the Launchpad (rocket logo) in the toolbar, search for “Terminal” and click on the icon.

12. Go to the project directory

```
cd ~/Downloads
cd NodeMicroservice
```

Note: You may need to unzip the download. If you need to, use the following:

```
unzip –d NodeMicroservice NodeMicroservice.zip
```

To continue the lab, move on to Section 5 (Run the Node.js Microservice)

4. NodeServer CLI: Create a Node.js Microservice

In this section, you will use the NodeServer CLI to create an Express.js microservice application that is “Cloud Ready” and can be run locally or used to any cloud that supports any of CloudFoundry, Docker and Kubernetes, including IBM Cloud.

This includes installing the NodeServer CLI and using it to create a Node.js Microservice

1. Open a Terminal window to access the command line:
   Click on the Launchpad (rocket logo) in the toolbar, search for “Terminal” and click on the icon.

2. Install the Yeoman utility by running the following command line:

```
sudo npm install –g yo
```

   If prompted, enter a password of ‘password’

1. Install the NodeServer utility by running the following command line:

```
sudo npm install –g generator-nodeserver
```

   To continue the lab, move on if prompted

   This has now installed the NodeServer CLI utility which allows you to quickly create a cloud enabled Node.js application.

13. Create a directory with the name of your project

```
mkdir NodeMicroservice
cd NodeMicroservice
```

2. Create your Node.js microservice
   Run the following command on the command line:

```
yo nodeserver
```

   This will prompt you to answer a number of questions. Provide the following answers:

```
[2018-03-14T16:33:08.932] [INFO] generator-nodeserver - Package info ::
generator-nodeserver 1.0.11
? Project name NodeMicroservice
```

```
? OpenAPI Document (None)   /Users/user/NodeMicroservices/petstore.yaml
? Add IBM Cloud Service Enablement? No
```

This creates a fully working skeleton Node.js project that provides monitoring, metrics and request tracking, which can then be extended with your application logic.

As we provided an OpenAPI Document (aka a Swagger definition), additional template code has been added to implement those API calls. The definition we provided is the “Petstore” sample, which provides the REST APIs for a simple petstore.

If you explore the generated assets you will see that there a number of configuration files generated for you, including:

1.	Jenkinsfile	A pipeline for Jenkins and IBM Cloud Private
2.	.bluemix/*	A pipeline for IBM Cloud Continuous Delivery Service
3.	Dockerfile	A dockerfile to build a Docker image for the application
4.	chart/*	A helm chart to enable deployment to Kubernetes
5.	manifest.yml	A configuration file for use with Cloud Foundry

5. Run the Node.js Microservice

In this section, you will enable the optional request tracking capability, and run the Express.js microservice locally, including viewing its monitoring and metrics capabilities.

1. Open the `server/server.js` file in your project and enable "appmetrics-zipkin"
   a. Open the file:
   ```
   open –a TextEdit ./server/server.js
   ```
   b. Uncomment the code at the top of the file to enable Zipkin request tracking. And optionally change the `serviceName`:
   The top of your file should be:
   ```
   var appzip = require('appmetrics-zipkin')({
        host: 'localhost',
        port: 9411,
        serviceName:'NodeMicroservice'
    });
   ```
   Once you've made the changes, save the file.

   This has enabled OpenTracing for any request received by the Node.js microservice, and for any outbound requests it makes to other services.

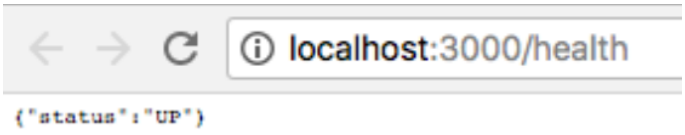
2. Launch and run the Zipkin server request tracking monitoring service:
   ```
   docker run -d -p 9411:9411 openzipkin/zipkin
   ```
   This will start running the Zipkin monitoring service in a Docker container on port 9411. Zipkin is and open source monitoring solution that is designed to integrated into Docker and Kubernetes deployments, and monitors requests across individual microservices.
   ```
   docker run -d -p 9090:9090 -v
   /Users/user/nodemicroservices/prometheus.yml:/etc/prometheus/prometheus.yml
   prom/prometheus
   ```
   This will start running the Prometheus monitoring service in a Docker container on port 9090. Prometheus is and open source monitoring solution that is designed to integrated into Docker and Kubernetes deployments to monitor applications.

3. Install the dependencies, and run the application:
   ```
   npm install
   npm start
   ```

4. View the liveness endpoint:
   To check that the application is running successfully, view the liveness endpoint:
   Liveness endpoint: http://localhost:3000/health

   The **liveness endpoint** provides a response that states whether the application is successfully running. This can be used by Cloud Foundry and Kubernetes to automatically restart the application if it fails or becomes unresponsive.

   It should report the following:



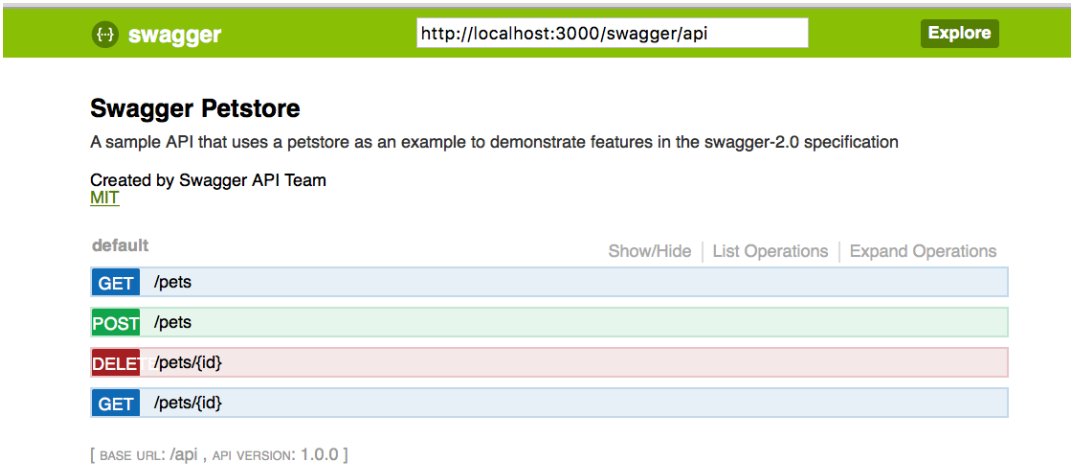
5. View the Swagger Explorer

As the Node.js microservice was built using a Open API (aka. Swagger) specification, skeleton code to implement the defined REST APIs have been added to the application, along with Swagger UI, which provides an Explorer.

The Explorer acts as both documentation for the provided REST API, and as a way of testing out the API in the browser.

1. View the Swagger Explorer
   The Swagger Explorer us hosted by the Node.js microservice on /explorer and reachable on the following URL:
   Swagger Explorer: http://localhost:3000/explorer

   Once you open the explore, you will be presented with the Petstore API:

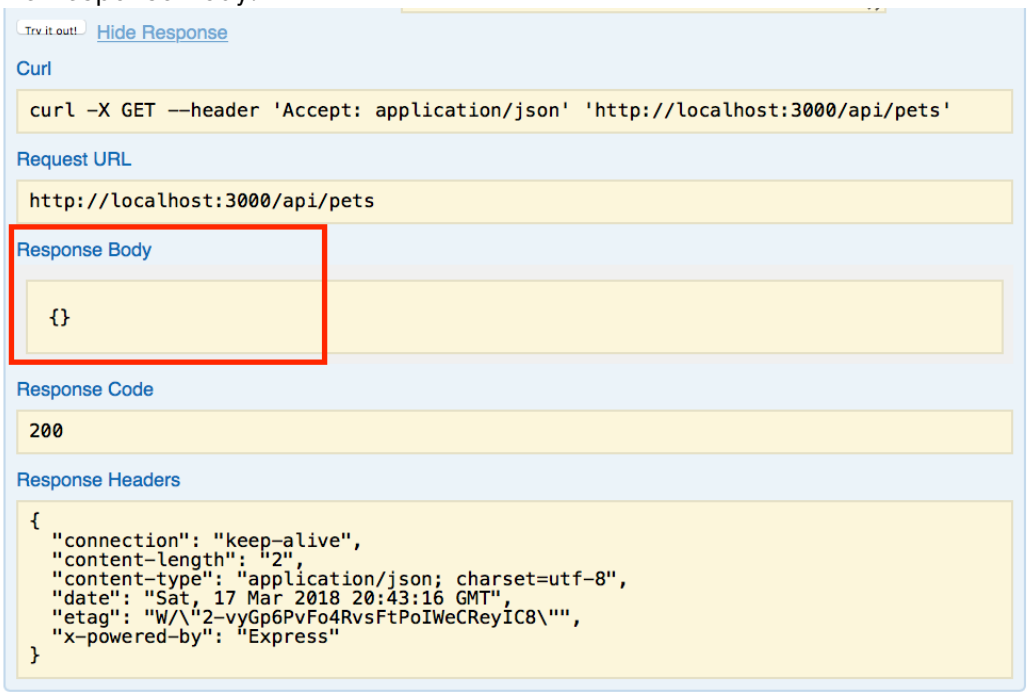


2. Test an API in the Explorer
   As well as showing you the APIs that have been defined, it is possible to use those APIs directly through the Explorer.

   a. Select the GET / pets API
      Selecting one of the APIs expands it to show more information, including any additional information on the API an the types of data it accepts or responds with.

   b. Click the “Try it out!” button
      The explorer also provides boxes to allow you to set up sample data and then a “Try it out!” button to make a request with that data and see the response. As

only the skeleton code is currently implemented, an empty result is returned for the Response Body:



The Swagger Explorer provides an invaluable tool during development, making it easy to incrementally develop and manually test the APIs. It also acts as documentation and testing for developers who need to build their own microservices that use your microservice.

6. View the Node.js Monitoring Dashboard

As part of building the Node.js microservice with either the IBM Cloud App Console or the Nodeserver CLI, an in-built monitoring dashboard has been added to the skeleton project.

This provides resource usage metrics for CPU and memory, as well as performance metrics for a large number of capabilities, including inbound and outbound HTTP and WebSocket requests, and outbound requests made of databases and messaging systems.

The dashboard also provide the ability to request additional data, in the form of function level performance profiling, heap memory usage dumps, and a “node report” that provides a summary of the state of the running application.

1. View the Monitoring Dashboard
   The monitoring dashboard is hosted by the Node.js microservice on /appmetrics-dash and reachable on the following URL
   Monitoring Dashboard: http://localhost:3000/appmetrics-dash

   Once you open the dashboard, it will begin to populate with data.

2. Make some HTTP requests of the Node.js microservice
   Open the the liveness endpoint in a new browser window:
   Liveness endpoint: http://localhost:3000/health

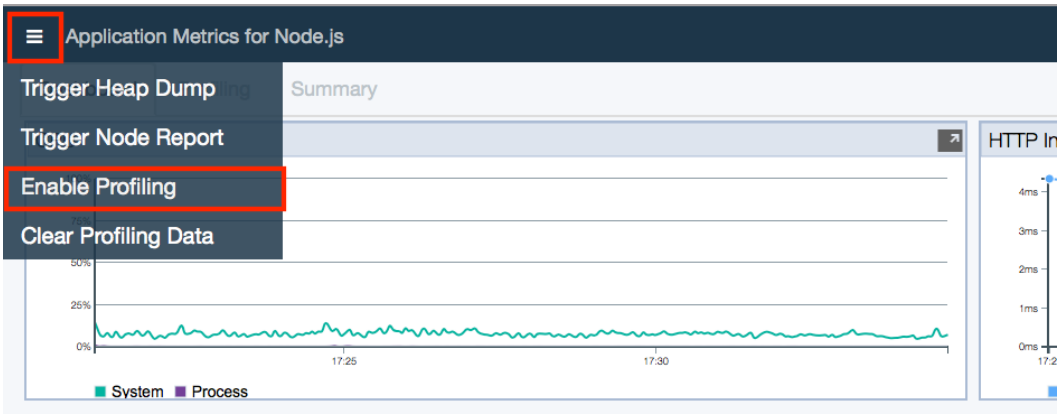
And drive some load by reloading the page using the ⌘+R key shortcut.

These requests will appear in the HTTP Incoming Requests and HTTP Throughput views:

3. Enable and view Performance Profiling
   The monitoring dashboard provides the ability for you to dynamically enable performance profiling, and to view the data using flame graphs.

   a. Enable performance profiling

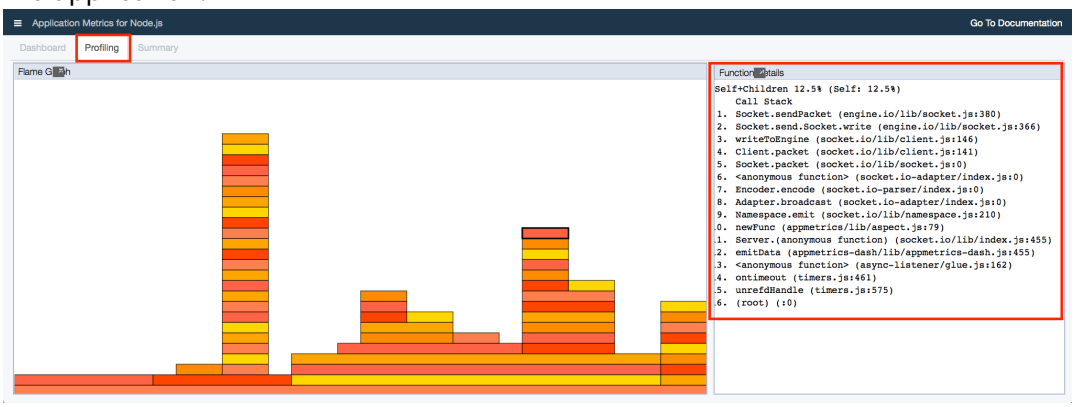
      Use the pulldown menu in the top left hand corner to select Enable Profiling:



      This enables the profiling, and enables the Profiling tab on the dashboard to allow you to view the collected data.

   b. View the profiling data
      Click on the Profiling tab to see a Flame Graph of the functions using CPU time in

the application:



The higher the “flame” the deeper the call stack of functions is. You can select a flame to see its corresponding stack trace in the right hand window.

The wider the cell in the flame, the more time is spent in that function.

The monitoring dashboard also allows you to request heapdumps and node reports, which are written to the local filesystem.

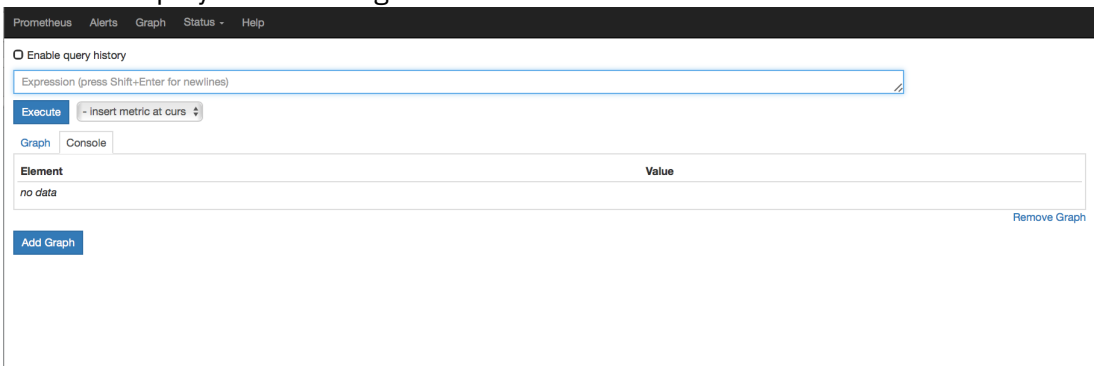
7. View Cloud Metrics in Prometheus

As well as building in the monitoring dashboard, which provides monitoring of the specific instance of the Node.js microservice, hosted by the microservice itself, support for Prometheus monitoring has been built in.

Prometheus is an open source cloud based monitoring solution that collects metrics from running applications and stores them for use in visualization and alerting. The data can be visualized using open source dashboarding technologies such as Graphana, but it also provides its own (simplistic) built-in option.

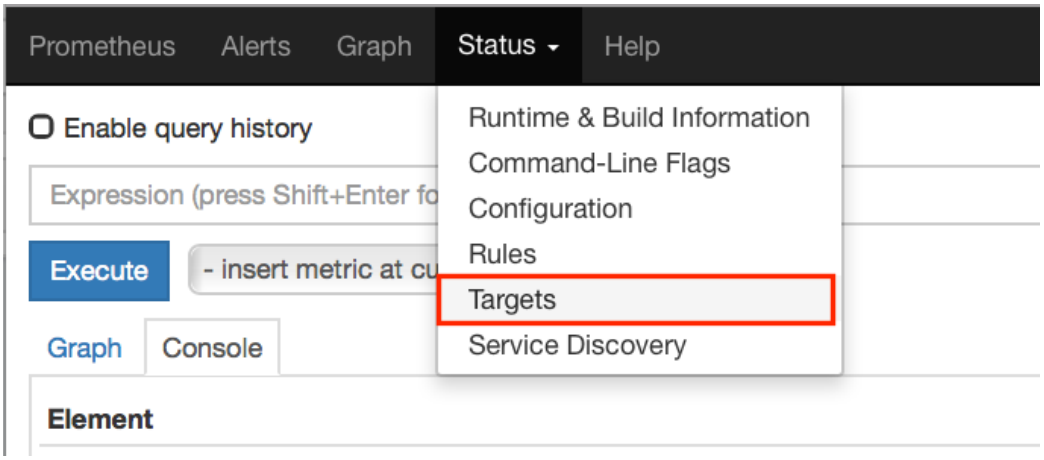
1. View the Prometheus Dashboard
   The Prometheus dashboard is reachable on the following URL
   Prometheus Dashboard: http://localhost:9090/

   This will display the following:

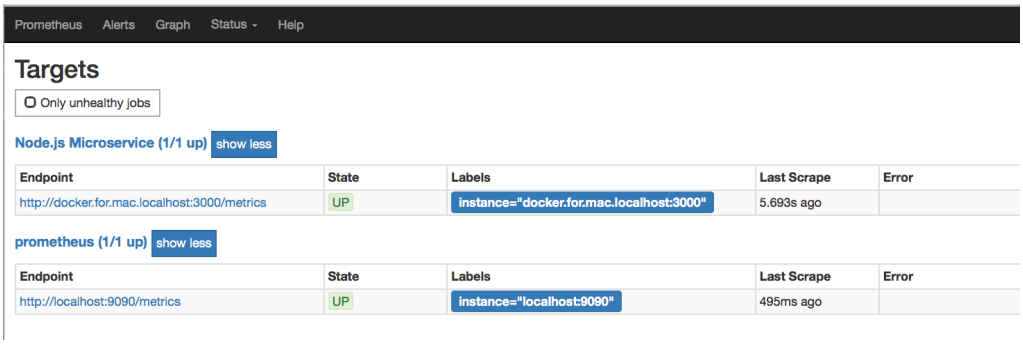


2. See the status of running services
   Prometheus will report the status of all of the services that it is monitoring, reporting whether they are currently UP or DOWN.

a. Select the Status pull down menu and choose Targets



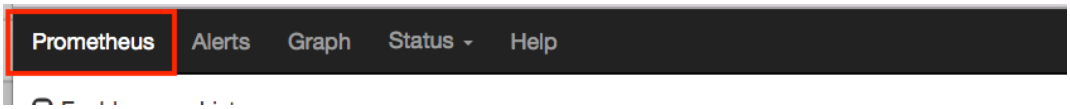
This reports a very limited set because we are only collecting metrics for the Node.js microservice, and the Prometheus service itself.



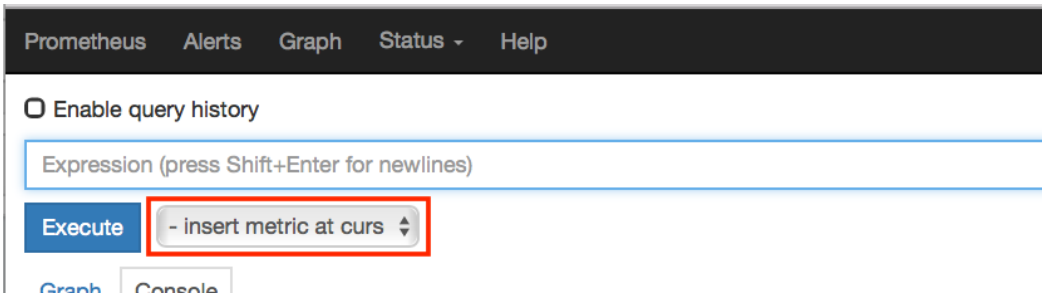
You can also select the "Endpoint" link to see the latest raw data reported from that service

3. View the Node.js microservices metrics
Prometheus provides the ability to run queries and build graphs using the collected data. We can use to this to look at information such as the CPU usage over time, or the responsiveness of HTTP URLs

a. Select the Prometheus tab



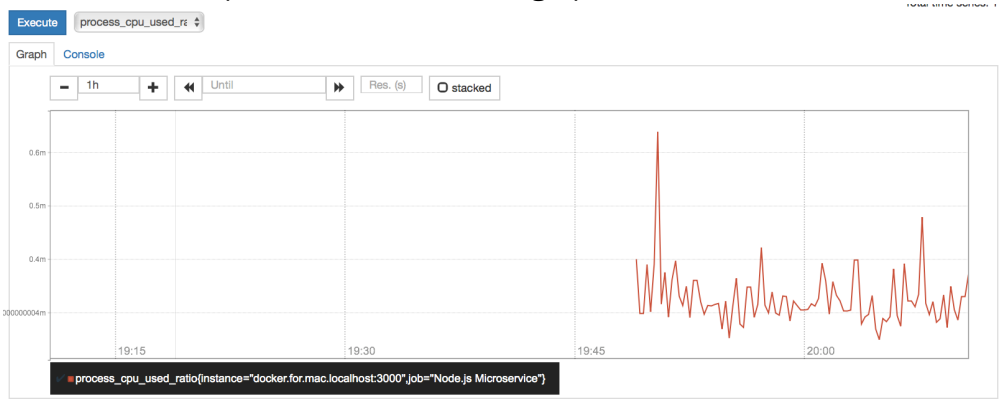
b. From the “insert metric” pull down, select “process_cpu_used_ration”:



The “process_cpu_used_ratio” represents the percentage of the machines CPU that is being used by each of the processes.

c. Click “Execute” to see the data
This will display the data in table form:

Click on the “Graph” tab to see this as a graph over time:



Prometheus has a significantly larger set of capabilities, including setting up alerts. Below is an example of the monitoring that can be built using Prometheus combined with a Graphana custom dashboard;:


Host Metrics
Load Avg. 1m
0.8
State
up
Memory
15.7 GiB
All disks
1007 GiB
Uptime
10.63 week
CPU usage
Disk I/O utilization
Memory usage
Network usage
Filesystem /data usage
Demo Dashboard
Prometheus QPS [rate-5m]
HTTP latency [s]
Memory series count
Prometheus chunk operations [rate-5m]
ADD ROW

7. View Cloud Request Tracking in Zipkin

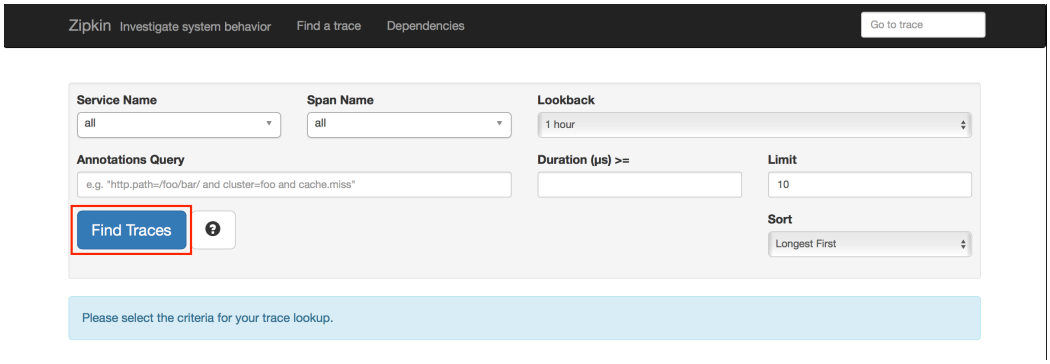
OpenTracing is a standard for how to add request tracking to microservices, with Zipkin as a commonly found implementation of that standard that has been implemented for multiple languages and frameworks.

Whilst the real value of OpenTracing and Zipkin is seen when using multiple microservices, it is important to introduce it into microservices from the beginning where possible. For Node.js it can be added with one line of code, but for other languages and frameworks it needs to be developed into the application.

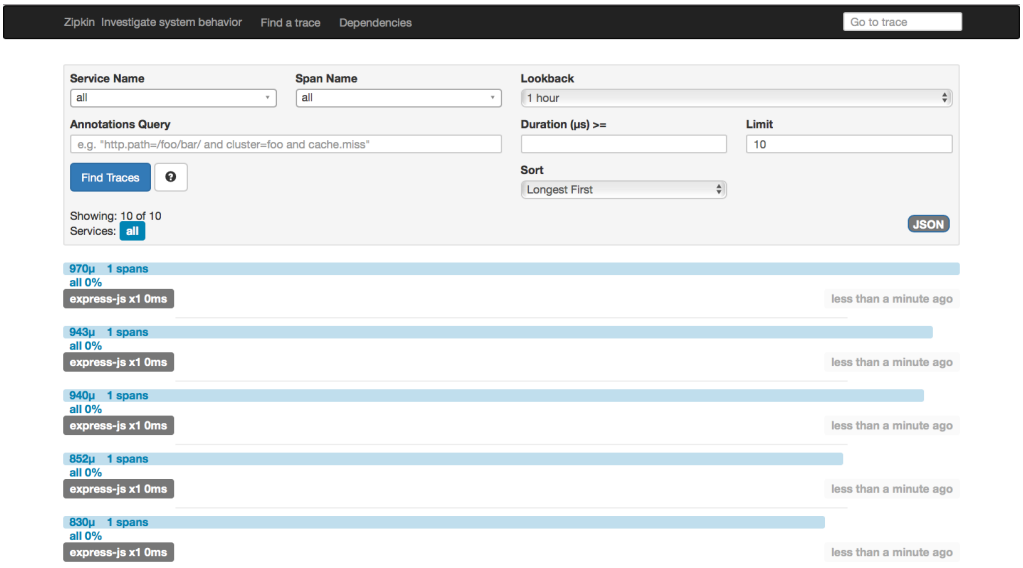
1. View the Zipkin request tracking data
   Zipkin is automatically collecting request tracking "spans" from the Node.js microservice, and the data can be viewed at any time.

   a. Visit the following URL:
   Zipkin Monitoring: http://localhost:9411

   b. Select "Find Traces" to view all of the available Request Tracking spans that Zipkin is aware of.



You should see a number of traces similar to the following:



This shows the duration of each request

If there were other microservices involved, you would see the time spent in each microservice that contributed to the overall elapsed time.

You will be able to see Zipkin being used across multiple microservices in DevZone Quick Lab: Create and Deploy Enterprise-Scale, Multi-Language Microservices

8. Conclusion

Congratulations! You have completed the lab.

You have successfully built and run a Express.js Microservice that is cloud-ready and can be deployed to any cloud supporting Cloud Foundry, Docker or Kubernetes , including IBM Cloud and IBM Cloud Private!

9. Resources

1. IBM Cloud App Service: Build a Node.js app to deploy on Containers to IBM Cloud - https://www.youtube.com/watch?v=1qAjtduM2TY
2. IBM Cloud App Service: http://bluemix.net/developer/appservice
3. IBM Cloud Container Service: https://www.ibm.com/cloud/container-service
4. IBM Cloud Garage Method: https://www.ibm.com/cloud/garage/
5. IBM Cloud Continuous Delivery Service: https://www.ibm.com/cloud/continuous-delivery
6. IBM Cloud DevOps: https://bluemix.net/devops
7. IBM Cloud Developer Tools: https://www.youtube.com/watch?v=z-ByHuI41dU&t=76s
8. IBM DevOps Overview: https://www.youtube.com/watch?v=psiMSUfn9oA
9. Develop a Kubernetes App Toolchain: https://www.ibm.com/cloud/garage/tutorials/use-develop-kubernetes-app-toolchain?task=2
10. IBM Cloud App Service: https://www.youtube.com/watch?v=VBZTwvLkGIk
11. IBM Cloud Developer Tools (IDT): https://console.bluemix.net/docs/cloudnative/idt/index.html
12. Using the IDT: https://www.youtube.com/watch?v=z-ByHuI41dU&t=76s
13. Jump Start Your Microservice Development: https://www.youtube.com/watch?v=1HdtILoL6O4
14. Spring@IBM Developer Center: http://developer.ibm.com/java/spring
15. Node@IBM Developer Center: http://developer.ibm.com/cloud/node

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