Micro Focus and AWS COBOL CI/CD Pipeline Configuration Guide

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Revision History

Date	Author(s)	Version	Comment
2020-03-31	Phil de Valence (Amazon Web Services) Mathias Mezger (Micro Focus) Gary Evans (Micro Focus)	V1.0	First baseline version
2020-05-10		V1.1	Added upload via z/OS FTP server

1 Introduction

1.1 Products Overview

Micro Focus Enterprise Developer for z Systems

Enterprise Developer for z Systems (EDz) supports IBM COBOL, IBM PL/I, IBM Assembler, IBM CICS, IBM IMS, IBM JCL, IBM DB2, IBM z/OS file formats and common batch utilities, including SORT. This means that you can develop and maintain the core mainframe online and batch applications under Enterprise Developer.

EDz gives customers the choice to develop directly on the mainframe or under Windows. Mainframe applications can be developed, maintained and modernized regardless of where they will be deployed, either back onto the mainframe or onto an alternative server environment. Support is provided for both the Visual Studio and Eclipse-based IDEs and for all the development and test tools for every target environment currently supported by Micro Focus - including z/Linux, AIX and x86 environments.

Micro Focus Enterprise Test Server

Enterprise Test Server (ETS) is a test execution environment that allows you to test mainframe applications on a lower cost Windows platform. You can use variables or the tilde syntax to relieve the mainframe test bottleneck by allowing you to perform a substantial part of your application testing on Windows prior to moving the application back to the mainframe for final pre-production testing and deployment.

ETS supports IBM COBOL, High Level Assembler, CICS, IMS TM and DB, JCL, DB2, and z/OS file formats. It also supports common batch utilities such as SORT. This means that applications running under ETS behave just as they would on the mainframe, so you can perform a wide variety of pre-production testing activities on low-cost hardware rather than on the mainframe.

AWS CodeCommit

AWS CodeCommit is a fully-managed source control service that hosts secure Git-based repositories. It makes it easy for teams to collaborate on code in a secure and highly scalable ecosystem. CodeCommit eliminates the need to operate your own source control system or worry about scaling its infrastructure. You can use CodeCommit to securely store anything from source code to binaries, and it works seamlessly with your existing Git tools.

AWS CodeCommit eliminates the need to host, maintain, back up, and scale your own source control servers. The service automatically scales to meet the growing needs of your project. It has a highly scalable, redundant, and durable architecture. The service is designed to keep your repositories highly available and accessible.

AWS CodePipeline

AWS CodePipeline automates your software release process, allowing you to rapidly release new features to your users. With CodePipeline, you can quickly iterate on feedback and get new features to your users faster.

Automating your build, test, and release process allows you to quickly and easily test each code change and catch bugs while they are small and simple to fix. You can ensure the quality of your application or infrastructure code by running each change through your staging and release process.

With AWS CodePipeline, you can immediately begin to model your software release process. There are no servers to provision or set up. CodePipeline is a fully managed continuous delivery service that connects to your existing tools and systems.

AWS CodeBuild

AWS CodeBuild is a fully managed continuous integration service that compiles source code, runs tests, and produces software packages that are ready to deploy. With CodeBuild, you don’t need to provision, manage, and scale your own build servers. CodeBuild scales continuously and processes multiple builds concurrently, so your builds are not left waiting in a queue. You can get started quickly by using prepackaged build environments, or you can create custom build environments that use your own build tools. With CodeBuild, you are charged by the minute for the compute resources you use.

AWS CodeDeploy

AWS CodeDeploy is a fully managed deployment service that automates software deployments to a variety of compute services such as Amazon EC2, AWS Fargate, AWS Lambda, and your on-premises servers. AWS CodeDeploy makes it easier for you to rapidly release new features, helps you avoid downtime during application deployment, and handles the complexity of updating your applications. You can use AWS CodeDeploy to automate software deployments, eliminating the need for error-prone manual operations. The service scales to match your deployment needs.

AWS Lambda

AWS Lambda lets you run code without provisioning or managing servers (serverless). You pay only for the compute time you consume. With Lambda, you can run code for virtually any type of application or backend service - all with zero administration. Just upload your code and Lambda takes care of everything required to run and scale your code with high availability. You can set up your code to automatically trigger from other AWS services or call it directly from any web or mobile app.

1.2 Documentation

Micro Focus Enterprise Developer 5.0 for Eclipse documentation:

https://www.microfocus.com/documentation/enterprise-developer/ed50/ED-Eclipse/GUID-8D6B7358-AC35-4DAF-A445-607D8D97EBB2.html

Micro Focus Enterprise Test Server 5.0 documentation:

https://www.microfocus.com/documentation/enterprise-developer/ed50/ETS-help/GUID-ECA56693-D9FE-4590-8798-133257BFEBE7.html

AWS CodeCommit documentation:

https://docs.aws.amazon.com/codecommit/latest/userguide/welcome.html

AWS CodeBuild documentation:

https://docs.aws.amazon.com/codebuild/latest/userguide/welcome.html

AWS CodeDeploy documentation:

https://docs.aws.amazon.com/codedeploy/latest/userguide/welcome.html

AWS CodePipeline documentation:

https://docs.aws.amazon.com/codepipeline/latest/userguide/welcome.html

AWS Lambda documentation:

https://docs.aws.amazon.com/lambda/latest/dg/welcome.html

AWS Systems Manager documentation:

https://docs.aws.amazon.com/systems-manager/latest/userguide/what-is-systems-manager.html

1.3 CI/CD pipeline description

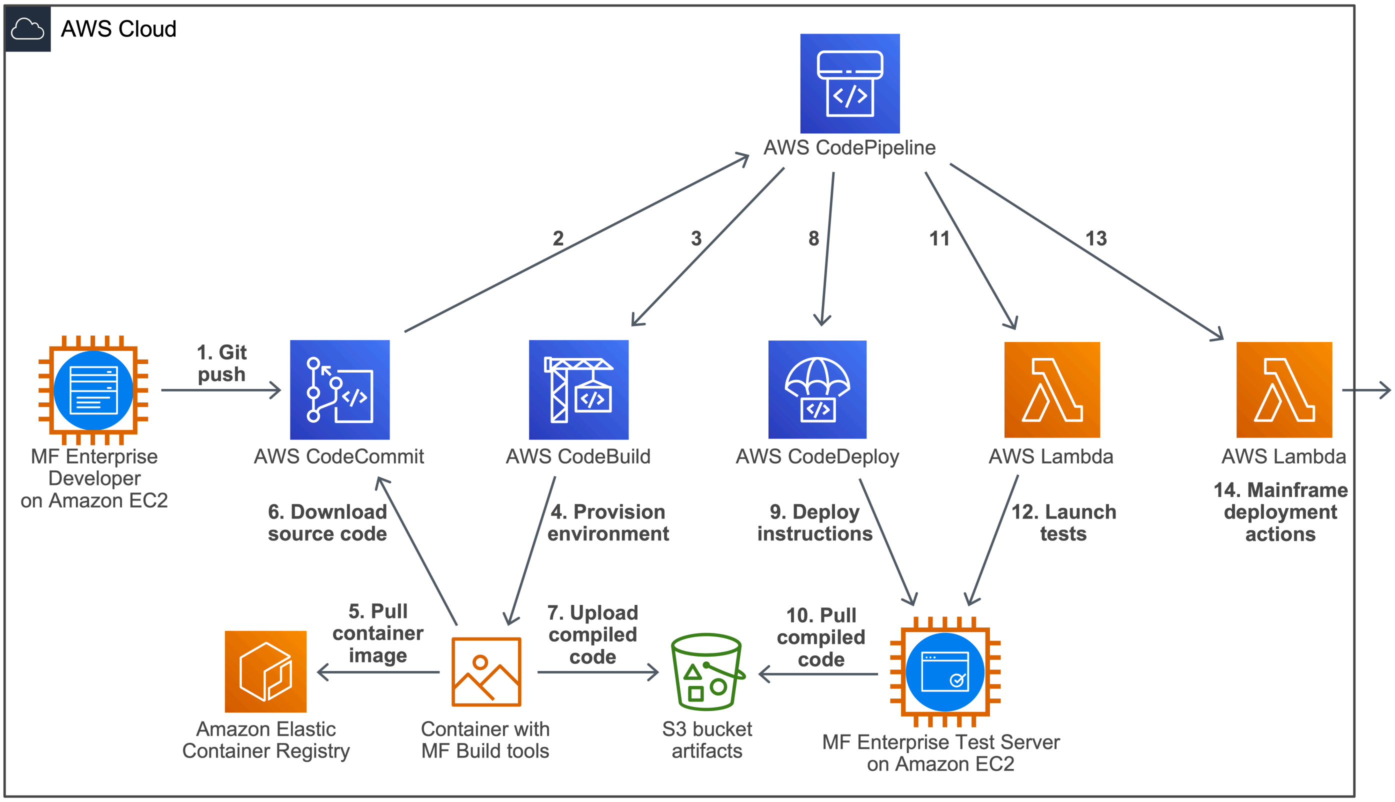
This document describes how to configure a COBOL Continuous Integration / Continuous Delivery (CI/CD) pipeline using Micro Focus (MF) and Amazon Web Services (AWS) components.

You can learn more about the pipeline incremental approach and components in this blog post:

https://aws.amazon.com/blogs/industries/enable-agile-mainframe-development-test-and-ci-cd-with-aws-and-micro-focus/

This pipeline is modular. This means you can swap some of the tools and you can decide to configure one stage but not the others.

The pipeline includes Micro Focus Enterprise Developer (MF EDz), Micro Focus Enterprise Test Server (MF ETS).



The CI/CD pipeline shown above executes the following steps:

1. A developer makes changes to the source code and commits the changes to the local Git repository. These source code changes are pushed to the upstream repository hosted by AWS CodeCommit.
2. The source code changes in CodeCommit trigger an AWS CloudWatch event which starts the pipeline in AWS CodePipeline.
3. The pipeline calls AWS CodeBuild in order to start the build phase.
4. AWS CodeBuild provisions a build environment in a container with Micro Focus Enterprise Developer Build tools.
5. This container is based on a container image pulled from Amazon Container Registry.
6. Once the container is provisioned, the build environments download the source code from AWS CodeCommit. The source code is compiled and linked.
7. Then the compiled code is uploaded in an Amazon S3 buckets which stores the generated build artifacts.
8. The build phase being complete, the pipeline calls AWS CodeDeploy as part of the test phase.
9. AWS CodeDeploy send code deployment instructions to the CodeDeploy agent residing on the Amazon EC2 instance hosting Micro Focus Enterprise Test Server.
10. The AWS CodeDeploy agent pulls the compiled code from the S3 bucket with the artifacts and deploys it to the proper destination folders and restarts Micro Focus Enterprise Test Server.
11. Once the code is deployed, the pipeline calls AWS Lambda to start the tests.
12. AWS Lambda sends the test command to the Amazon EC2 test instance via Amazon Systems Manager (SSM). The test command triggers a batch test script on the test instance. The batch test script calls a Visual Basic script with can either trigger a Rumba or a UFT automation script. The test script executes test cases against the modified compiled code and Micro Focus Enterprise Test Server verifying the new code is operational. The result of the tests is sent back to the pipeline in AWS CodePipeline.

13. If tests are successful, the pipeline calls AWS Lambda in order to send the source code back to the mainframe Source Code Management (SCM) system.
14. The AWS Lambda function retrieves the code changes from AWS Code Commit, and processes the modified files for deploying to production. We show one option for deploying with z/OS FTP server.

1.4 Configuration samples

In order to facilitate the configuration of this pipeline, we have made available some reusable sample configuration files on GitHub: https://github.com/aws-samples/mainframe-cobol-cicd-pipeline-aws-microfocus

For example, you will find the Lambda functions and the CodeBuild or CodeDeploy configuration files on GitHub.

1.5 Feedback

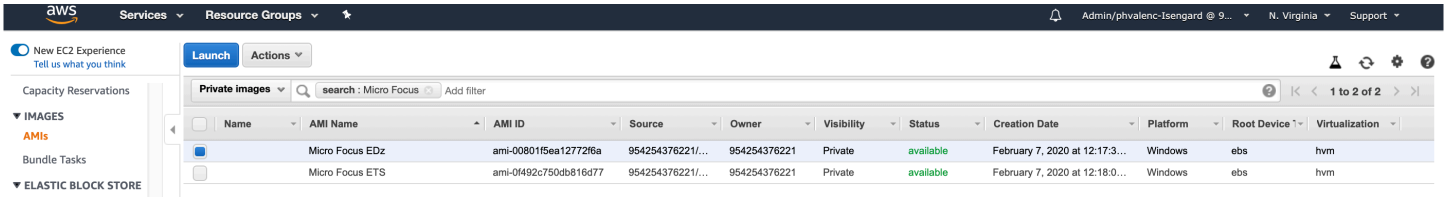
We are glad to improve this pipeline, the configuration samples, and this documentation. If you have comments, suggestions, or challenges, feel free to let us know and we will be glad to help. You can contact us via your AWS representative, your Micro Focus representative, or by opening an issue on GitHub: https://github.com/aws-samples/mainframe-cobol-cicd-pipeline-aws-microfocus/issues

2 Development environment

2.1 DEV – MF EDz configuration for Bankdemo

For getting access to Micro Focus software, please contact your Micro Focus representative or contact Micro Focus following this link: https://www.microfocus.com/en-us/contact/contactme

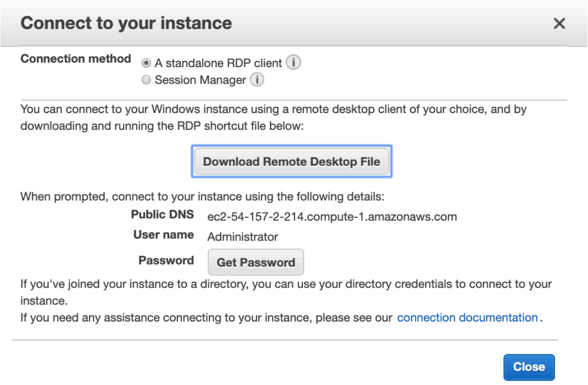
First you need to retrieve an AMI with Micro Focus Enterprise Developer (EDz) or deploy the EDz software on an EC2 instance.



	Name	AMI Name	AMI ID	Source	Owner	Visibility	Status	Creation Date	Platform	Root Device	Virtualization
☑		Micro Focus EDz	ami-00801f5ea12772f6a	954254376221/...	954254376221	Private	available	February 7, 2020 at 12:17:3...	Windows	ebs	hvm
□		Micro Focus ETS	ami-0f492c750db816d77	954254376221/...	954254376221	Private	available	February 7, 2020 at 12:18:0...	Windows	ebs	hvm

If you retrieve Micro Focus software from an AMI, launch EC2 instance from Micro Focus EDz AMI.

Once started, choose to Connect to the instance.



Connect to your instance

Connection method ● A standalone RDP client ○ Session Manager

You can connect to your Windows instance using a remote desktop client of your choice, and by downloading and running the RDP shortcut file below:

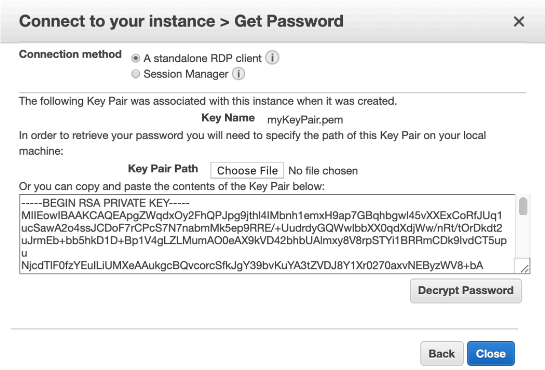
When prompted, connect to your instance using the following details:

Public DNS	ec2-54-157-2-214.compute-1.amazonaws.com
User name	Administrator
Password	Get Password

If you've joined your instance to a directory, you can use your directory credentials to connect to your instance.

If you need any assistance connecting to your instance, please see our connection documentation.

Download Remote Desktop File and Get Password



Connect to your instance > Get Password

Connection method ● A standalone RDP client ○ Session Manager

The following Key Pair was associated with this instance when it was created.

Key Name myKeyPair.pem

In order to retrieve your password you will need to specify the path of this Key Pair on your local machine:

Key Pair Path Choose File No file chosen

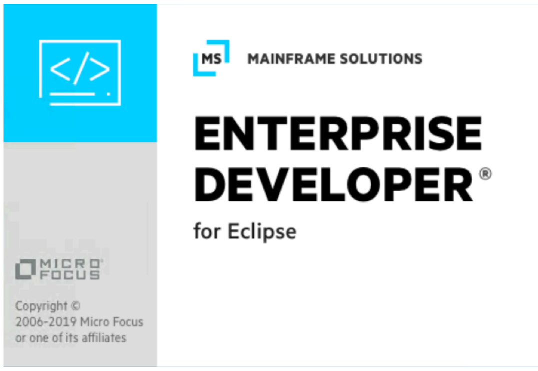
Or you can copy and paste the contents of the Key Pair below:

```
-----BEGIN RSA PRIVATE KEY-----
MIIEowIBAAKCAQEApgZWqdxOy2FhQPJpg9jthl4IMbnh1emxH9ap7GBqhbgwl45vXXExCoRfJUq1
ucSawA2o4ssJCDoF7rCPcS7N7nabmMk5ep9RRE/+UudrdyGQWwlbbXX0qdXdjWw/nRt/tOrDkdt2
uJrmEb+bb5hkD1D+Bp1V4gLZLMumAO0eAX9kVD42bhbUAlmxy8V8rpSTYi1BRRmCDk9lvdCT5up
u
NjcdTlF0fzYEulLiUMXeAAukgcBQvcorcSfkJgY39bvKuYA3tZVDJ8Y1Xr0270axvNEByzWV8+bA
```

Decrypt password.

Open RDP file and connect to instance with Administrator username and decrypted password.

Start Enterprise Developer for Eclipse



MS MAINFRAME SOLUTIONS

ENTERPRISE DEVELOPER®

for Eclipse

MICRO FOCUS

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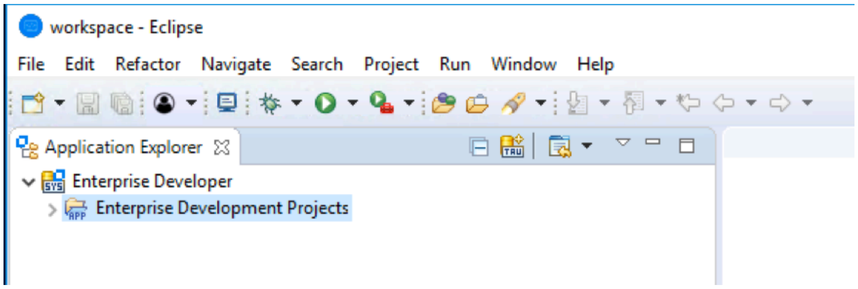
Go to Application Explorer view

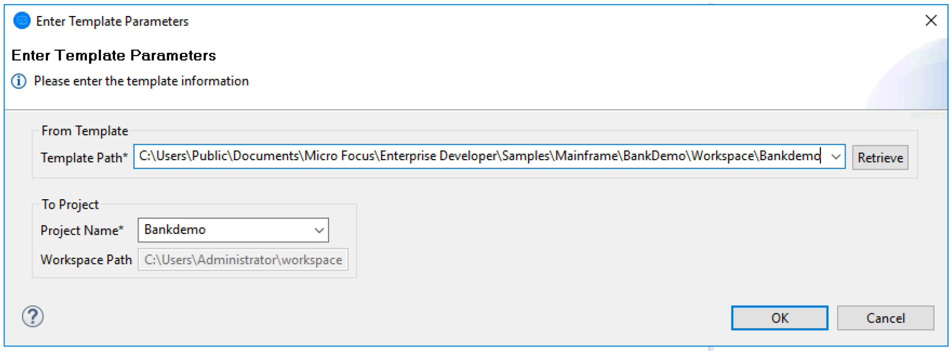


Right-click Enterprise Development Projects, which is the node for the standard application.

Click New Project from Template.

You can find more details for help at this link:

https://www.microfocus.com/documentation/enterprise-developer/ed50/ED-Eclipse/GUID-5A27996B-F03D-471A-ACDF-36E680E5939E.html



Enter Template Parameters

Enter Template Parameters

Please enter the template information

From Template

Template Path* C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\Workspace\Bankdemo

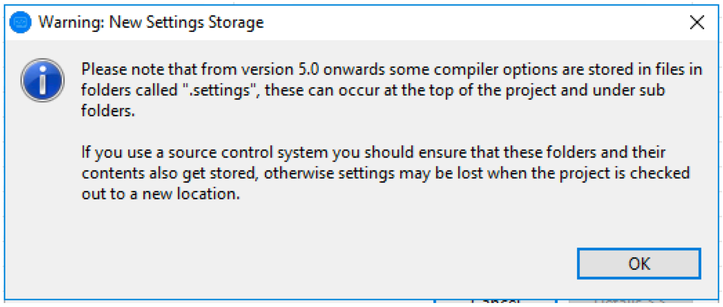
To Project

Project Name* Bankdemo

Workspace Path C:\Users\Administrator\workspace

Browse to the C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\Workspace\Bankdemo and click Select Folder.

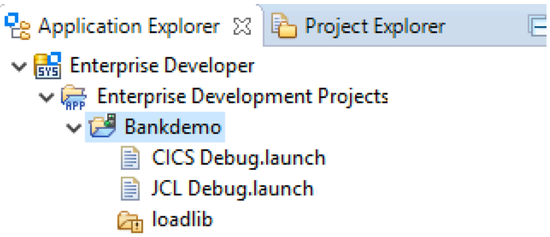
Type Bankdemo in the project name field and click OK.


Warning: New Settings Storage

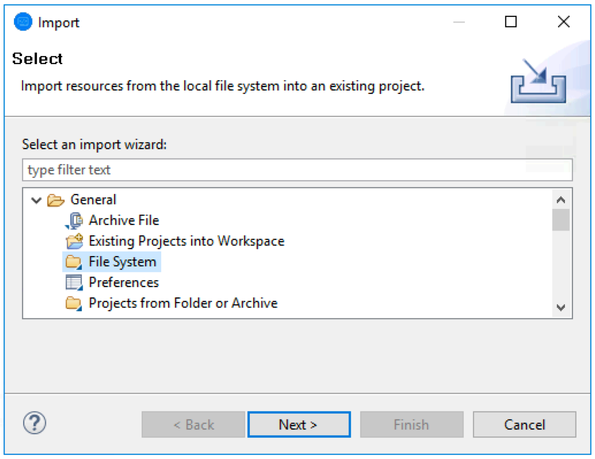
Please note that from version 5.0 onwards some compiler options are stored in files in folders called ".settings", these can occur at the top of the project and under sub folders.

If you use a source control system you should ensure that these folders and their contents also get stored, otherwise settings may be lost when the project is checked out to a new location.

This creates a copy of the Bankdemo project in your Eclipse workspace and adds the project to the application in the Application Explorer view. If the Bankdemo project entry is not displayed in the tree view, refresh the Enterprise Development Projects entry.



Add the demo source files, in Application Explorer view, right-click the Bankdemo project, and click Import…

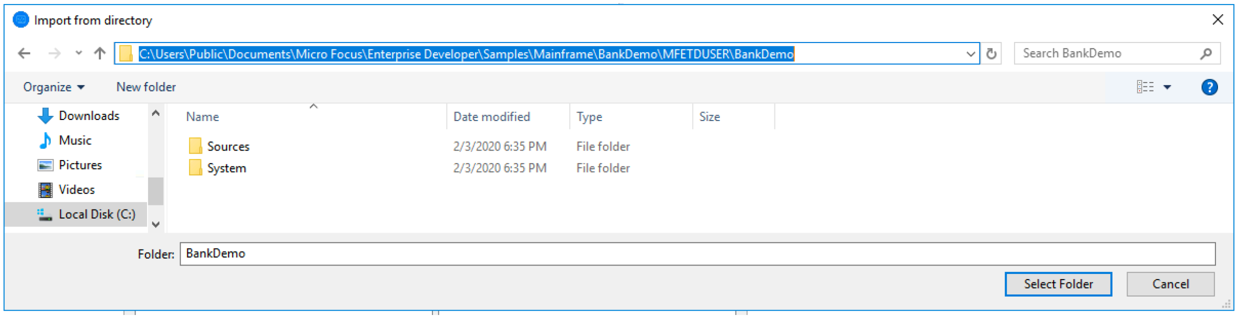

Import

Select

Import resources from the local file system into an existing project.

Select an import wizard:

Next

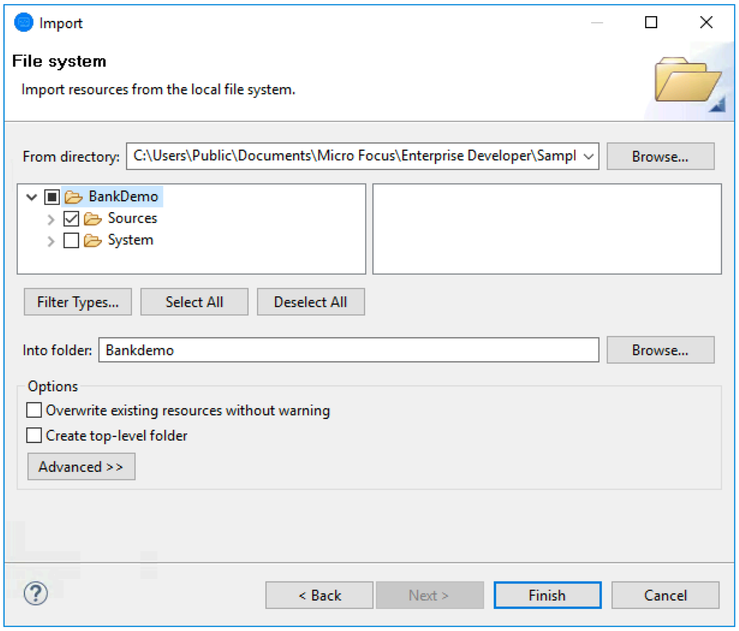

Import from directory

C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo

Name	Date modified	Type	Size
Sources	2/3/2020 6:35 PM	File folder	
System	2/3/2020 6:35 PM	File folder	

Folder: BankDemo

Select folder C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo



Import

File system

Import resources from the local file system.

From directory: C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Sampl

- ■ BankDemo
  - ☑ Sources
  - □ System

Into folder: Bankdemo

Options

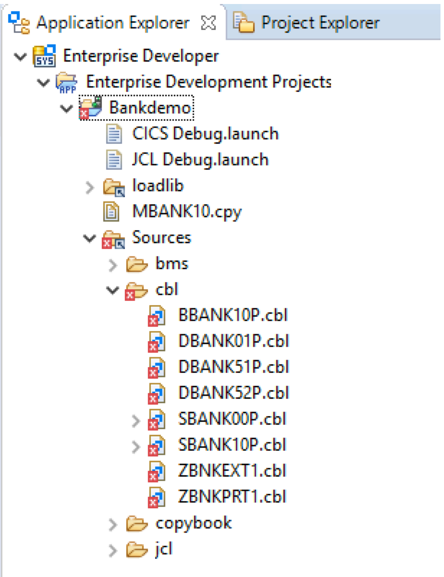
□ Overwrite existing resources without warning

□ Create top-level folder

Select Source subdirectory.

Click Finish.

This adds the folders storing the source files to your project as imported resources:



- Enterprise Developer
  - Enterprise Development Projects
    - Bankdemo
      - CICS Debug.launch
      - JCL Debug.launch
      - loadlib
      - MBANK10.cpy
      - Sources
        - bms
        - cbl
          - BBANK10P.cbl
          - DBANK01P.cbl
          - DBANK51P.cbl
          - DBANK52P.cbl
          - SBANK00P.cbl
          - SBANK10P.cbl
          - ZBNKEXT1.cbl
          - ZBNKPRT1.cbl
        - copybook
        - jcl

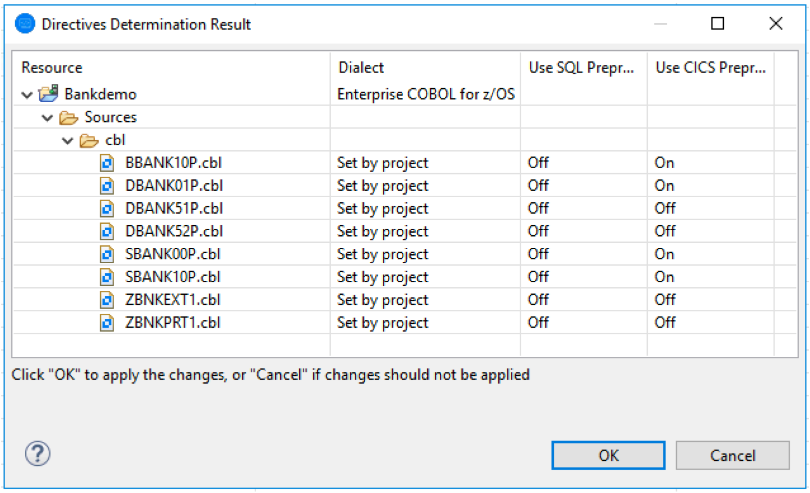
By default, Eclipse is set to build projects automatically (see Project > Build Automatically), so it immediately compiles the files you have just added.

Check the Console and Problems views and see that some of the programs failed to compile. In Application Explorer view, you can select a program and check the error and warning count property in the Properties view to indicate that there are compilation problems.

The errors are due to the correct copybook paths not being specified in the project properties.

Right-click Bankdemo and click Determine Directives.

The IDE performs a scan of the files and shows a report of what directives for dialect and for CICS must be set on the programs in your project in order for them to compile cleanly.



Resource	Dialect	Use SQL Prepr...	Use CICS Prepr...
Bankdemo	Enterprise COBOL for z/OS		
Sources			
cbl			
BBANK10P.cbl	Set by project	Off	On
DBANK01P.cbl	Set by project	Off	On
DBANK51P.cbl	Set by project	Off	Off
DBANK52P.cbl	Set by project	Off	Off
SBANK00P.cbl	Set by project	Off	On
SBANK10P.cbl	Set by project	Off	On
ZBNKEXT1.cbl	Set by project	Off	Off
ZBNKPRT1.cbl	Set by project	Off	Off

Click "OK" to apply the changes, or "Cancel" if changes should not be applied

Click OK to set the directives.

If you are prompted to delete some user files, choose No.

Setting the missing Compiler directives triggers a full rebuild of the project. There are still some errors in the COBOL sources due to the fact that the project cannot resolve the paths to the copybook files.

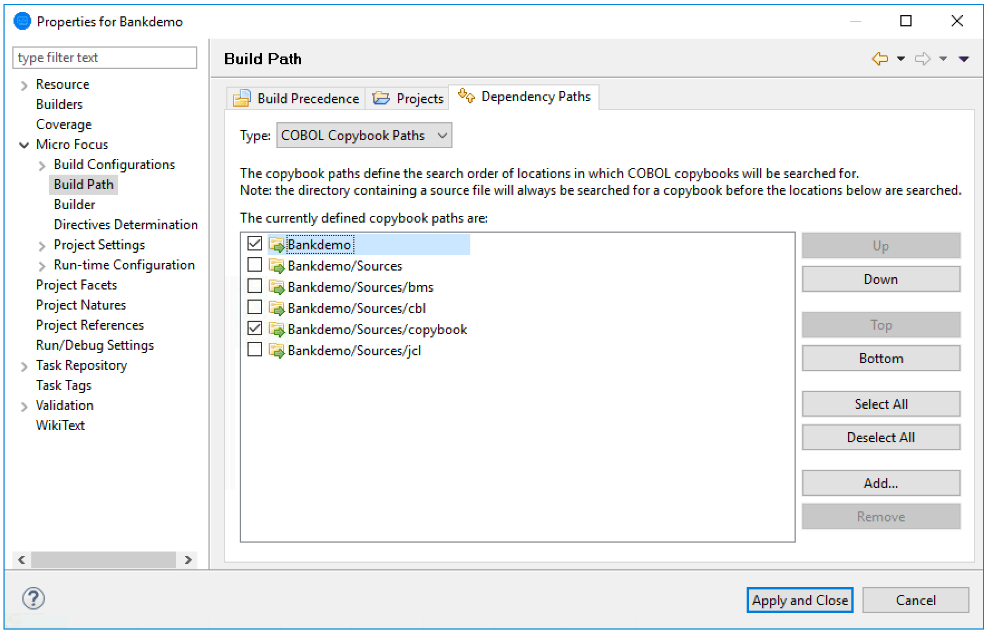
Then we specify the copybook paths for the project.

In Application Explorer view, right-click the Bankdemo project, and click Properties.

Expand Micro Focus, and then click Build Path.

Click the Dependency Paths tab and ensure Type is set to COBOL Copybook Paths.

Check the Bankdemo/Sources/copybook entry in the list, and then click Apply and Close.



Properties for Bankdemo

- Resource
- Builders
- Coverage
- Micro Focus
  - Build Configurations
  - Build Path
  - Builder
  - Directives Determination
  - Project Settings
  - Run-time Configuration
- Project Facets
- Project Natures
- Project References
- Run/Debug Settings
- Task Repository
- Task Tags
- Validation
- WikiText

Build Path

Build Precedence | Projects | Dependency Paths

Type: COBOL Copybook Paths

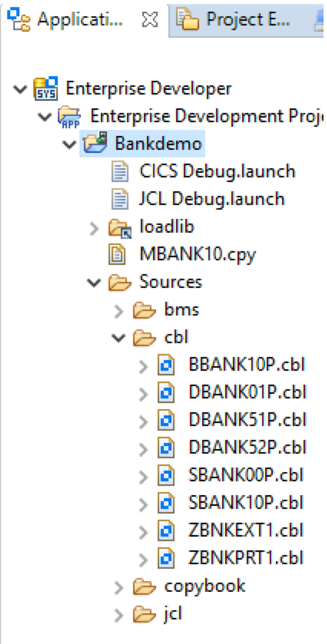
The copybook paths define the search order of locations in which COBOL copybooks will be searched for.
Note: the directory containing a source file will always be searched for a copybook before the locations below are searched.

The currently defined copybook paths are:

- ☑ Bankdemo
- ☐ Bankdemo/Sources
- ☐ Bankdemo/Sources/bms
- ☐ Bankdemo/Sources/cbl
- ☑ Bankdemo/Sources/copybook
- ☐ Bankdemo/Sources/jcl

Eclipse rebuilds the project and now all COBOL programs should compile cleanly.

```
BUILD SUCCESSFUL
Build finished with no errors.

Total time: 3 seconds
-------------------------------BUILD FINISHED------------------------------
```



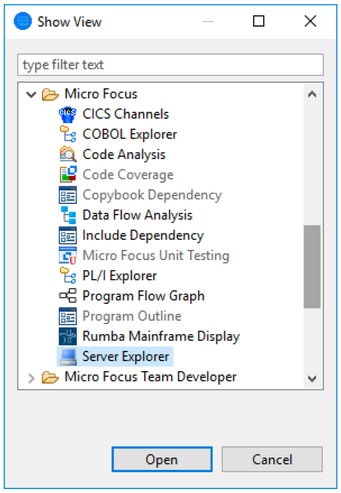
- Enterprise Developer
  - Enterprise Development Proj
    - Bankdemo
      - CICS Debug.launch
      - JCL Debug.launch
      - loadlib
      - MBANK10.cpy
      - Sources
        - bms
        - cbl
          - BBANK10P.cbl
          - DBANK01P.cbl
          - DBANK51P.cbl
          - DBANK52P.cbl
          - SBANK00P.cbl
          - SBANK10P.cbl
          - ZBNKEXT1.cbl
          - ZBNKPRT1.cbl
        - copybook
        - jcl

2.2 DEV – MF EDz configuration for Bankdemo unit test server

You can find more details for help at this link:

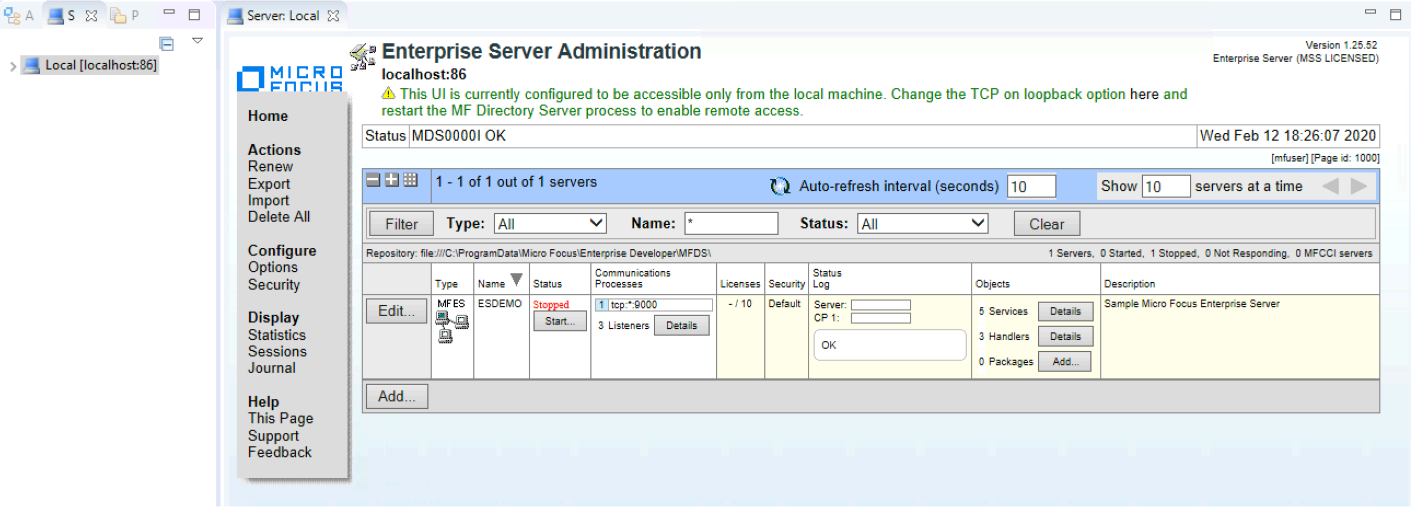
https://www.microfocus.com/documentation/enterprise-developer/ed50/ED-Eclipse/GUID-CA516B8B-0435-426B-859F-DBFF8026B813.html

Click the Server Explorer tab. If the tab is not visible, click Window > Show View > Other. Select Micro Focus > Server Explorer and then click Open.



First, we import the Bankdemo server.

In Server Explorer, right-click Local [localhost:86] and click Open Administration Page.



Enterprise Server Administration

localhost:86

Version 1.25.52
Enterprise Server (MSS LICENSED)

⚠ This UI is currently configured to be accessible only from the local machine. Change the TCP on loopback option here and restart the MF Directory Server process to enable remote access.

Status MDS0000I OK   Wed Feb 12 18:26:07 2020

[mfuser] [Page id: 1000]

1 - 1 of 1 out of 1 servers   Auto-refresh interval (seconds) 10   Show 10 servers at a time

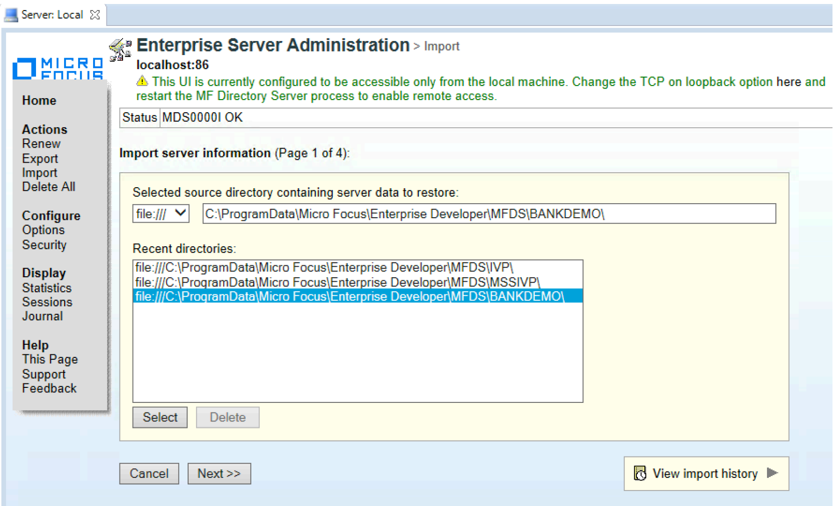
Filter   Type: All   Name: *   Status: All   Clear

Repository: file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\   1 Servers, 0 Started, 1 Stopped, 0 Not Responding, 0 MFCCI servers

	Type	Name	Status	Communications Processes	Licenses	Security	Status Log	Objects	Description
Edit...	MFES	ESDEMO	Stopped Start...	1 tcp:*:9000 3 Listeners Details	- / 10	Default	Server: CP 1: OK	5 Services Details 3 Handlers Details 0 Packages Add...	Sample Micro Focus Enterprise Server
Add...									

Click Import in the left upper corner of Enterprise Server Administration.

On the Import server information page and under Recent directories click the directory for the BANKDEMO server.



Enterprise Server Administration > Import

localhost:86

⚠ This UI is currently configured to be accessible only from the local machine. Change the TCP on loopback option here and restart the MF Directory Server process to enable remote access.

Status MDS0000I OK

Import server information (Page 1 of 4):

Selected source directory containing server data to restore:

file:/// C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\BANKDEMO\

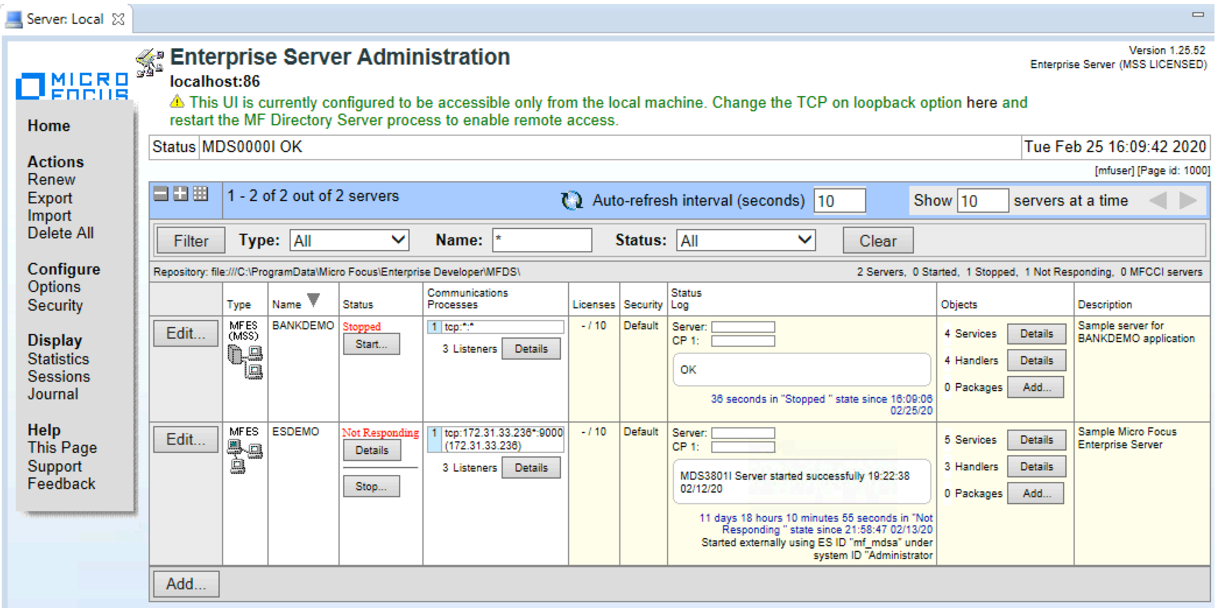
Recent directories:

file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\IVP\
file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\MSSIVP\
file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\BANKDEMO\

This adds the path to the Selected source directory containing server data to restore field.

Click Next 3 times and then OK to import the BankDemo server (keep the BankDemo server in 32 bit).

The system returns to the main Enterprise Server Administration page.



Enterprise Server Administration

Version 1.25.52
Enterprise Server (MSS LICENSED)

localhost:86

⚠ This UI is currently configured to be accessible only from the local machine. Change the TCP on loopback option here and restart the MF Directory Server process to enable remote access.

Status MDS0000I OK — Tue Feb 25 16:09:42 2020

[mfuser] [Page id: 1000]

1 - 2 of 2 out of 2 servers — Auto-refresh interval (seconds) 10 — Show 10 servers at a time

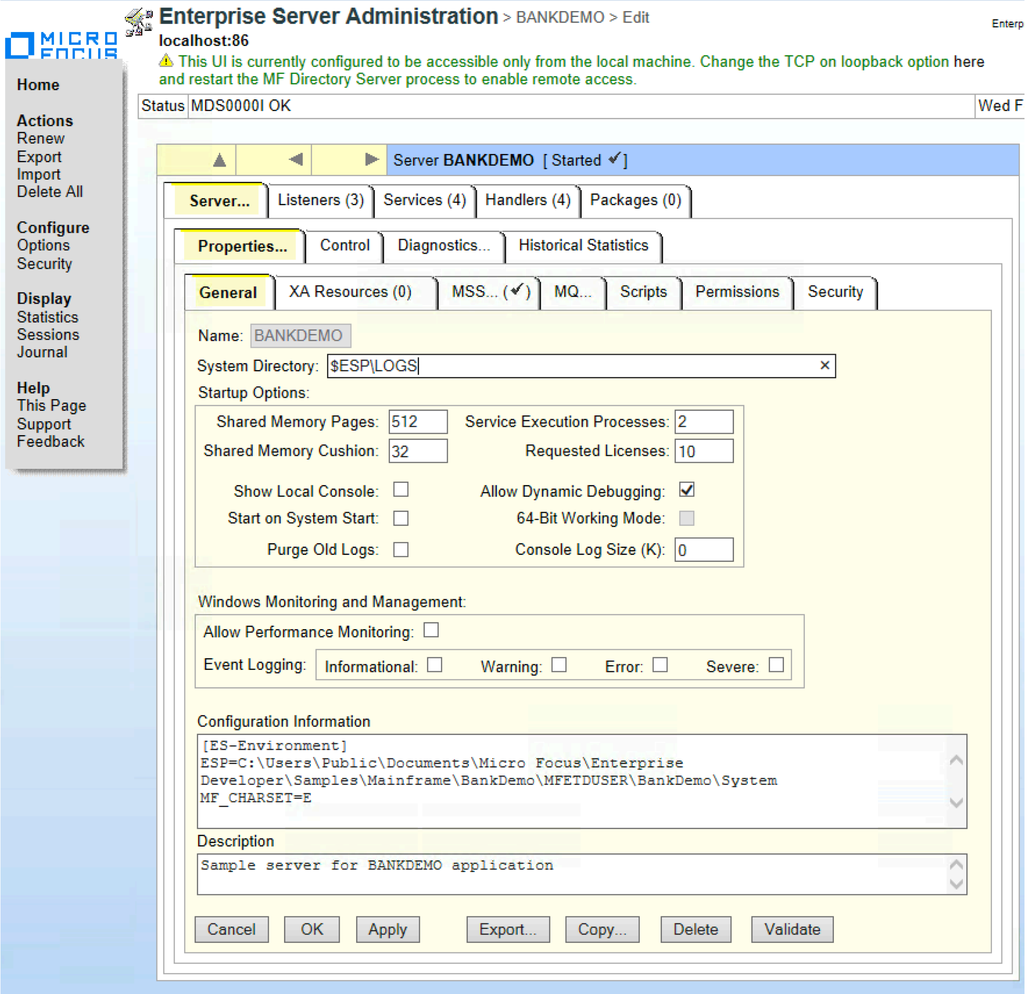
Filter Type: All Name: * Status: All Clear

Repository: file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\ — 2 Servers, 0 Started, 1 Stopped, 1 Not Responding, 0 MFCCI servers

	Type	Name	Status	Communications Processes	Licenses	Security	Status Log	Objects	Description
Edit...	MFES (MSS)	BANKDEMO	Stopped Start...	1 tcp:*:* 3 Listeners Details	- / 10	Default	Server: CP 1: OK 36 seconds in "Stopped " state since 16:09:06 02/25/20	4 Services Details 4 Handlers Details 0 Packages Add...	Sample server for BANKDEMO application
Edit...	MFES	ESDEMO	Not Responding Details Stop...	1 tcp:172.31.33.236*:9000 (172.31.33.236) 3 Listeners Details	- / 10	Default	Server: CP 1: MDS3801I Server started successfully 19:22:38 02/12/20 11 days 18 hours 10 minutes 55 seconds in "Not Responding " state since 21:58:47 02/13/20 Started externally using ES ID "mf_mdsa" under system ID "Administrator	5 Services Details 3 Handlers Details 0 Packages Add...	Sample Micro Focus Enterprise Server

You can see the Bankdemo server appears in the list of servers.

In front of the BANKDEMO server, select Edit…



Enterprise Server Administration > BANKDEMO > Edit

localhost:86

⚠ This UI is currently configured to be accessible only from the local machine. Change the TCP on loopback option here and restart the MF Directory Server process to enable remote access.

Status MDS0000I OK | Wed F

Server BANKDEMO [Started ✓]

Name: BANKDEMO

System Directory: $ESP\LOGS

Startup Options:

Shared Memory Pages:	512	Service Execution Processes:	2
Shared Memory Cushion:	32	Requested Licenses:	10
Show Local Console:	☐	Allow Dynamic Debugging:	☑
Start on System Start:	☐	64-Bit Working Mode:	☐
Purge Old Logs:	☐	Console Log Size (K):	0

Windows Monitoring and Management:

Allow Performance Monitoring: ☐

Event Logging: Informational: ☐ Warning: ☐ Error: ☐ Severe: ☐

Configuration Information

```
[ES-Environment]
ESP=C:\Users\Public\Documents\Micro Focus\Enterprise
Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo\System
MF_CHARSET=E
```

Description

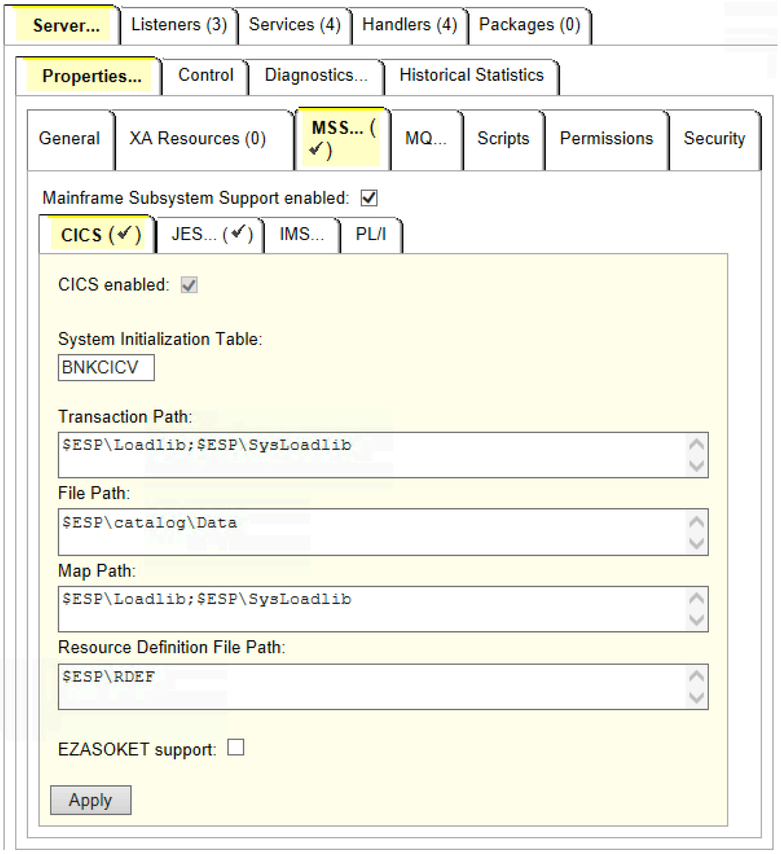
```
Sample server for BANKDEMO application
```

Under Configuration Information, update the ESP variable path to the actual location on EDz:

```
ESP=C:\Users\Public\Documents\Micro Focus\Enterprise
Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo\System
```

Click OK to save.

Make sure the CICS paths for SysLoadlib configuration match the file system.



Mainframe Subsystem Support enabled: ☑

CICS enabled: ☑

System Initialization Table:
BNKCICV

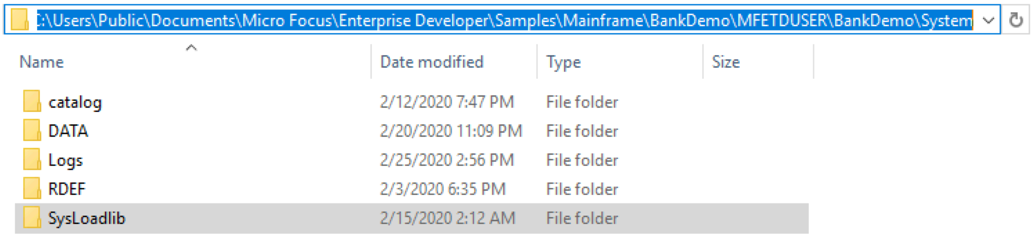
Transaction Path:
```
$ESP\Loadlib;$ESP\SysLoadlib
```

File Path:
```
$ESP\catalog\Data
```

Map Path:
```
$ESP\Loadlib;$ESP\SysLoadlib
```

Resource Definition File Path:
```
$ESP\RDEF
```

EZASOKET support: □

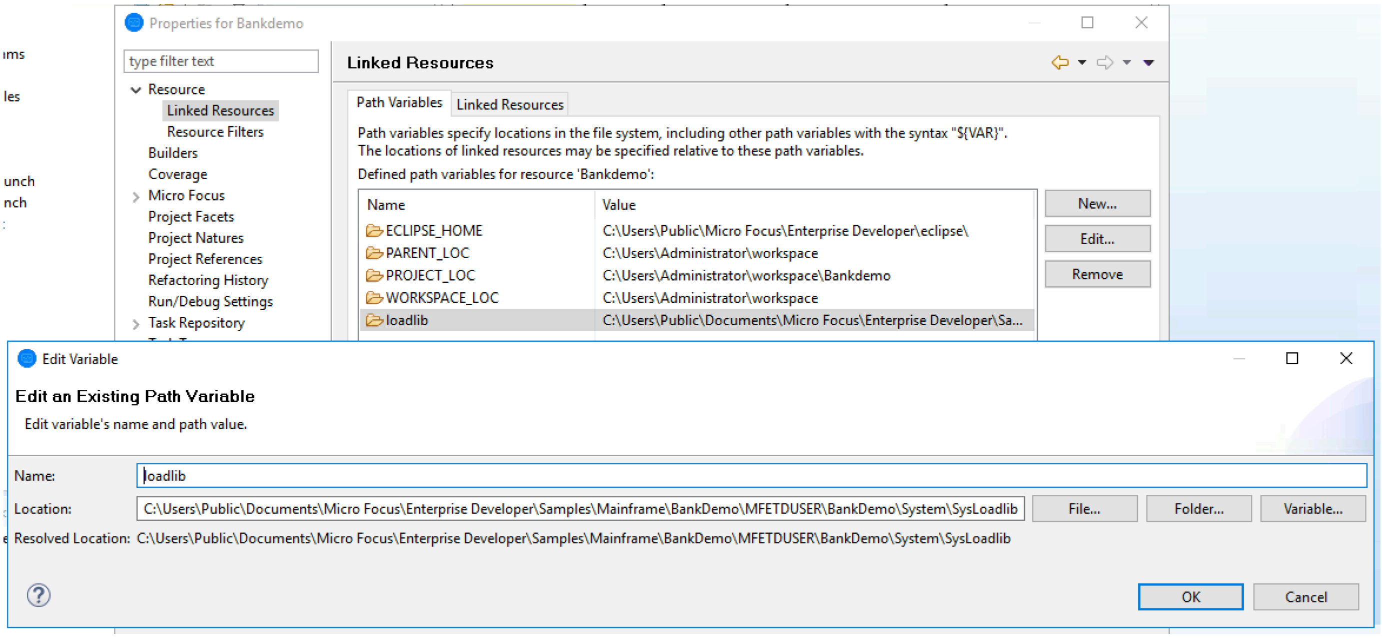


C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo\System

Name	Date modified	Type	Size
catalog	2/12/2020 7:47 PM	File folder	
DATA	2/20/2020 11:09 PM	File folder	
Logs	2/25/2020 2:56 PM	File folder	
RDEF	2/3/2020 6:35 PM	File folder	
SysLoadlib	2/15/2020 2:12 AM	File folder	

Be careful with the SysLoadlib case. You may have to adjust the folder name for proper upper-case letters.

For the Bankdemo project, under Properties -> Resource -> Linked Resources -> Path Variables, Edit the loadlib variable to match the BANKDEMO server loadlib folder in C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo\System\sysloadlib



Path variables specify locations in the file system, including other path variables with the syntax "${VAR}".
The locations of linked resources may be specified relative to these path variables.

Defined path variables for resource 'Bankdemo':

Name	Value
ECLIPSE_HOME	C:\Users\Public\Micro Focus\Enterprise Developer\eclipse\
PARENT_LOC	C:\Users\Administrator\workspace
PROJECT_LOC	C:\Users\Administrator\workspace\Bankdemo
WORKSPACE_LOC	C:\Users\Administrator\workspace
loadlib	C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Sa...

Edit Variable
Edit an Existing Path Variable
Edit variable's name and path value.
File...
Folder...
Variable...
OK
Cancel

Name: loadlib

Location: C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo\System\SysLoadlib

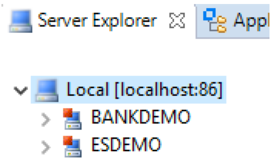
Resolved Location: C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo\System\SysLoadlib

Then choose Apply and Close.

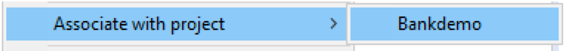
Clean the Bankdemo project to rebuild.

Then we associate the Bankdemo Enterprise Server with the application project.

In Server Explorer, right-click Local, and click Refresh to show the BankDemo server. If you get a Directory Server offline message appears, restart EDz.



Right-click the BANKDEMO server, point to Associate with project, then select Bankdemo.



Configure EDz to start the associated BankDemo server automatically as follows. Click Window > Preferences.

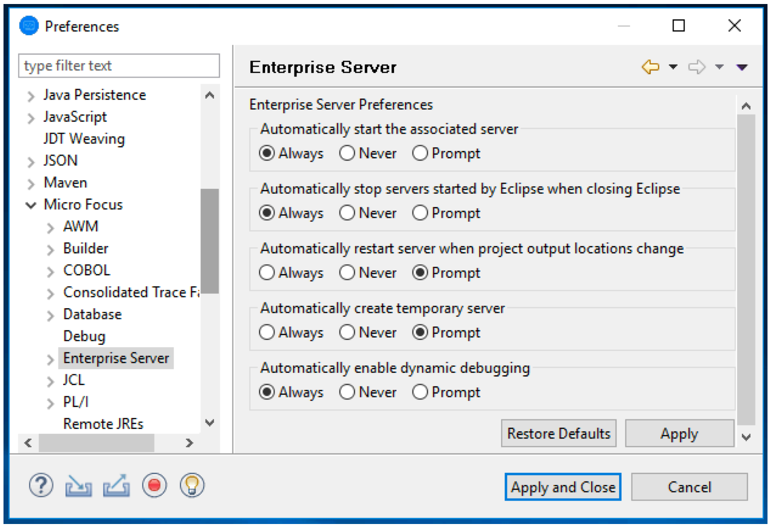
Expand Micro Focus, and click Enterprise Server.

Set the following options on this page to Always in order to enable the IDE to start or stop the associated server, and to enable dynamic debugging, for when it is not enabled in the server:

Automatically start the associated server - this ensures the IDE will start the server if it is not running when you execute the application.

Automatically stop servers started by Eclipse when closing Eclipse - this enables the IDE to stop servers when you close Eclipse.

Automatically enable dynamic debugging - this ensures the IDE will check whether the server has dynamic debugging enabled and, if it is not, will enable it when you start debugging.



Enterprise Server

Enterprise Server Preferences

Automatically start the associated server
● Always ○ Never ○ Prompt

Automatically stop servers started by Eclipse when closing Eclipse
● Always ○ Never ○ Prompt

Automatically restart server when project output locations change
○ Always ○ Never ● Prompt

Automatically create temporary server
○ Always ○ Never ● Prompt

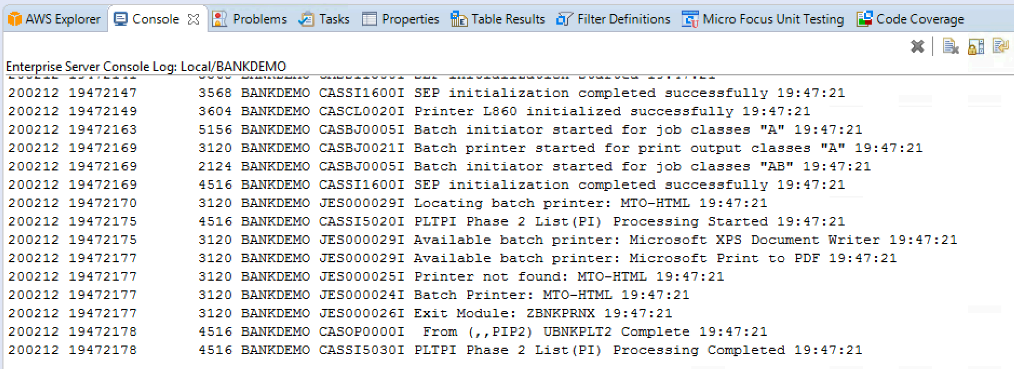
Automatically enable dynamic debugging
● Always ○ Never ○ Prompt

Click Apply and Close.

In the Server Explorer window, right-click the Bankdemo server and then click Start.

Wait until the server has started. In the list of servers in Server Explorer, BANKDEMO still has a red square next to it. This is a refresh delay.

If any server start problem you can check the logs doing a right-click on BANKDEMO server then Show Console Log or in C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\MFETDUSER\BankDemo\System\Logs\console.txt.



Enterprise Server Console Log: Local/BANKDEMO

```
200212 19472147     3568 BANKDEMO CASSI1600I SEP initialization completed successfully 19:47:21
200212 19472149     3604 BANKDEMO CASCL0020I Printer L860 initialized successfully 19:47:21
200212 19472163     5156 BANKDEMO CASBJ0005I Batch initiator started for job classes "A" 19:47:21
200212 19472169     3120 BANKDEMO CASBJ0021I Batch printer started for print output classes "A" 19:47:21
200212 19472169     2124 BANKDEMO CASBJ0005I Batch initiator started for job classes "AB" 19:47:21
200212 19472169     4516 BANKDEMO CASSI1600I SEP initialization completed successfully 19:47:21
200212 19472170     3120 BANKDEMO JES000029I Locating batch printer: MTO-HTML 19:47:21
200212 19472175     4516 BANKDEMO CASSI5020I PLTPI Phase 2 List(PI) Processing Started 19:47:21
200212 19472175     3120 BANKDEMO JES000029I Available batch printer: Microsoft XPS Document Writer 19:47:21
200212 19472177     3120 BANKDEMO JES000029I Available batch printer: Microsoft Print to PDF 19:47:21
200212 19472177     3120 BANKDEMO JES000025I Printer not found: MTO-HTML 19:47:21
200212 19472177     3120 BANKDEMO JES000024I Batch Printer: MTO-HTML 19:47:21
200212 19472177     3120 BANKDEMO JES000026I Exit Module: ZBNKPRNX 19:47:21
200212 19472178     4516 BANKDEMO CASOP0000I  From (,,PIP2) UBNKPLT2 Complete 19:47:21
200212 19472178     4516 BANKDEMO CASSI5030I PLTPI Phase 2 List(PI) Processing Completed 19:47:21
```

2.3 DEV – MF EDz BankDemo online unit test

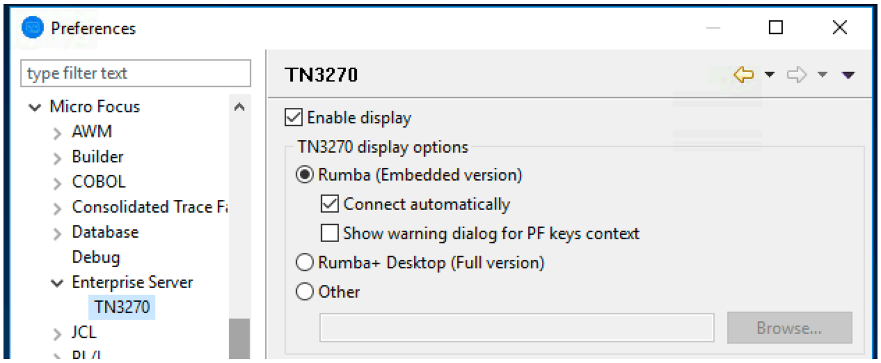
You can find more details for help at this link:

https://www.microfocus.com/documentation/enterprise-developer/ed50/ED-Eclipse/index.html?t=GUID-A0221822-CF44-4698-ABD6-7F77F7A862A2.html

In the EDz IDE, click Window > Preferences.

Expand Micro Focus > Enterprise Server, and click TN3270.

Ensure that Enable display, Rumba (Embedded) and Connect automatically are all selected.



Preferences

type filter text

- Micro Focus
  - AWM
  - Builder
  - COBOL
  - Consolidated Trace F
  - Database
  - Debug
  - Enterprise Server
    - TN3270
  - JCL
  - PL/I

TN3270

☑ Enable display

TN3270 display options

● Rumba (Embedded version)

☑ Connect automatically

□ Show warning dialog for PF keys context

○ Rumba+ Desktop (Full version)

○ Other

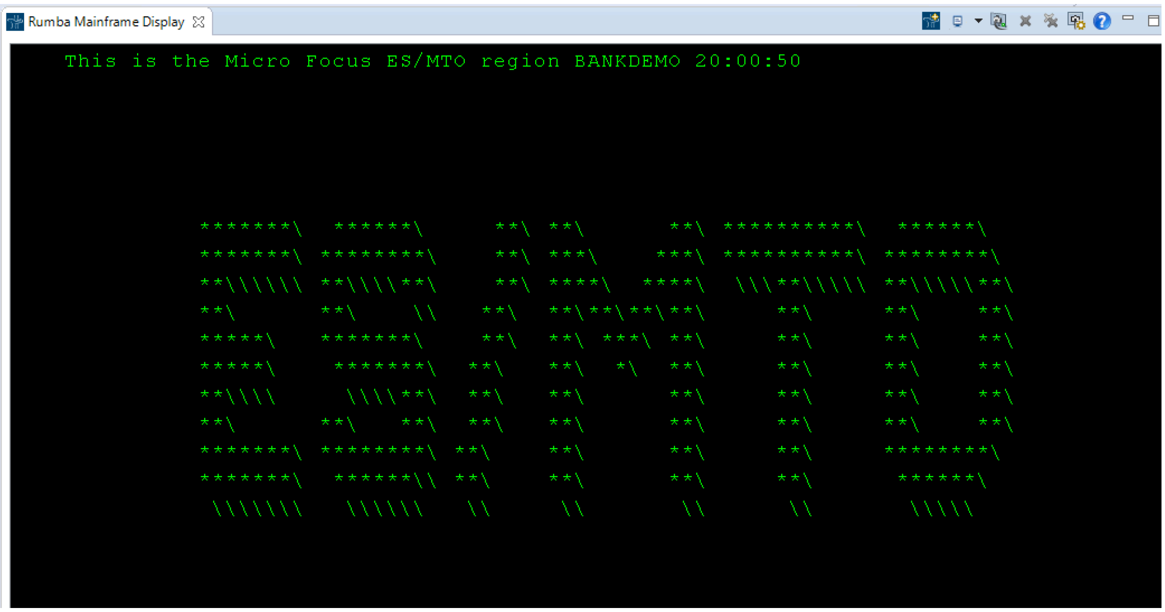
Browse...

Click OK.

Right-click the BANKDEMO server in Server Explorer, and click Show TN3270 Display.

This opens the Rumba+ Desktop Mainframe Display view and automatically establishes a 3270 terminal connection to the BANKDEMO server. You can see the starting page of the ES/MTO region BANKDEMO.

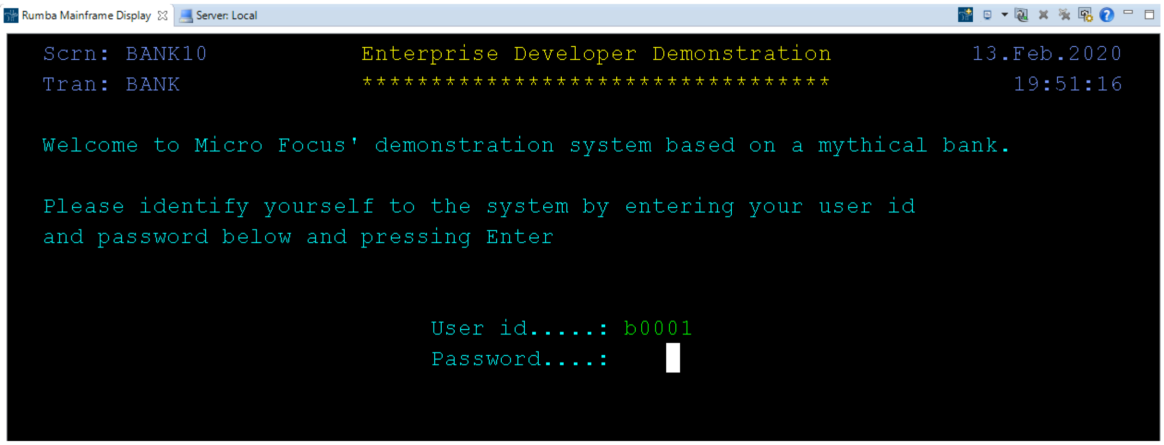
You can drag the Rumba Mainframe Display view to reposition it.



```
    This is the Micro Focus ES/MTO region BANKDEMO 20:00:50




              *******\  ******\     **\ **\      **\ **********\  ******\
              *******\ ********\    **\ ***\    ***\ **********\ ********\
              **\\\\\\ **\\\\**\    **\ ****\  ****\  \\\**\\\\\ **\\\\\**\
              **\      **\    \\   **\  **\**\**\**\     **\     **\    **\
              *****\   *******\    **\  **\ ***\ **\     **\     **\    **\
              *****\    *******\  **\   **\  *\  **\     **\     **\    **\
              **\\\\     \\\\**\  **\   **\      **\     **\     **\    **\
              **\      **\   **\  **\   **\      **\     **\     **\    **\
              *******\ ********\ **\    **\      **\     **\     ********\
              *******\  ******\\ **\    **\      **\     **\      ******\
               \\\\\\\   \\\\\\   \\     \\       \\      \\       \\\\\
```

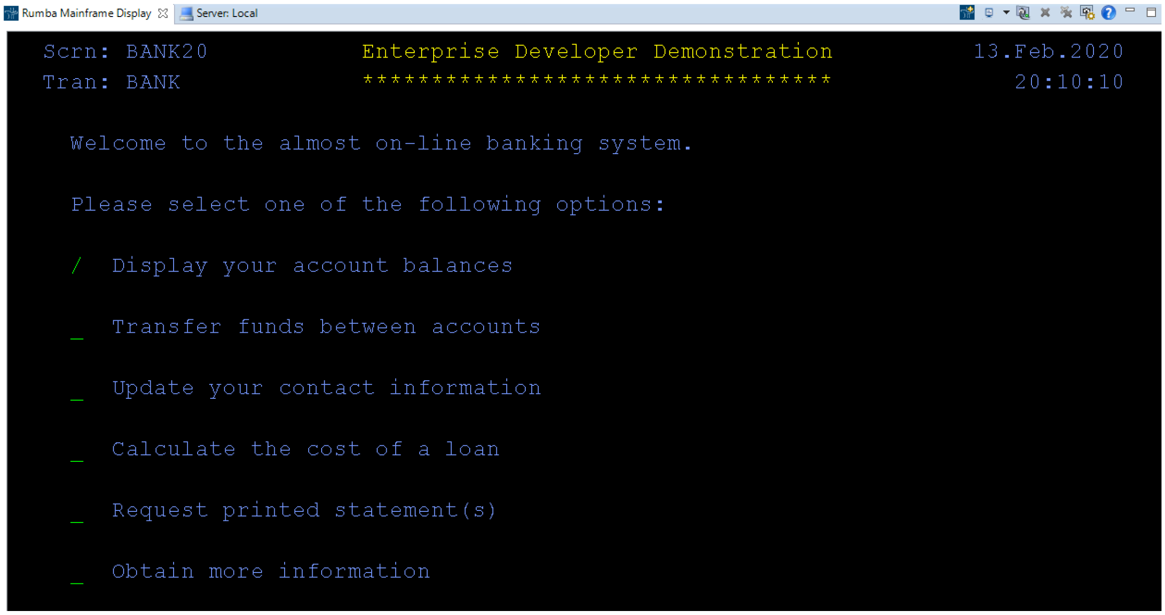
Press Ctrl+Shift+Z to clear this window.

Type in the transaction id BANK and press Enter (Crtl) to navigate to an application logon window.



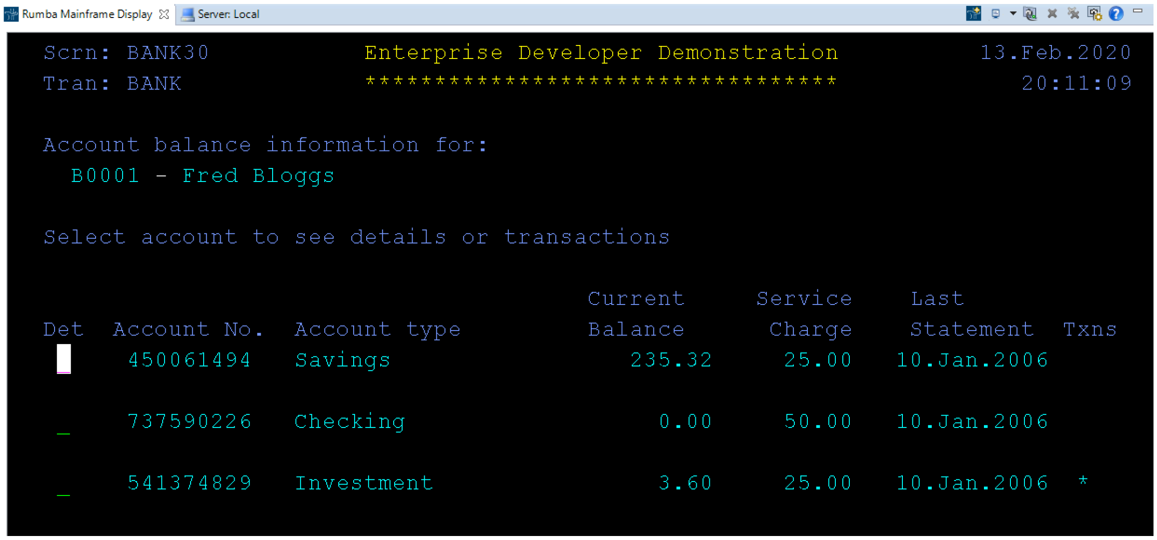
```
Scrn: BANK10            Enterprise Developer Demonstration           13.Feb.2020
Tran: BANK              **********************************              19:51:16

Welcome to Micro Focus' demonstration system based on a mythical bank.

Please identify yourself to the system by entering your user id
and password below and pressing Enter


                             User id.....: b0001
                             Password....:
```

Type your logon details and press Enter. A suitable User Id is b0001. You can type anything as a Password - the field must not be empty though.



```
Scrn: BANK20            Enterprise Developer Demonstration           13.Feb.2020
Tran: BANK              **********************************              20:10:10

  Welcome to the almost on-line banking system.

  Please select one of the following options:

  /  Display your account balances

  _  Transfer funds between accounts

  _  Update your contact information

  _  Calculate the cost of a loan

  _  Request printed statement(s)

  _  Obtain more information
```

Type / against Display your account balances and press Enter to see the details for this customer.



```
 Scrn: BANK30           Enterprise Developer Demonstration          13.Feb.2020
 Tran: BANK             **********************************             20:11:09

 Account balance information for:
   B0001 - Fred Bloggs

 Select account to see details or transactions

                                             Current     Service    Last
 Det  Account No.   Account type             Balance      Charge    Statement  Txns
      450061494     Savings                     235.32     25.00   10.Jan.2006

  _   737590226     Checking                      0.00     50.00   10.Jan.2006

  _   541374829     Investment                    3.60     25.00   10.Jan.2006  *
```

You can explore this application further if you wish or press F3 to terminate it.

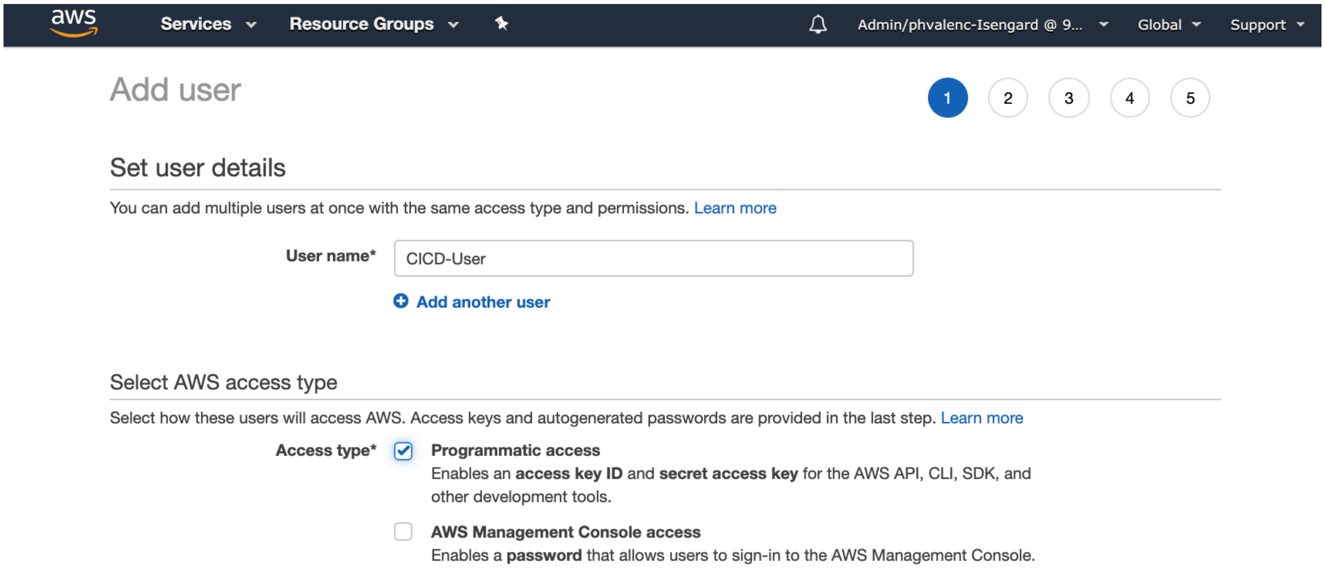
3 SOURCE stage

3.1 SOURCE – MF EDz and AWS CodeCommit integration

You can find more details for help at this link:

https://docs.aws.amazon.com/codecommit/latest/userguide/setting-up-ide-ec.html

In AWS IAM, create a new AWS user for integration



Add user

Set user details

You can add multiple users at once with the same access type and permissions. Learn more

User name* CICD-User

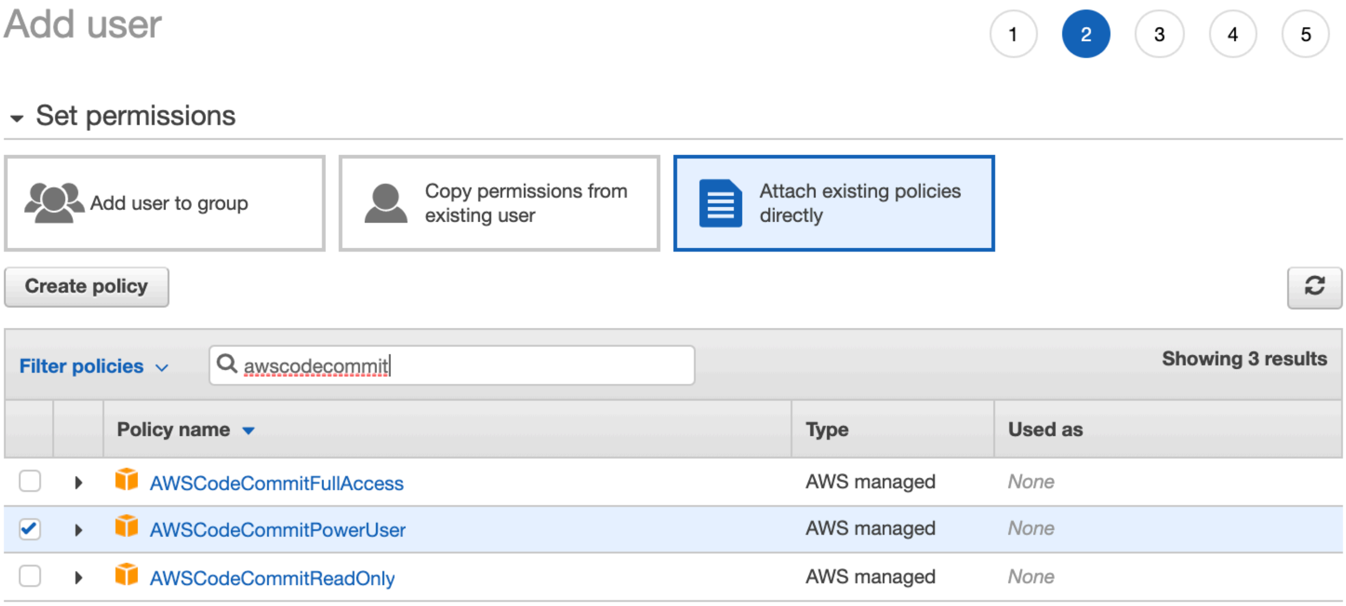
Select AWS access type

Select how these users will access AWS. Access keys and autogenerated passwords are provided in the last step. Learn more

Access type*

☑ **Programmatic access**
Enables an **access key ID** and **secret access key** for the AWS API, CLI, SDK, and other development tools.

□ **AWS Management Console access**
Enables a **password** that allows users to sign-in to the AWS Management Console.


1
2
3
4
5
Add user to group
Copy permissions from existing user
Attach existing policies directly
Create policy
Filter policies

Add user

Set permissions

awscodecommit

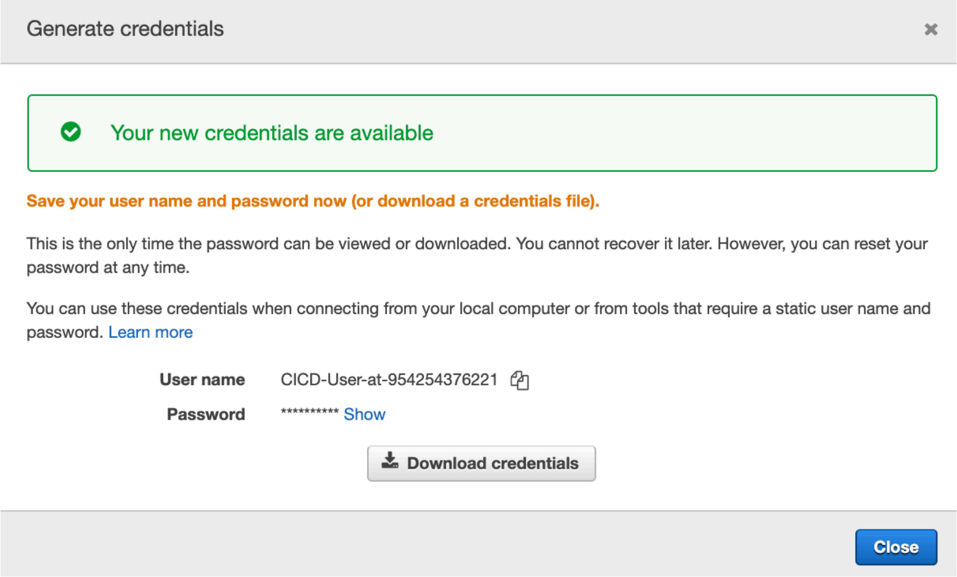
Showing 3 results

		Policy name	Type	Used as
□	▸	AWSCodeCommitFullAccess	AWS managed	*None*
☑	▸	AWSCodeCommitPowerUser	AWS managed	*None*
□	▸	AWSCodeCommitReadOnly	AWS managed	*None*

Attach the AWSCodeCommitPowerUser policy and create User.

Download and save the Access Key and the Secret Access Key.

Select the User, then Under Security Credentials, go to HTTPS Git credentials for AWS CodeCommit and click Generate credentials.



Generate credentials

Your new credentials are available

Save your user name and password now (or download a credentials file).

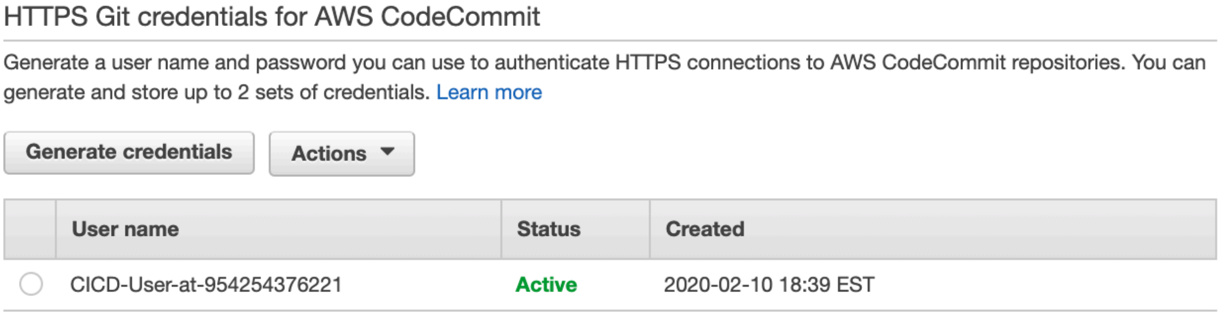
This is the only time the password can be viewed or downloaded. You cannot recover it later. However, you can reset your password at any time.

You can use these credentials when connecting from your local computer or from tools that require a static user name and password. Learn more

User name CICD-User-at-954254376221

Password ********** Show

Download and save the credentials.



HTTPS Git credentials for AWS CodeCommit

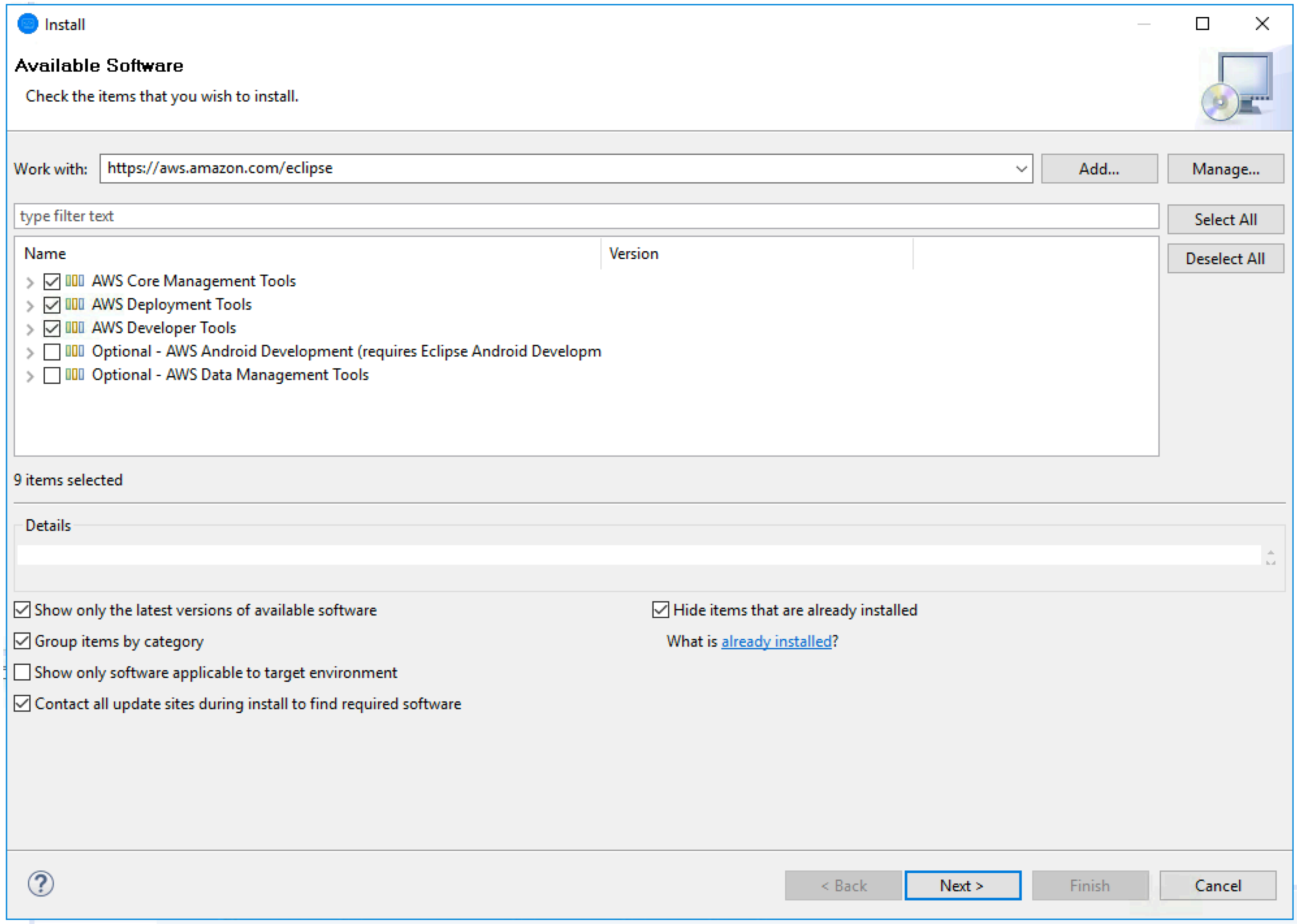
Generate a user name and password you can use to authenticate HTTPS connections to AWS CodeCommit repositories. You can generate and store up to 2 sets of credentials. Learn more

	User name	Status	Created
○	CICD-User-at-954254376221	Active	2020-02-10 18:39 EST

Back to the MF EDz instance, Install the AWS Toolkit for Eclipse with the following instructions. Instructions can be found here: https://aws.amazon.com/eclipse/

Within Eclipse, click Help and then click Install New Software.

In the Work with field, type https://aws.amazon.com/eclipse and then press Enter.



Install

Available Software

Check the items that you wish to install.

Work with: https://aws.amazon.com/eclipse

type filter text

Name	Version
☑ AWS Core Management Tools	
☑ AWS Deployment Tools	
☑ AWS Developer Tools	
□ Optional - AWS Android Development (requires Eclipse Android Developm	
□ Optional - AWS Data Management Tools	

9 items selected

Details

☑ Show only the latest versions of available software

☑ Group items by category

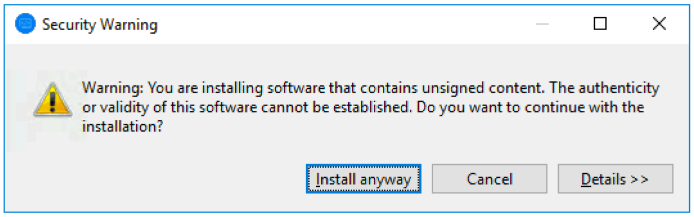
□ Show only software applicable to target environment

☑ Contact all update sites during install to find required software

☑ Hide items that are already installed

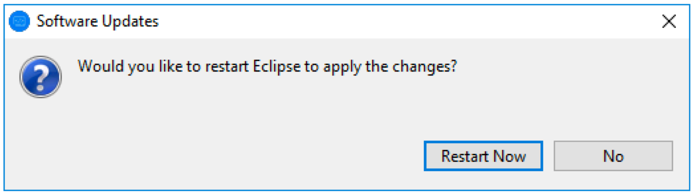
What is already installed?

Select the main AWS components and click Next, then review packages, accept license and install.



Security Warning

Warning: You are installing software that contains unsigned content. The authenticity or validity of this software cannot be established. Do you want to continue with the installation?

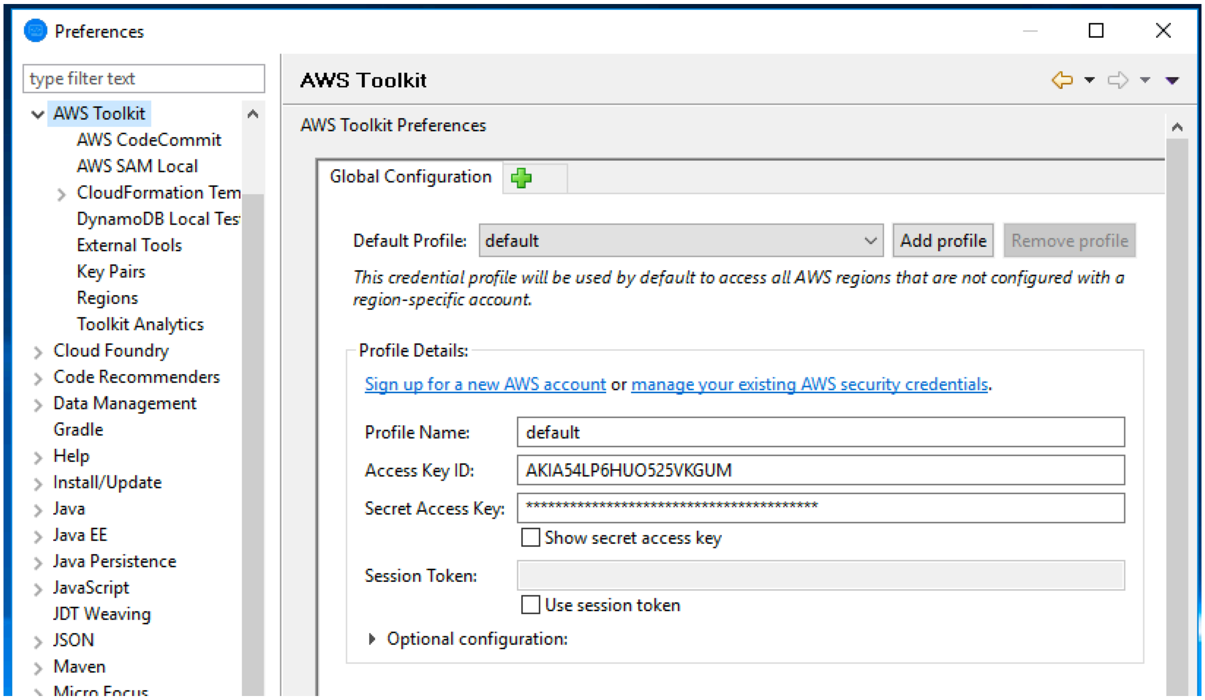


Software Updates

Would you like to restart Eclipse to apply the changes?

After restart, enter the Access Key and Secret Access Key for the CICD-User.

It will then show in the Eclipse Preferences



AWS Toolkit

AWS Toolkit Preferences

Default Profile: default

This credential profile will be used by default to access all AWS regions that are not configured with a region-specific account.

Profile Details:

Sign up for a new AWS account or manage your existing AWS security credentials.

Profile Name: default

Access Key ID: AKIA54LP6HUO525VKGUM

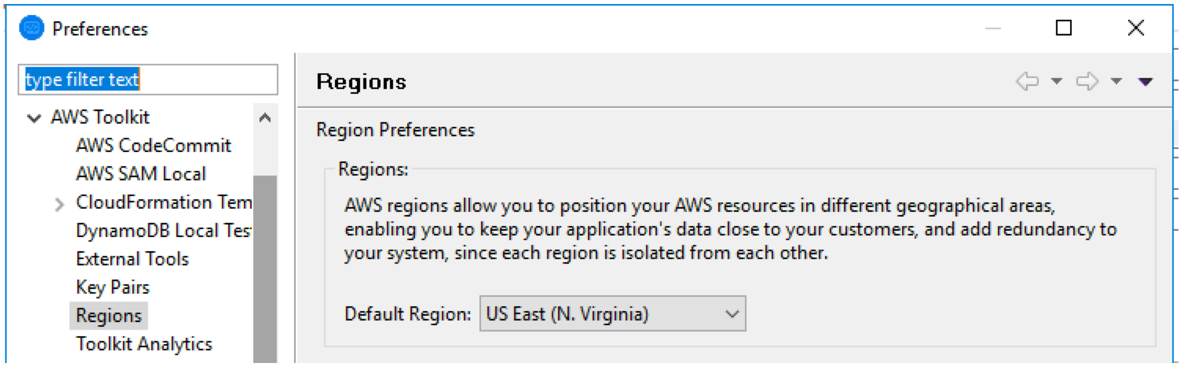
Secret Access Key: **

□ Show secret access key

Session Token:

□ Use session token

Under AWS Toolkit => Regions, verify or set your desired region for your setup.



Regions

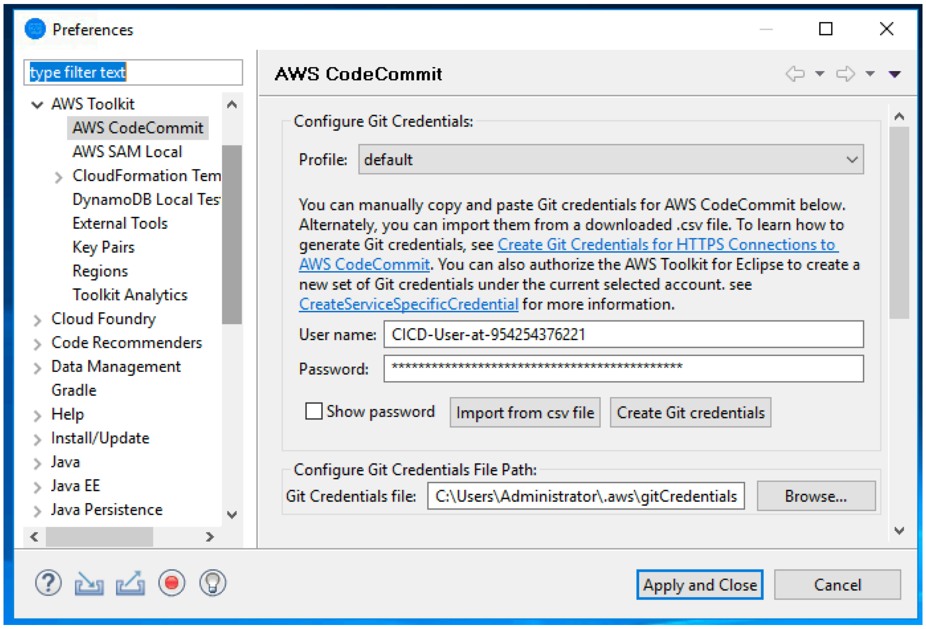
Region Preferences

Regions:

AWS regions allow you to position your AWS resources in different geographical areas, enabling you to keep your application's data close to your customers, and add redundancy to your system, since each region is isolated from each other.

Default Region: US East (N. Virginia)

Expand the AWS Toolkit menu and choose AWS CodeCommit. Enter the user name and password for your Git credentials importing them from the .csv file. Choose Apply, and then choose OK.



AWS CodeCommit

Configure Git Credentials:

Profile: default

You can manually copy and paste Git credentials for AWS CodeCommit below. Alternately, you can import them from a downloaded .csv file. To learn how to generate Git credentials, see Create Git Credentials for HTTPS Connections to AWS CodeCommit. You can also authorize the AWS Toolkit for Eclipse to create a new set of Git credentials under the current selected account. see CreateServiceSpecificCredential for more information.

User name: CICD-User-at-954254376221

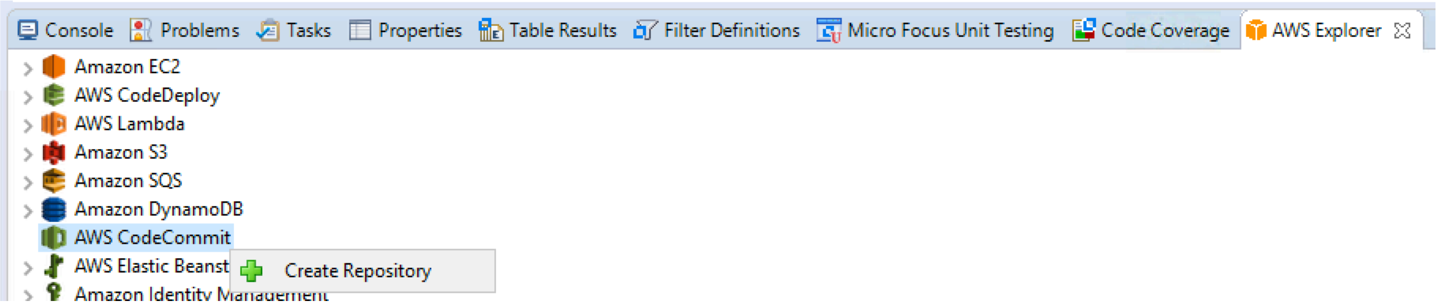
Password: **

□ Show password Import from csv file Create Git credentials

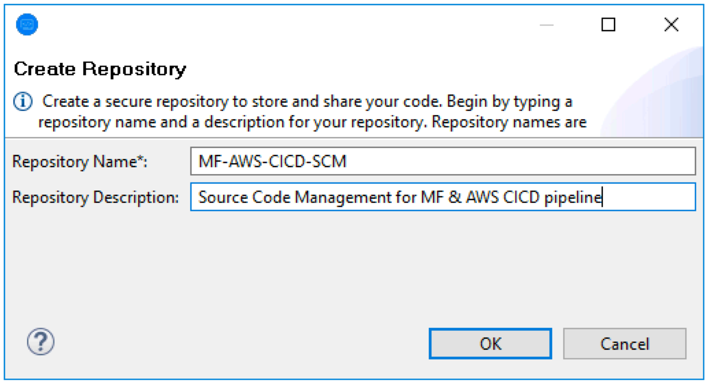
Configure Git Credentials File Path:

Git Credentials file: C:\Users\Administrator\.aws\gitCredentials Browse...

Save with Apply and Close.



In AWS Explorer, right-click on AWS CodeCommit and click Create Repository.



Create Repository

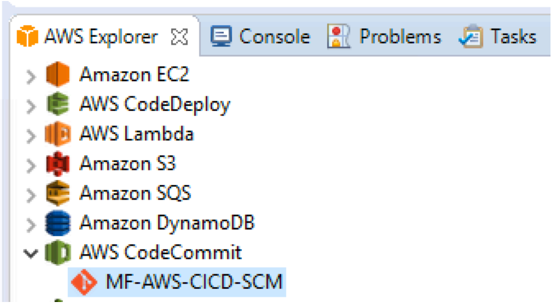
Create a secure repository to store and share your code. Begin by typing a repository name and a description for your repository. Repository names are

Repository Name*: MF-AWS-CICD-SCM

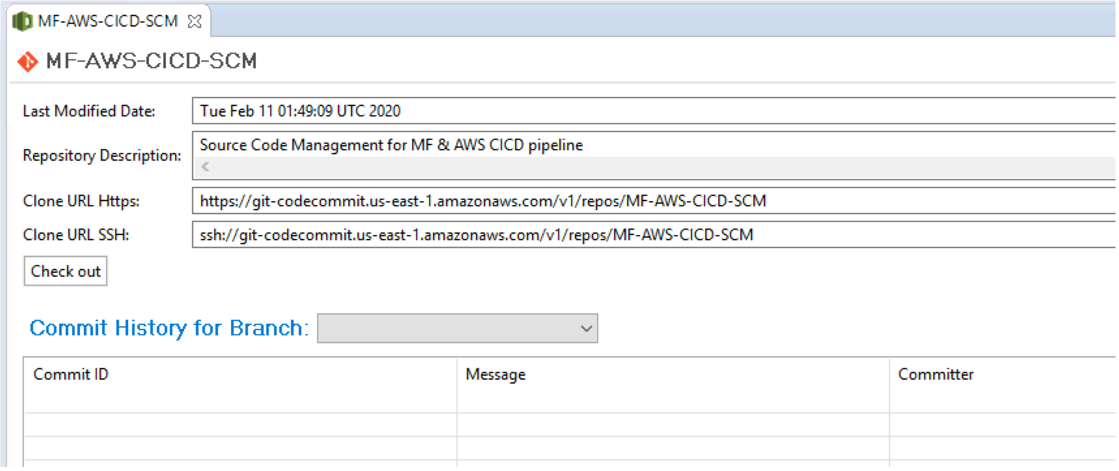
Repository Description: Source Code Management for MF & AWS CICD pipeline

Enter the Repository Name: MF-AWS-CICD-SCM

Enter the Repository Description: Source Code Management for MF & AWS CICD pipeline



It can be opened in CodeCommit Repository Editor.



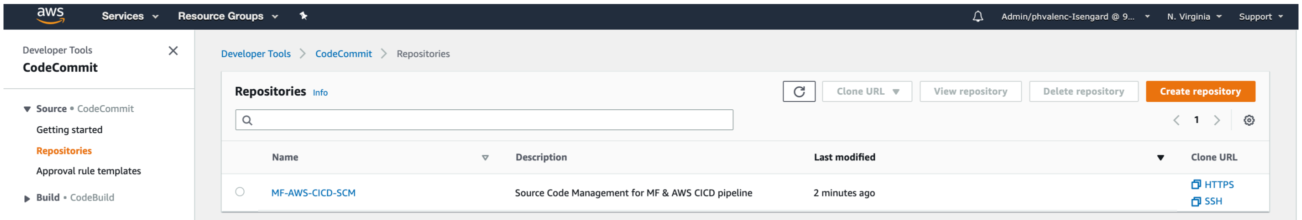
MF-AWS-CICD-SCM

Last Modified Date:	Tue Feb 11 01:49:09 UTC 2020
Repository Description:	Source Code Management for MF & AWS CICD pipeline
Clone URL Https:	https://git-codecommit.us-east-1.amazonaws.com/v1/repos/MF-AWS-CICD-SCM
Clone URL SSH:	ssh://git-codecommit.us-east-1.amazonaws.com/v1/repos/MF-AWS-CICD-SCM

Commit History for Branch:

Commit ID	Message	Committer

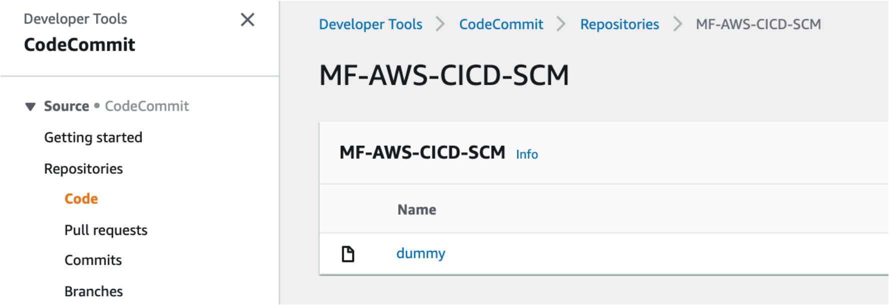
And also shows in AWS console:



Repositories Info

Name	Description	Last modified	Clone URL
MF-AWS-CICD-SCM	Source Code Management for MF & AWS CICD pipeline	2 minutes ago	HTTPS SSH

In AWS CodeCommit, create a dummy file (this creates the master branch in the repository).

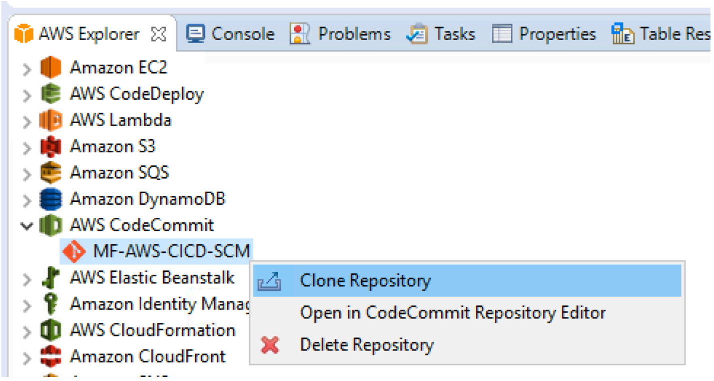


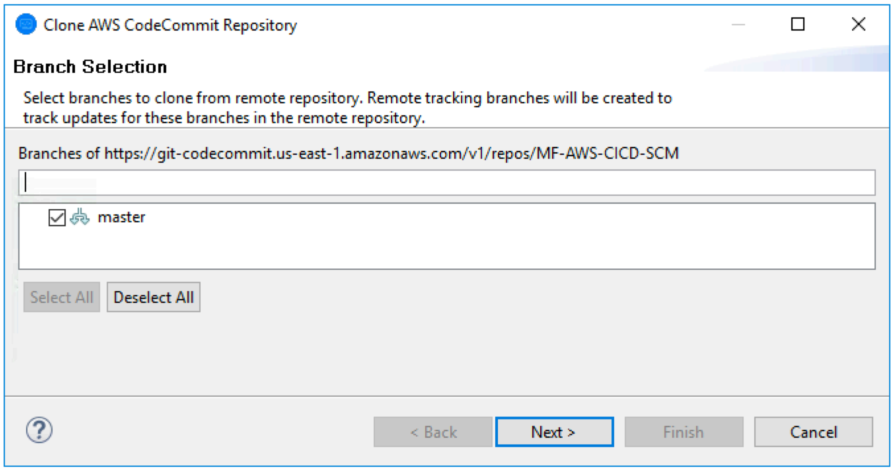
MF-AWS-CICD-SCM

MF-AWS-CICD-SCM Info

Name
dummy

In Eclipse AWS Explorer choose Clone Repository




Clone AWS CodeCommit Repository

Branch Selection

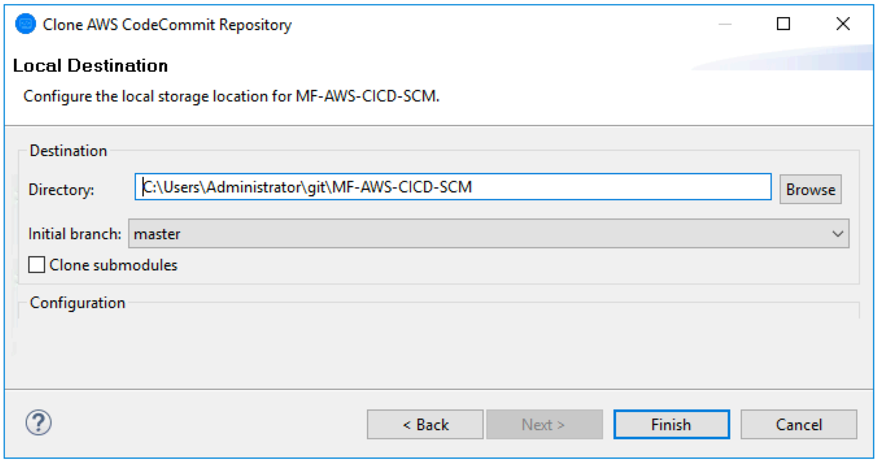
Select branches to clone from remote repository. Remote tracking branches will be created to track updates for these branches in the remote repository.

Branches of https://git-codecommit.us-east-1.amazonaws.com/v1/repos/MF-AWS-CICD-SCM

☑ master

The master branch was created by the dummy file.

Click Next.


Clone AWS CodeCommit Repository

Local Destination

Configure the local storage location for MF-AWS-CICD-SCM.

Destination

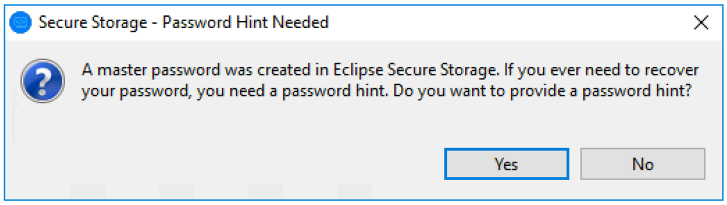
Directory: C:\Users\Administrator\git\MF-AWS-CICD-SCM

Initial branch: master

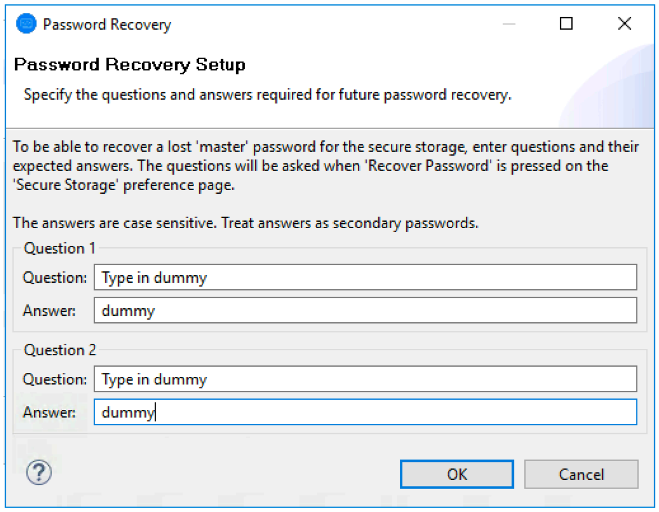
□ Clone submodules

Configuration

Click Finish.


Secure Storage - Password Hint Needed

A master password was created in Eclipse Secure Storage. If you ever need to recover your password, you need a password hint. Do you want to provide a password hint?



Password Recovery

Password Recovery Setup

Specify the questions and answers required for future password recovery.

To be able to recover a lost 'master' password for the secure storage, enter questions and their expected answers. The questions will be asked when 'Recover Password' is pressed on the 'Secure Storage' preference page.

The answers are case sensitive. Treat answers as secondary passwords.

Question 1

Question: Type in dummy

Answer: dummy

Question 2

Question: Type in dummy

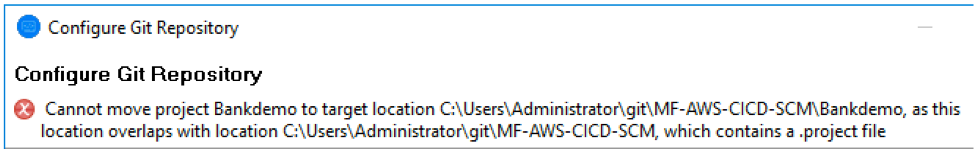
Answer: dummy

3.2 SOURCE – MF EDz to AWS CodeCommit code push

Now that we have a local clone of our repository, we're ready to start putting the BankDemo source code into the Git local clone repository.

Select BankDemo project and use Team -> Share Project… to connect that project with the repository we just cloned.

Select the local Git repository in the working tree: C:\Users\Administrator\git\MF-AWS-CICD-SCM

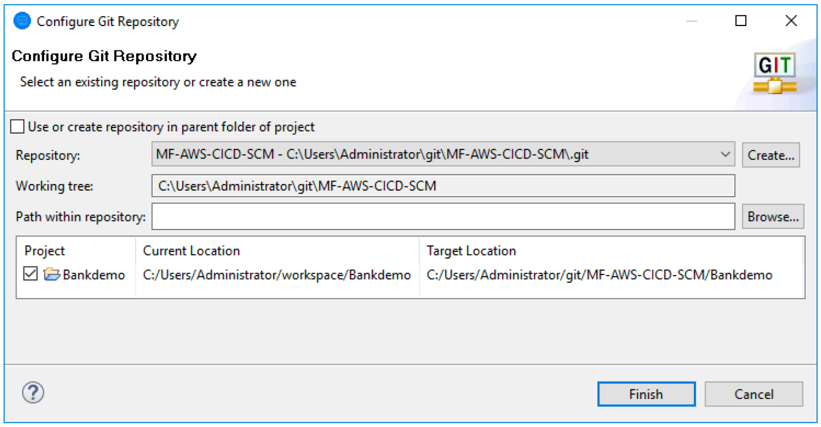


Configure Git Repository

Configure Git Repository

Cannot move project Bankdemo to target location C:\Users\Administrator\git\MF-AWS-CICD-SCM\Bankdemo, as this location overlaps with location C:\Users\Administrator\git\MF-AWS-CICD-SCM, which contains a .project file

If you see the above error message, delete the C:\Users\Administrator\git\MF-AWS-CICD-SCM\.project file and redo Select BankDemo project and use Team -> Share Project…



Configure Git Repository

Configure Git Repository

Select an existing repository or create a new one

☐ Use or create repository in parent folder of project

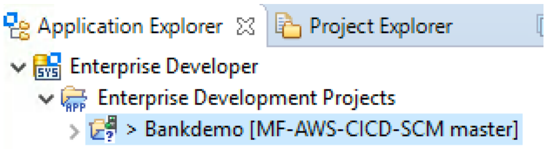
Repository: MF-AWS-CICD-SCM - C:\Users\Administrator\git\MF-AWS-CICD-SCM\.git

Working tree: C:\Users\Administrator\git\MF-AWS-CICD-SCM

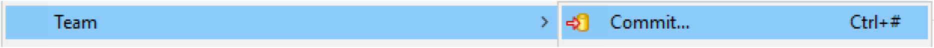
Path within repository:

Project	Current Location	Target Location
☑ Bankdemo	C:/Users/Administrator/workspace/Bankdemo	C:/Users/Administrator/git/MF-AWS-CICD-SCM/Bankdemo

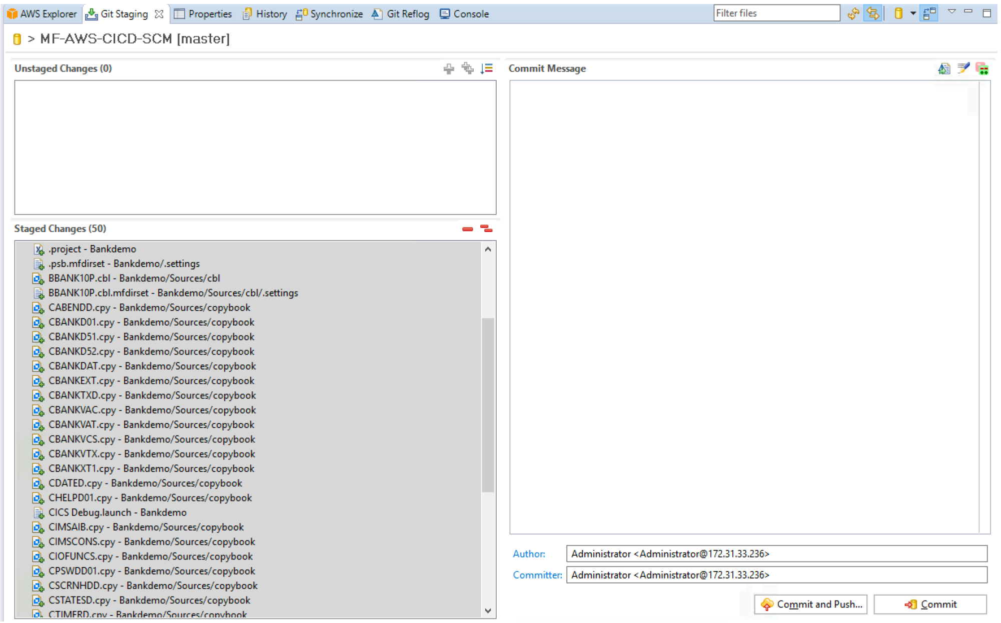
Click Finish. Bankdemo will then recompile/rebuild. You will then notice the Bankdemo project associated with the cloned local Git.


Application Explorer
Project Explorer
Enterprise Developer
Enterprise Development Projects
> Bankdemo [MF-AWS-CICD-SCM master]

On the Bankdemo project, select Team -> Commit



Add all Unstaged Changes to Staged Changes



.project - Bankdemo
.psb.mfdirset - Bankdemo/.settings
BBANK10P.cbl - Bankdemo/Sources/cbl
BBANK10P.cbl.mfdirset - Bankdemo/Sources/cbl/.settings
CABENDD.cpy - Bankdemo/Sources/copybook
CBANKD01.cpy - Bankdemo/Sources/copybook
CBANKD51.cpy - Bankdemo/Sources/copybook
CBANKD52.cpy - Bankdemo/Sources/copybook
CBANKDAT.cpy - Bankdemo/Sources/copybook
CBANKEXT.cpy - Bankdemo/Sources/copybook
CBANKTXD.cpy - Bankdemo/Sources/copybook
CBANKVAC.cpy - Bankdemo/Sources/copybook
CBANKVAT.cpy - Bankdemo/Sources/copybook
CBANKVCS.cpy - Bankdemo/Sources/copybook
CBANKVTX.cpy - Bankdemo/Sources/copybook
CBANKXT1.cpy - Bankdemo/Sources/copybook
CDATED.cpy - Bankdemo/Sources/copybook
CHELPD01.cpy - Bankdemo/Sources/copybook
CICS Debug.launch - Bankdemo
CIMSAIB.cpy - Bankdemo/Sources/copybook
CIMSCONS.cpy - Bankdemo/Sources/copybook
CIOFUNCS.cpy - Bankdemo/Sources/copybook
CPSWDD01.cpy - Bankdemo/Sources/copybook
CSCRNHDD.cpy - Bankdemo/Sources/copybook
CSTATESD.cpy - Bankdemo/Sources/copybook
CTIMERD.cpy - Bankdemo/Sources/copybook

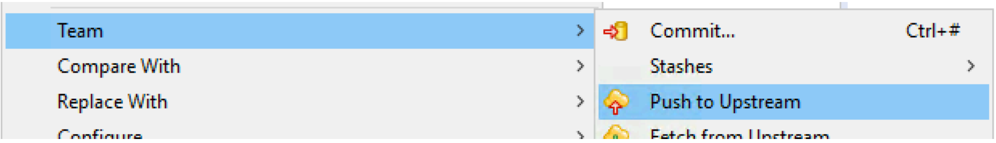
Author: Administrator <Administrator@172.31.33.236>

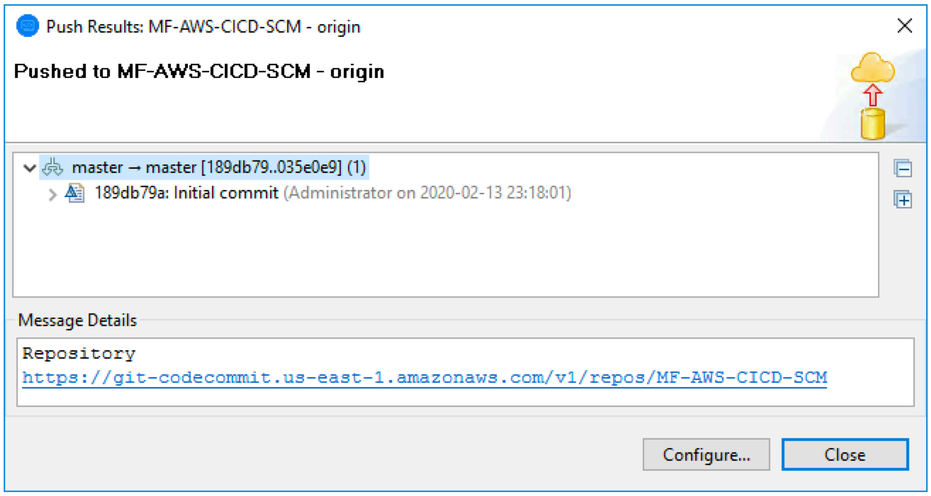
Committer: Administrator <Administrator@172.31.33.236>

Enter a Commit Message and click Commit.

Changes are committed to the local cloned Git repository.

On the Bankdemo project, select Team -> Push to Upstream to push the source code to CodeCommit.





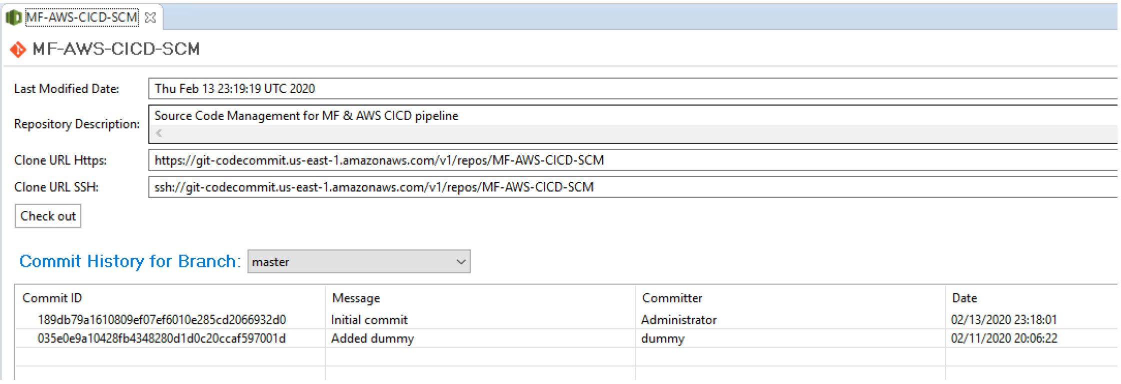
Pushed to MF-AWS-CICD-SCM - origin

master → master [189db79..035e0e9] (1)
189db79a: Initial commit (Administrator on 2020-02-13 23:18:01)

Message Details

```
Repository
https://git-codecommit.us-east-1.amazonaws.com/v1/repos/MF-AWS-CICD-SCM
```

You can then see the code pushed to CodeCommit via the Repository Editor



MF-AWS-CICD-SCM

Last Modified Date: Thu Feb 13 23:19:19 UTC 2020

Repository Description: Source Code Management for MF & AWS CICD pipeline

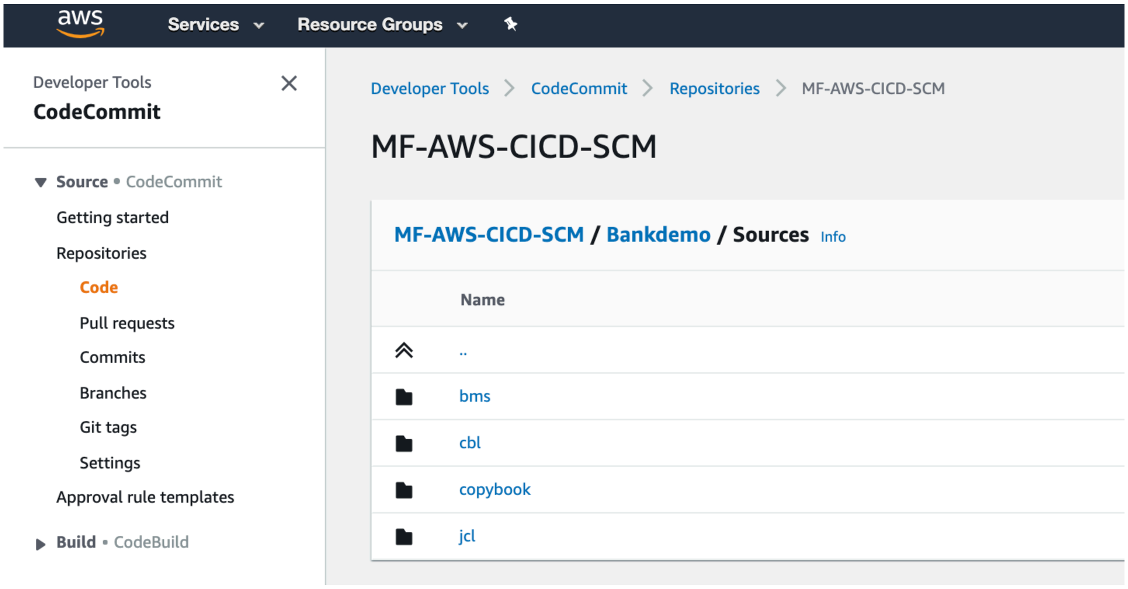
Clone URL Https: https://git-codecommit.us-east-1.amazonaws.com/v1/repos/MF-AWS-CICD-SCM

Clone URL SSH: ssh://git-codecommit.us-east-1.amazonaws.com/v1/repos/MF-AWS-CICD-SCM

Commit History for Branch: master

Commit ID	Message	Committer	Date
189db79a1610809ef07ef6010e285cd2066932d0	Initial commit	Administrator	02/13/2020 23:18:01
035e0e9a10428fb4348280d1d0c20ccaf597001d	Added dummy	dummy	02/11/2020 20:06:22

And you can see all the files from AWS Console in CodeCommit:



MF-AWS-CICD-SCM

MF-AWS-CICD-SCM / Bankdemo / Sources Info

Name
..
bms
cbl
copybook
jcl

4 BUILD stage

4.1 BUILD – Amazon ECR docker image with Micro Focus build tools

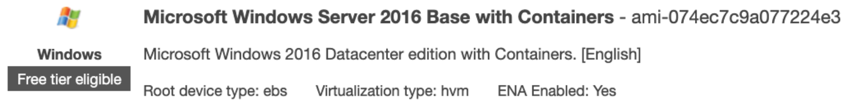
For getting access to Micro Focus software, please contact your Micro Focus representative or contact Micro Focus following this link: https://www.microfocus.com/en-us/contact/contactme

For this section we need the Micro Focus Build tools packaged as Docker containers. In our example, these containers are initially stored in AWS S3.

Create an EC2-to-S3-ECR-microfocus-aws IAM role with inline policy

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:Get*",
                "s3:List*"
            ],
            "Resource": "arn:aws:s3:::microfocus-aws/*"
        },
        {
            "Effect": "Allow",
            "Action": [
                "ecr:ListTagsForResource",
                "ecr:UploadLayerPart",
                "ecr:ListImages",
                "ecr:CompleteLayerUpload",
                "ecr:DescribeRepositories",
                "ecr:BatchCheckLayerAvailability",
                "ecr:GetLifecyclePolicy",
                "ecr:DescribeImageScanFindings",
                "s3:ListAccessPoints",
                "ecr:GetLifecyclePolicyPreview",
                "ecr:GetDownloadUrlForLayer",
                "ecr:GetAuthorizationToken",
                "ecr:PutImage",
                "ecr:BatchGetImage",
                "ecr:DescribeImages",
                "ecr:InitiateLayerUpload"
            ],
            "Resource": "*"
        }
    ]
}
```

Launch a new EC2 instance with "Microsoft Windows Server 2016 Base with Containers" (because AWS CodeBuild executes Windows Server containers using Windows Server 2016 hosts). This instance is temporary to prepare and push the container image to Amazon ECR.

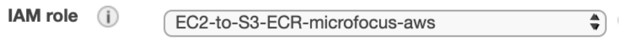


Microsoft Windows Server 2016 Base with Containers - ami-074ec7c9a077224e3

Microsoft Windows 2016 Datacenter edition with Containers. [English]

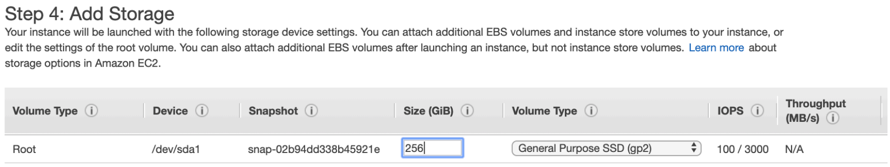
Root device type: ebs   Virtualization type: hvm   ENA Enabled: Yes

Include the EC2-to-S3-ECR-microfocus-aws role



IAM role ⓘ EC2-to-S3-ECR-microfocus-aws

Allocate 256 GB of disk space



Step 4: Add Storage

Your instance will be launched with the following storage device settings. You can attach additional EBS volumes and instance store volumes to your instance, or edit the settings of the root volume. You can also attach additional EBS volumes after launching an instance, but not instance store volumes. Learn more about storage options in Amazon EC2.

Volume Type ⓘ	Device ⓘ	Snapshot ⓘ	Size (GiB) ⓘ	Volume Type ⓘ	IOPS ⓘ	Throughput (MB/s) ⓘ
Root	/dev/sda1	snap-02b94dd338b45921e	256	General Purpose SSD (gp2)	100 / 3000	N/A

Log on to the instance.

Start Command Prompt as an administrator.

Check the docker version in your instance:

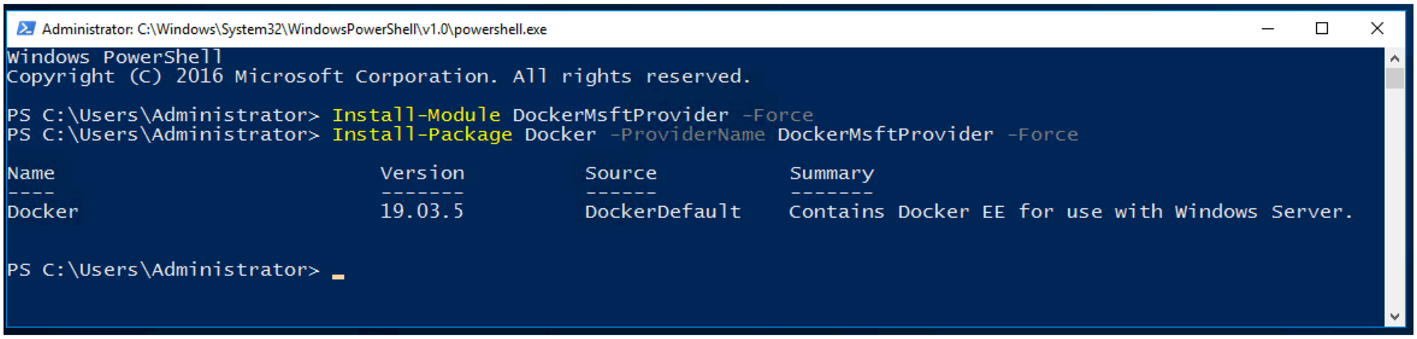
```
docker version
Client:
 Version:      1.12.2-cs2-ws-beta
 API version:  1.25
 Go version:   go1.7.1
 Git commit:   050b611
 Built:        Tue Oct 11 02:35:40 2016
 OS/Arch:      windows/amd64

Server:
 Version:      1.12.2-cs2-ws-beta
 API version:  1.25
 Go version:   go1.7.1
 Git commit:   050b611
 Built:        Tue Oct 11 02:35:40 2016
 OS/Arch:      windows/amd64
```

If the docker version is not Docker Enterprise v19 (like the above is not the proper version), we need to install it with the following instructions:

```
start powershell
```

In the new Administrator PowerShell windows, enter commands:

```
Install-Module DockerMsftProvider -Force
Install-Package Docker -ProviderName DockerMsftProvider -Force
```



Administrator: C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe

```
Windows PowerShell
Copyright (C) 2016 Microsoft Corporation. All rights reserved.

PS C:\Users\Administrator> Install-Module DockerMsftProvider -Force
PS C:\Users\Administrator> Install-Package Docker -ProviderName DockerMsftProvider -Force

Name                           Version          Source           Summary
----                           -------          ------           -------
Docker                         19.03.5          DockerDefault    Contains Docker EE for use with Windows Server.


PS C:\Users\Administrator> _
```

Start Docker Enterprise

```
net start docker
The Docker Engine service is starting.
The Docker Engine service was started successfully.
```

Check the new docker version in your instance:

```
docker version
Client: Docker Engine - Enterprise
 Version:           19.03.5
 API version:       1.40
 Go version:        go1.12.12
 Git commit:        2ee0c57608
 Built:             11/13/2019 08:00:16
 OS/Arch:           windows/amd64
 Experimental:      false

Server: Docker Engine - Enterprise
 Engine:
  Version:          19.03.5
  API version:      1.40 (minimum version 1.24)
  Go version:       go1.12.12
  Git commit:       2ee0c57608
  Built:            11/13/2019 07:58:51
  OS/Arch:          windows/amd64
  Experimental:     false
```

Docker Enterprise v19 is good and we can proceed.

Reboot the instance.

Download AWS CLI installer from https://s3.amazonaws.com/aws-cli/AWSCLI64PY3.msi

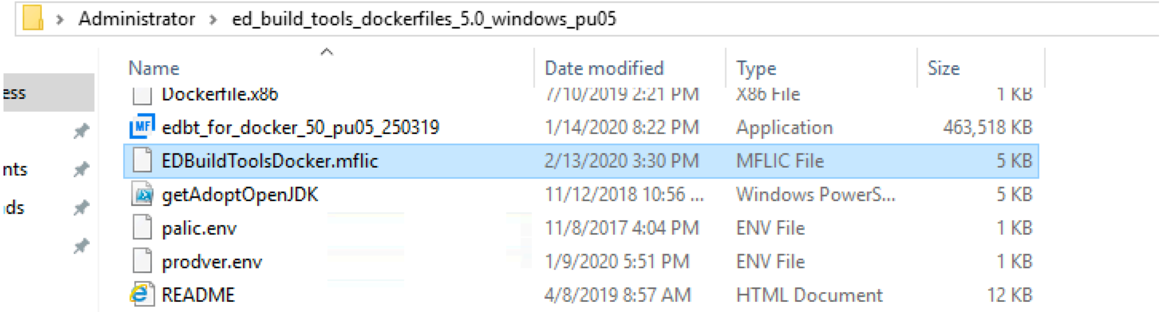
Run CLI Setup installer.

Then copy the Micro Focus docker container file from your S3 bucket:

```
aws s3 cp s3://microfocus-aws/ed_build_tools_dockerfiles_5.0_windows_pu05.zip .
download: s3://microfocus-aws/ed_build_tools_dockerfiles_5.0_windows_pu05.zip to
./ed_build_tools_dockerfiles_5.0_windows_pu05.zip
```

Extract the zip file.

In the extracted location, copy in the correct license file (.mflic) for that product



Administrator > ed_build_tools_dockerfiles_5.0_windows_pu05

Name	Date modified	Type	Size
Dockerfile.x86	7/10/2019 2:21 PM	X86 File	1 KB
edbt_for_docker_50_pu05_250319	1/14/2020 8:22 PM	Application	463,518 KB
EDBuildToolsDocker.mflic	2/13/2020 3:30 PM	MFLIC File	5 KB
getAdoptOpenJDK	11/12/2018 10:56 ...	Windows PowerS...	5 KB
palic.env	11/8/2017 4:04 PM	ENV File	1 KB
prodver.env	1/9/2020 5:51 PM	ENV File	1 KB
README	4/8/2019 8:57 AM	HTML Document	12 KB

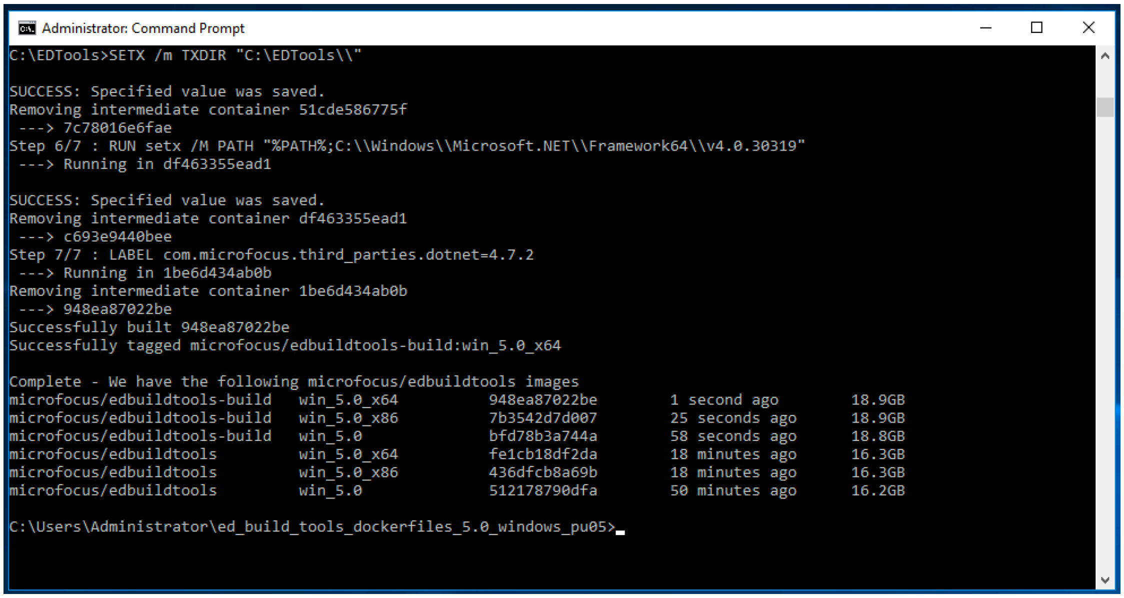
Also copy the C:\MicroFocus_Software\EDBT\edbt_50.exe from the EDz instance to the extracted folder.

From the extracted folder, run bld.bat IacceptEULA which will build the container images for you

```
bld.bat IacceptEULA
```

If you receive an error message such as the following, you likely don't have Docker Enterprise v19 installed and see previous steps to install it.

```
Step 1/26 : ARG BASE_SUFFIX=
Please provide a source image with `from` prior to commit
```



```
C:\EDTools>SETX /m TXDIR "C:\EDTools\\"

SUCCESS: Specified value was saved.
Removing intermediate container 51cde586775f
 ---> 7c78016e6fae
Step 6/7 : RUN setx /M PATH "%PATH%;C:\\Windows\\Microsoft.NET\\Framework64\\v4.0.30319"
 ---> Running in df463355ead1

SUCCESS: Specified value was saved.
Removing intermediate container df463355ead1
 ---> c693e9440bee
Step 7/7 : LABEL com.microfocus.third_parties.dotnet=4.7.2
 ---> Running in 1be6d434ab0b
Removing intermediate container 1be6d434ab0b
 ---> 948ea87022be
Successfully built 948ea87022be
Successfully tagged microfocus/edbuildtools-build:win_5.0_x64

Complete - We have the following microfocus/edbuildtools images
microfocus/edbuildtools-build   win_5.0_x64         948ea87022be        1 second ago        18.9GB
microfocus/edbuildtools-build   win_5.0_x86         7b3542d7d007        25 seconds ago      18.9GB
microfocus/edbuildtools-build   win_5.0             bfd78b3a744a        58 seconds ago      18.8GB
microfocus/edbuildtools         win_5.0_x64         fe1cb18df2da        18 minutes ago      16.3GB
microfocus/edbuildtools         win_5.0_x86         436dfcb8a69b        18 minutes ago      16.3GB
microfocus/edbuildtools         win_5.0             512178790dfa        50 minutes ago      16.2GB

C:\Users\Administrator\ed_build_tools_dockerfiles_5.0_windows_pu05>_
```

Build output:

```
Complete - We have the following microfocus/edbuildtools images
microfocus/edbuildtools-build   win_5.0_x64         948ea87022be        1 second ago        18.9GB
microfocus/edbuildtools-build   win_5.0_x86         7b3542d7d007        25 seconds ago      18.9GB
microfocus/edbuildtools-build   win_5.0             bfd78b3a744a        58 seconds ago      18.8GB
microfocus/edbuildtools         win_5.0_x64         fe1cb18df2da        18 minutes ago      16.3GB
microfocus/edbuildtools         win_5.0_x86         436dfcb8a69b        18 minutes ago      16.3GB
microfocus/edbuildtools         win_5.0             512178790dfa        50 minutes ago      16.2GB
```

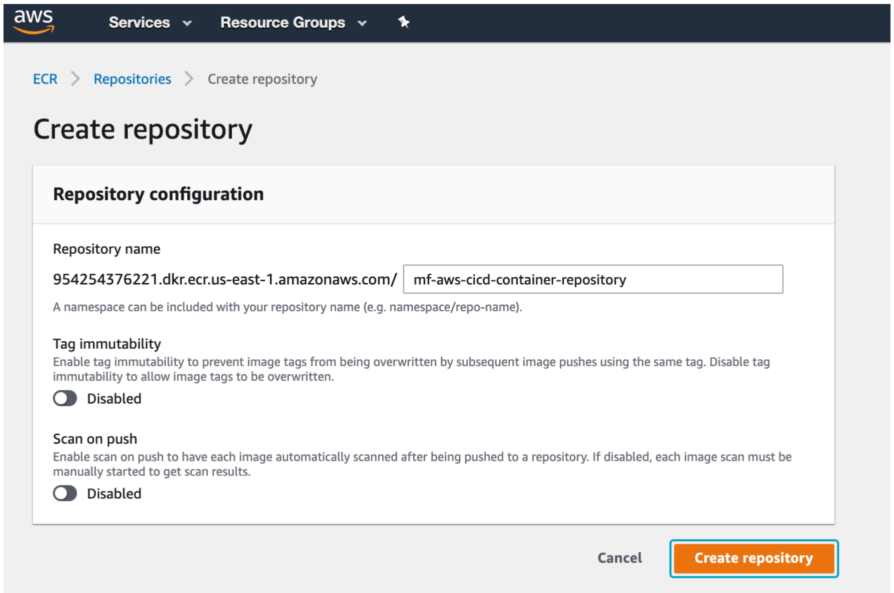
You can then display images with:

```
docker image ls
REPOSITORY                      TAG                 IMAGE ID            CREATED             SIZE
microfocus/edbuildtools-build   win_5.0_x64         948ea87022be        25 minutes ago      18.9GB
microfocus/edbuildtools-build   win_5.0_x86         7b3542d7d007        25 minutes ago      18.9GB
microfocus/edbuildtools-build   win_5.0             bfd78b3a744a        25 minutes ago      18.8GB
microfocus/edbuildtools         win_5.0_x64         fe1cb18df2da        43 minutes ago      16.3GB
microfocus/edbuildtools         win_5.0_x86         436dfcb8a69b        43 minutes ago      16.3GB
microfocus/edbuildtools         win_5.0             512178790dfa        About an hour ago   16.2GB
microsoft/dotnet-framework      4.7.2-runtime       da6e6a287bce        4 weeks ago         13.3GB
microsoft/dotnet-framework      4.7.2-sdk           bab65b1f870b        4 months ago        15.8GB
hello-world                     nanoserver-sac2016  2c911f8d79db        13 months ago       1.17GB
```

Explore the edbuildtools-build win_5.0_x64 docker image with commands similar to the followings:

```
docker run -it 948ea87022be cmd
dir
exit
```

In Amazon ECR, create a repository to store the docker image.



Create repository

Repository configuration

Repository name

954254376221.dkr.ecr.us-east-1.amazonaws.com/ mf-aws-cicd-container-repository

A namespace can be included with your repository name (e.g. namespace/repo-name).

Tag immutability

Enable tag immutability to prevent image tags from being overwritten by subsequent image pushes using the same tag. Disable tag immutability to allow image tags to be overwritten.

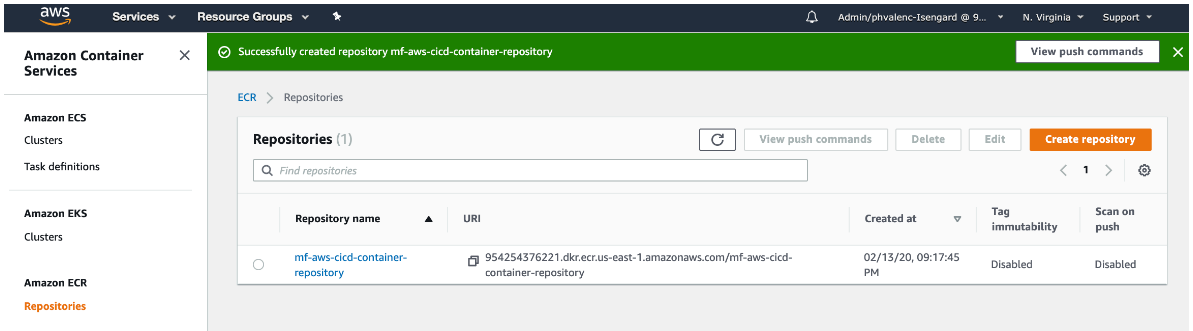
Disabled

Scan on push

Enable scan on push to have each image automatically scanned after being pushed to a repository. If disabled, each image scan must be manually started to get scan results.

Disabled

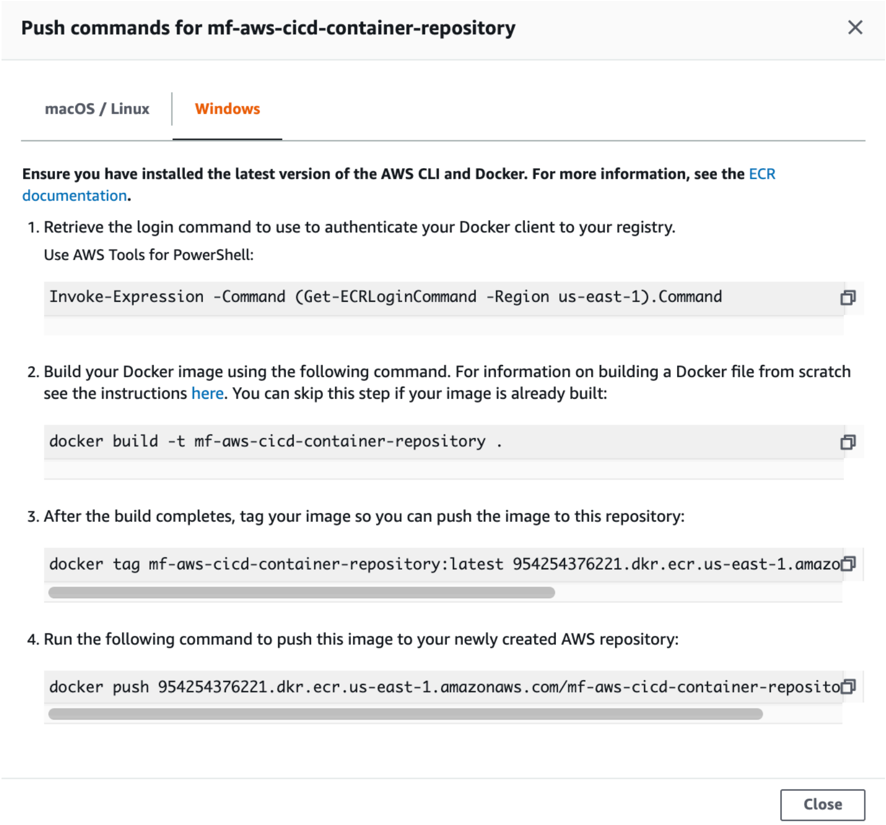
Enter repository name: mf-aws-cicd-container-repository, then select Create repository.



Successfully created repository mf-aws-cicd-container-repository

	Repository name	URI	Created at	Tag immutability	Scan on push
○	mf-aws-cicd-container-repository	954254376221.dkr.ecr.us-east-1.amazonaws.com/mf-aws-cicd-container-repository	02/13/20, 09:17:45 PM	Disabled	Disabled

Click View push commands



Push commands for mf-aws-cicd-container-repository

Ensure you have installed the latest version of the AWS CLI and Docker. For more information, see the ECR documentation.

1. Retrieve the login command to use to authenticate your Docker client to your registry.
   Use AWS Tools for PowerShell:

```
Invoke-Expression -Command (Get-ECRLoginCommand -Region us-east-1).Command
```

2. Build your Docker image using the following command. For information on building a Docker file from scratch see the instructions here. You can skip this step if your image is already built:

```
docker build -t mf-aws-cicd-container-repository .
```

3. After the build completes, tag your image so you can push the image to this repository:

```
docker tag mf-aws-cicd-container-repository:latest 954254376221.dkr.ecr.us-east-1.amazo
```

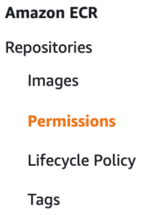
4. Run the following command to push this image to your newly created AWS repository:

```
docker push 954254376221.dkr.ecr.us-east-1.amazonaws.com/mf-aws-cicd-container-reposito
```

Copy-paste the commands which will be customized to push the docker image from the temporary EC2 instance to Amazon ECR.

```
Invoke-Expression -Command (Get-ECRLoginCommand -Region us-east-1).Command
docker build -t mf-aws-cicd-container-repository .
docker tag mf-aws-cicd-container-repository:latest 954254376221.dkr.ecr.us-east-1.amazonaws.com/mf-aws-cicd-container-repository:latest
docker push 954254376221.dkr.ecr.us-east-1.amazonaws.com/mf-aws-cicd-container-repository:latest
```

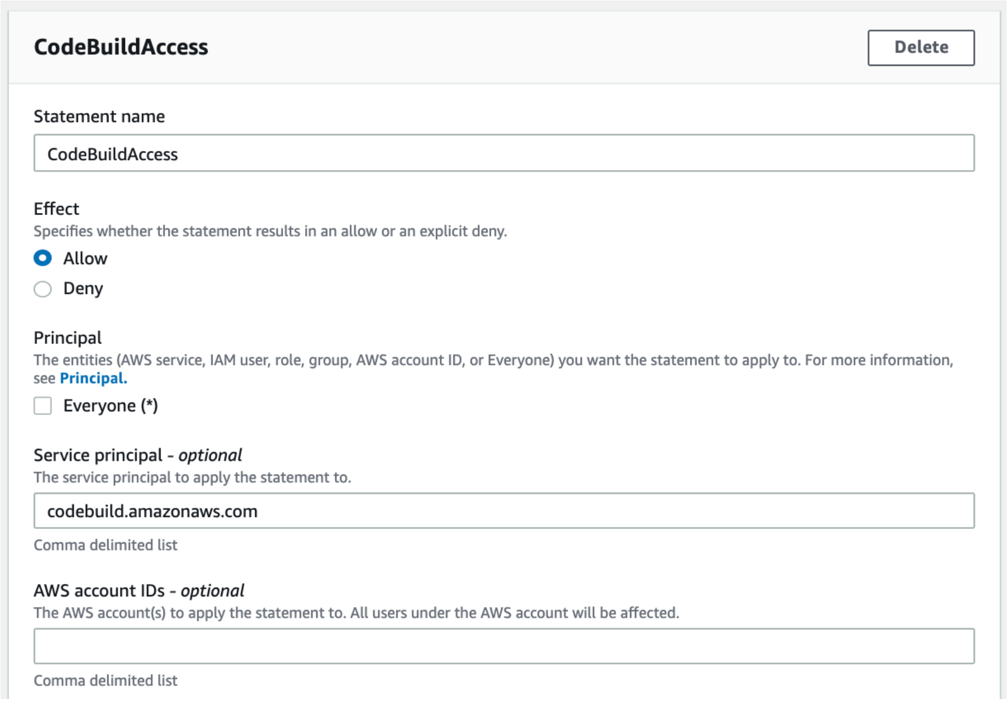
Click on the mf-aws-cicd-container-repository name, then select Permissions.



Under Permissions – Statements, click Edit to create one, then choose Add statement.

Enter CodeBuildAccess for the Statement name.

Enter codebuild.amazonaws.com for the Service principal.



Statement name

CodeBuildAccess

Effect

Specifies whether the statement results in an allow or an explicit deny.

● Allow

○ Deny

Principal

The entities (AWS service, IAM user, role, group, AWS account ID, or Everyone) you want the statement to apply to. For more information, see **Principal.**

□ Everyone (*)

Service principal - *optional*

The service principal to apply the statement to.

codebuild.amazonaws.com

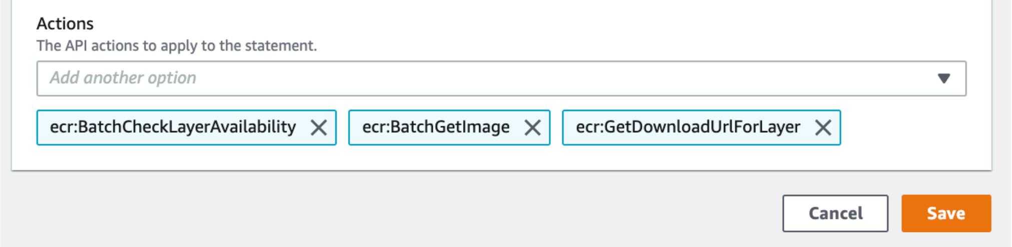
Comma delimited list

AWS account IDs - *optional*

The AWS account(s) to apply the statement to. All users under the AWS account will be affected.

Comma delimited list

For Actions, select the pull-only actions ecr:GetDownloadUrlForLayer, ecr:BatchGetImage, and ecr:BatchCheckLayerAvailability.



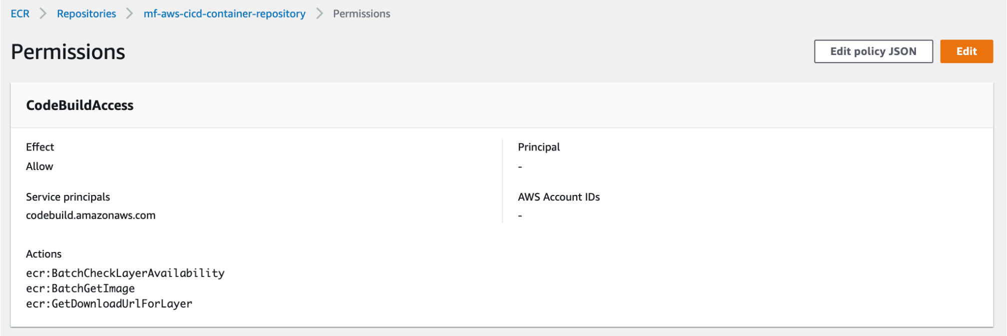
Actions

The API actions to apply to the statement.

Add another option

ecr:BatchCheckLayerAvailability ✕ ecr:BatchGetImage ✕ ecr:GetDownloadUrlForLayer ✕

Click Save.



ECR > Repositories > mf-aws-cicd-container-repository > Permissions
Edit policy JSON
Edit

Permissions

CodeBuildAccess

Effect

Allow

Principal

-

Service principals

codebuild.amazonaws.com

AWS Account IDs

-

Actions

```
ecr:BatchCheckLayerAvailability
ecr:BatchGetImage
ecr:GetDownloadUrlForLayer
```

Back in the temporary EC2 instance with the build images, start a PowerShell window and run this command to login to Amazon ECR:

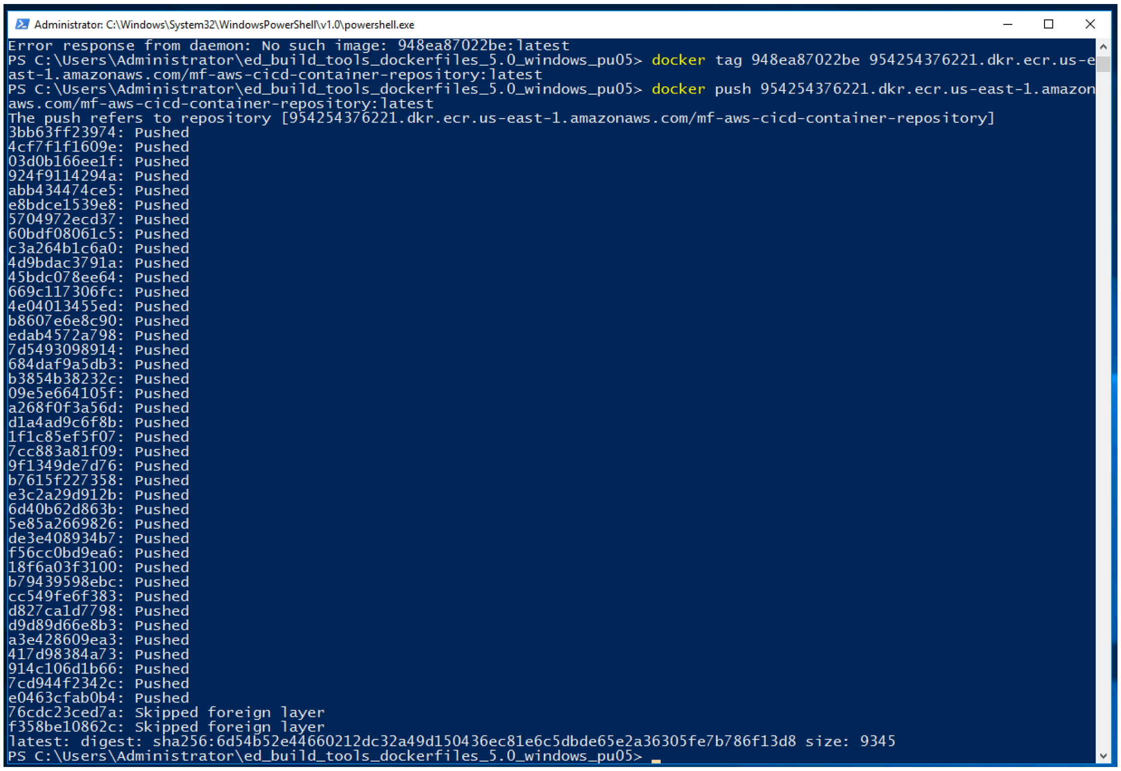
```
Invoke-Expression -Command (Get-ECRLoginCommand -Region us-east-1).Command
WARNING! Using --password via the CLI is insecure. Use --password-stdin.
WARNING! Your password will be stored unencrypted in C:\Users\Administrator\.docker\config.json.
Configure a credential helper to remove this warning. See
https://docs.docker.com/engine/reference/commandline/login/#credentials-store
Login Succeeded
```

From the list of images previously displayed, find the image ID for the microfocus/edbuildtools-build win_5.0_x64 image which is 948ea87022be in our example). Then incorporate the image ID in the following command and run the command to tag the image:

```
docker tag 948ea87022be 954254376221.dkr.ecr.us-east-1.amazonaws.com/mf-aws-cicd-container-
repository:edbuildtools-build-win_5.0_x64
```

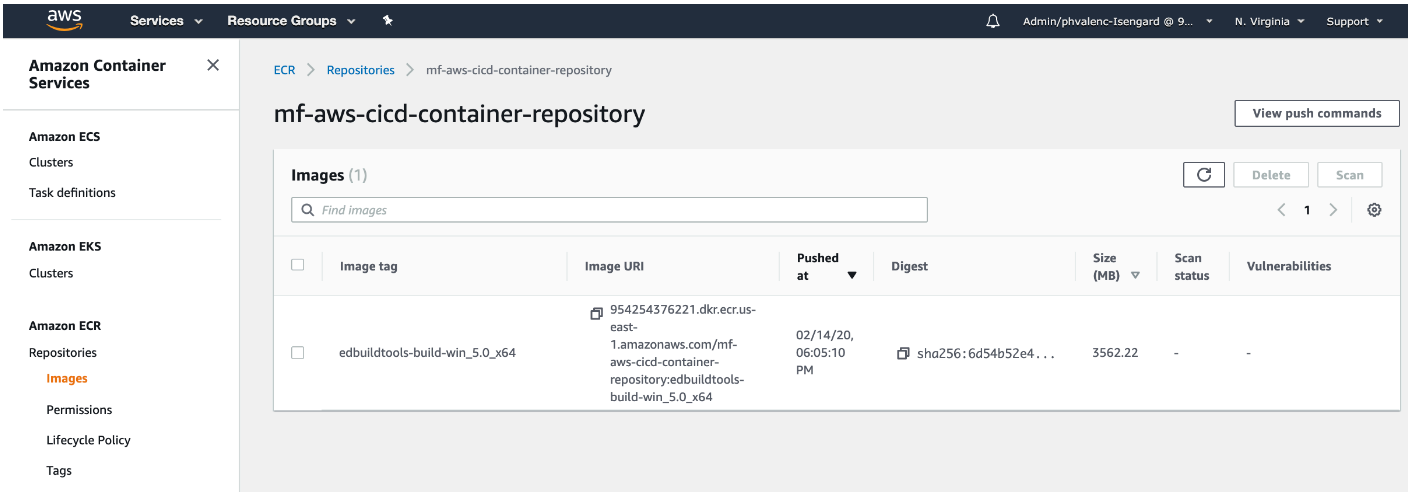
Then push this image in the Amazon ECR repository:

```
docker push 954254376221.dkr.ecr.us-east-1.amazonaws.com/mf-aws-cicd-container-
repository:edbuildtools-build-win_5.0_x64
```


Administrator: C:\Windows\System32\WindowsPowerShell\v1.0\powershell.exe

```
Error response from daemon: No such image: 948ea87022be:latest
PS C:\Users\Administrator\ed_build_tools_dockerfiles_5.0_windows_pu05> docker tag 948ea87022be 954254376221.dkr.ecr.us-e
ast-1.amazonaws.com/mf-aws-cicd-container-repository:latest
PS C:\Users\Administrator\ed_build_tools_dockerfiles_5.0_windows_pu05> docker push 954254376221.dkr.ecr.us-east-1.amazon
aws.com/mf-aws-cicd-container-repository:latest
The push refers to repository [954254376221.dkr.ecr.us-east-1.amazonaws.com/mf-aws-cicd-container-repository]
3bb63ff23974: Pushed
4cf7f1f1609e: Pushed
03d0b166ee1f: Pushed
924f9114294a: Pushed
abb434474ce5: Pushed
e8bdce1539e8: Pushed
5704972ecd37: Pushed
60bdf08061c5: Pushed
c3a264b1c6a0: Pushed
4d9bdac3791a: Pushed
45bdc078ee64: Pushed
669c117306fc: Pushed
4e04013455ed: Pushed
b8607e6e8c90: Pushed
edab4572a798: Pushed
7d5493098914: Pushed
684daf9a5db3: Pushed
b3854b38232c: Pushed
09e5e664105f: Pushed
a268f0f3a56d: Pushed
d1a4ad9c6f8b: Pushed
1f1c85ef5f07: Pushed
7cc883a81f09: Pushed
9f1349de7d76: Pushed
b7615f227358: Pushed
e3c2a29d912b: Pushed
6d40b62d863b: Pushed
5e85a2669826: Pushed
de3e408934b7: Pushed
f56cc0bd9ea6: Pushed
18f6a03f3100: Pushed
b79439598ebc: Pushed
cc549fe6f383: Pushed
d827ca1d7798: Pushed
d9d89d66e8b3: Pushed
a3e428609ea3: Pushed
417d98384a73: Pushed
914c106d1b66: Pushed
7cd944f2342c: Pushed
e0463cfab0b4: Pushed
76cdc23ced7a: Skipped foreign layer
f358be10862c: Skipped foreign layer
latest: digest: sha256:6d54b52e44660212dc32a49d150436ec81e6c5dbde65e2a36305fe7b786f13d8 size: 9345
PS C:\Users\Administrator\ed_build_tools_dockerfiles_5.0_windows_pu05> _
```

On the Amazon ECR side, you can then see the new image in the repository



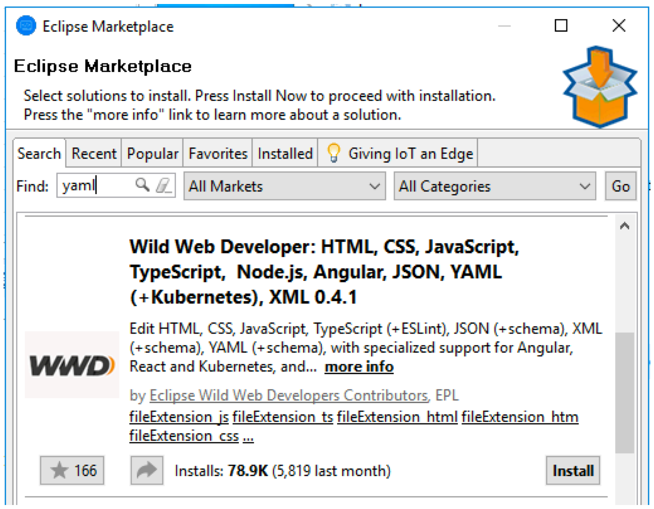
mf-aws-cicd-container-repository

Images (1)

□	Image tag	Image URI	Pushed at ▼	Digest	Size (MB) ▽	Scan status	Vulnerabilities
□	edbuildtools-build-win_5.0_x64	954254376221.dkr.ecr.us-east-1.amazonaws.com/mf-aws-cicd-container-repository:edbuildtools-build-win_5.0_x64	02/14/20, 06:05:10 PM	sha256:6d54b52e4...	3562.22	-	-

4.2 BUILD – AWS CodeBuild configuration

In EDz, select Help -> Eclipse Marketplace… Enter yaml in Find field and search.



Eclipse Marketplace

Select solutions to install. Press Install Now to proceed with installation.
Press the "more info" link to learn more about a solution.

Find: yaml — All Markets — All Categories — Go

Wild Web Developer: HTML, CSS, JavaScript, TypeScript, Node.js, Angular, JSON, YAML (+Kubernetes), XML 0.4.1

Edit HTML, CSS, JavaScript, TypeScript (+ESLint), JSON (+schema), XML (+schema), YAML (+schema), with specialized support for Angular, React and Kubernetes, and... more info

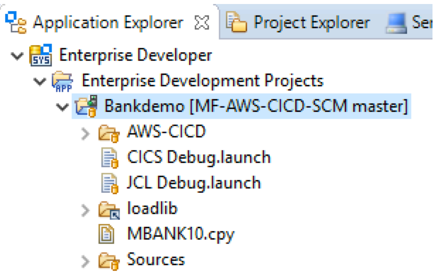
by Eclipse Wild Web Developers Contributors, EPL
fileExtension_js fileExtension_ts fileExtension_html fileExtension_htm fileExtension_css ...

166 — Installs: 78.9K (5,819 last month) — Install

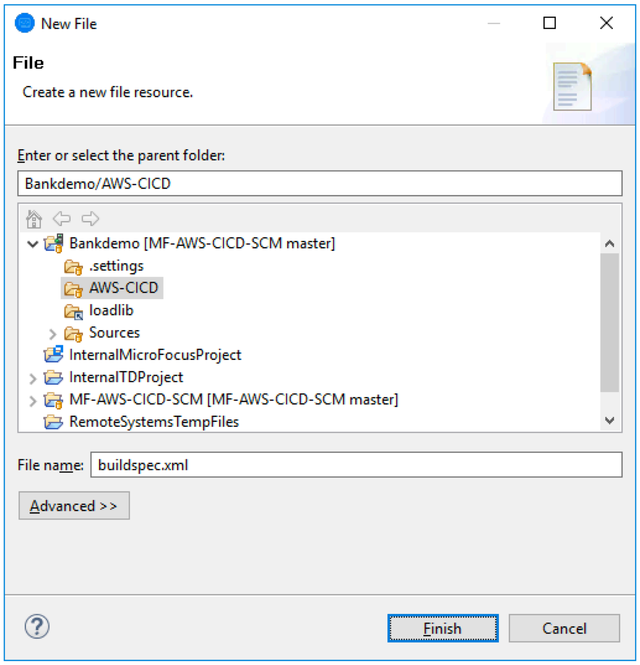
Install Wild Web Developer. It facilitates the editing of Yaml files that we will create next.

In EDz Bankdemo project, select New -> Folder -> Folder… and create an AWS-CICD folder.

You may need to Refresh Resource (F5) to see it.



In this AWS-CICD folder, select New -> File -> Other File… and create a buildspec.yml file.



File

Create a new file resource.

Enter or select the parent folder: Bankdemo/AWS-CICD

File name: buildspec.xml

The buildspec.yml file is a build specification file which contains a collection of build commands and related settings, in YAML format, that CodeBuild uses to run a build.

Details about the buildspec.yml file and syntax are here: https://docs.aws.amazon.com/codebuild/latest/userguide/build-spec-ref.html

Buildspec.yml commands run in a Windows Server Core 2016 image using the Powershell shell.

Edit the buildspec.yml file:

```
version: 0.2

env:
  variables:
    SOURCE_COBOL_FOLDER: .\Bankdemo\Sources\cbl
    AWS_CICD_FOLDER: .\Bankdemo\AWS-CICD
    COBCPY: .\Bankdemo\Sources\copybook;C:\EDTools\cpylib # where to find copybooks such as DFHAID and
application copybooks
    COBOL_EXE_PATH_FILE: C:\EDTools\bin\cobol.exe
    CBLLINK_EXE_PATH_FILE: C:\EDTools\bin\cbllink.exe
    COBOL_COMPILER_DIRECTIVES:
"preprocess(EXCI),CICSECM(),CHARSET(EBCDIC),DIALECT(ENTCOBOL),SOURCEFORMAT(fixed),NOPANVALET,NOLIBRARIAN
,ANIM,EXITPROGRAM(ANSI),WARNING(1),MAX-ERROR(100)"
    COBDIR: C:\EDTools # where to find the message file

phases:
  pre_build:
    commands:
      - echo ================================================================================
      - echo Variables
      - 'echo SOURCE_COBOL_FOLDER: $env:SOURCE_COBOL_FOLDER'
      - 'echo AWS_CICD_FOLDER: $env:AWS_CICD_FOLDER'
      - 'echo COBOL_COMPILER_DIRECTIVES: $env:COBOL_COMPILER_DIRECTIVES'
      - 'echo COBOL_EXE_PATH_FILE: $env:COBOL_EXE_PATH_FILE'
      - 'echo CBLLINK_EXE_PATH_FILE: $env:CBLLINK_EXE_PATH_FILE'
      - 'echo COBDIR: $env:COBDIR'
      - 'echo COBCPY: $env:COBCPY'
      - dir
      - dir  $env:SOURCE_COBOL_FOLDER

  build:
    commands:
      - echo ================================================================================
      - echo "Compiling begins"
      - foreach ($f in Get-ChildItem $env:SOURCE_COBOL_FOLDER -Filter "*.cbl") {
            echo --------------------------------------------------------------------------------;
            echo "Compiling $($f.FullName)";
            & $env:COBOL_EXE_PATH_FILE "$($f.FullName),,,$($env:COBOL_COMPILER_DIRECTIVES);";
            }
      - echo --------------------------------------------------------------------------------
      - echo "Compiling ends"
      - echo ""
      - echo ================================================================================
      - echo "Linking begins"
      - foreach ($f in Get-ChildItem "." -Filter "*.obj") {
            echo --------------------------------------------------------------------------------;
            echo "Linking $($f.FullName)";
            & $env:CBLLINK_EXE_PATH_FILE -d $f.FullName;
            }
      - echo --------------------------------------------------------------------------------
      - echo "Linking ends"

  post_build:
    commands:
      - echo ================================================================================
      - echo "Preparing build output files for packaging"
      - mkdir ./dll
      - cp *.dll ./dll
      - cp $env:AWS_CICD_FOLDER/* .
      - compress-archive -path ./dll -destinationpath ./deploy.zip
      - compress-archive -path $env:AWS_CICD_FOLDER/* -update -destinationpath ./deploy.zip

artifacts:
  files:
    - deploy.zip                    # For CodeDeploy manual deployment
    - appspec.yml                   # For CodePipeline automated deployment
    - codedeploy-before-install.bat # For CodePipeline automated deployment
    - codedeploy-after-install.bat  # For CodePipeline automated deployment
    - dll/*                         # For CodePipeline automated deployment
  discard-paths: no
```

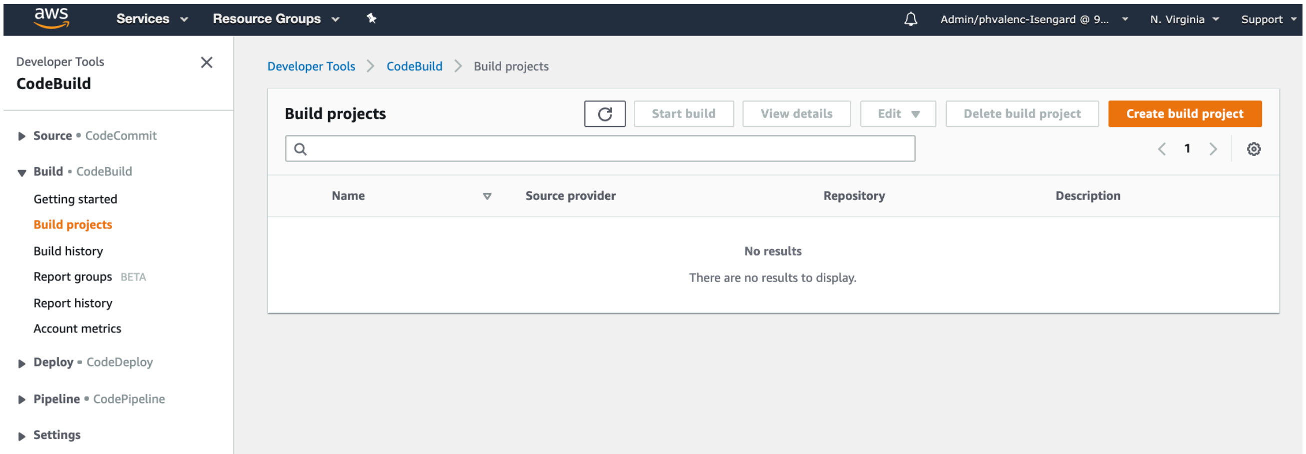
Save this buildspec.yml file.

Commit and push this change to CodeCommit.

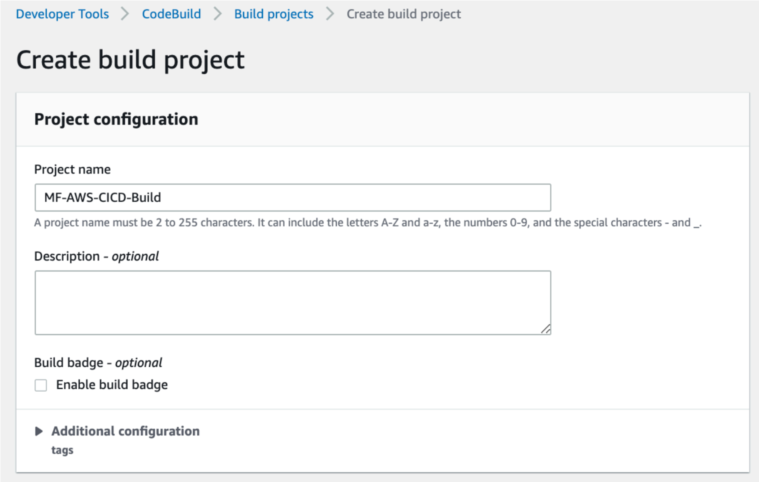
In S3, create a S3 bucket for the build artefact. We use mf-aws-cicd-artifacts in our example.

☐ mf-aws-cicd-artifacts | Bucket and objects not public | US East (N. Virginia)

Go to CodeBuild



Click Create build project.



Developer Tools > CodeBuild > Build projects > Create build project

Create build project

Project configuration

Project name

MF-AWS-CICD-Build

A project name must be 2 to 255 characters. It can include the letters A-Z and a-z, the numbers 0-9, and the special characters - and _.

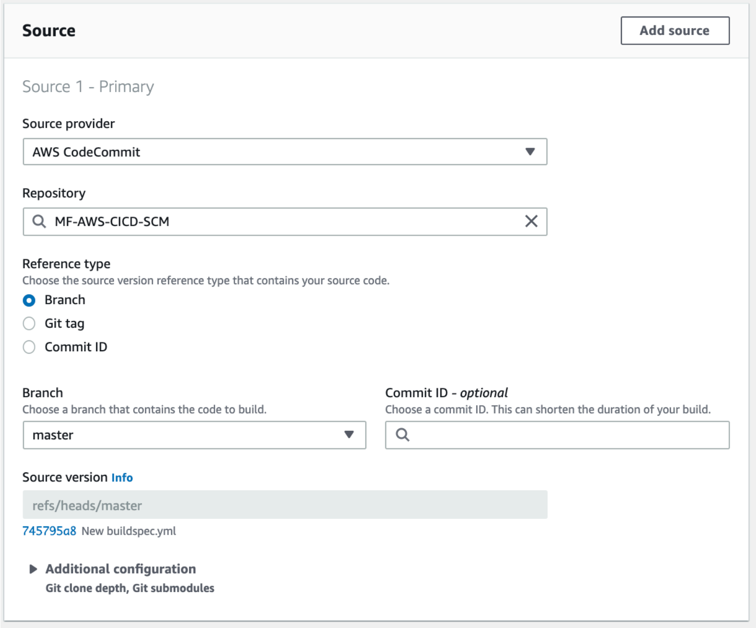
Description - *optional*

Build badge - *optional*

□ Enable build badge

▶ **Additional configuration**
tags

Enter the project name: MF-AWS-CICD-Build.



Source

Source 1 - Primary

Source provider

AWS CodeCommit ▼

Repository

MF-AWS-CICD-SCM

Reference type

Choose the source version reference type that contains your source code.

● Branch
○ Git tag
○ Commit ID

Branch

Choose a branch that contains the code to build.

master ▼

Commit ID - *optional*

Choose a commit ID. This can shorten the duration of your build.

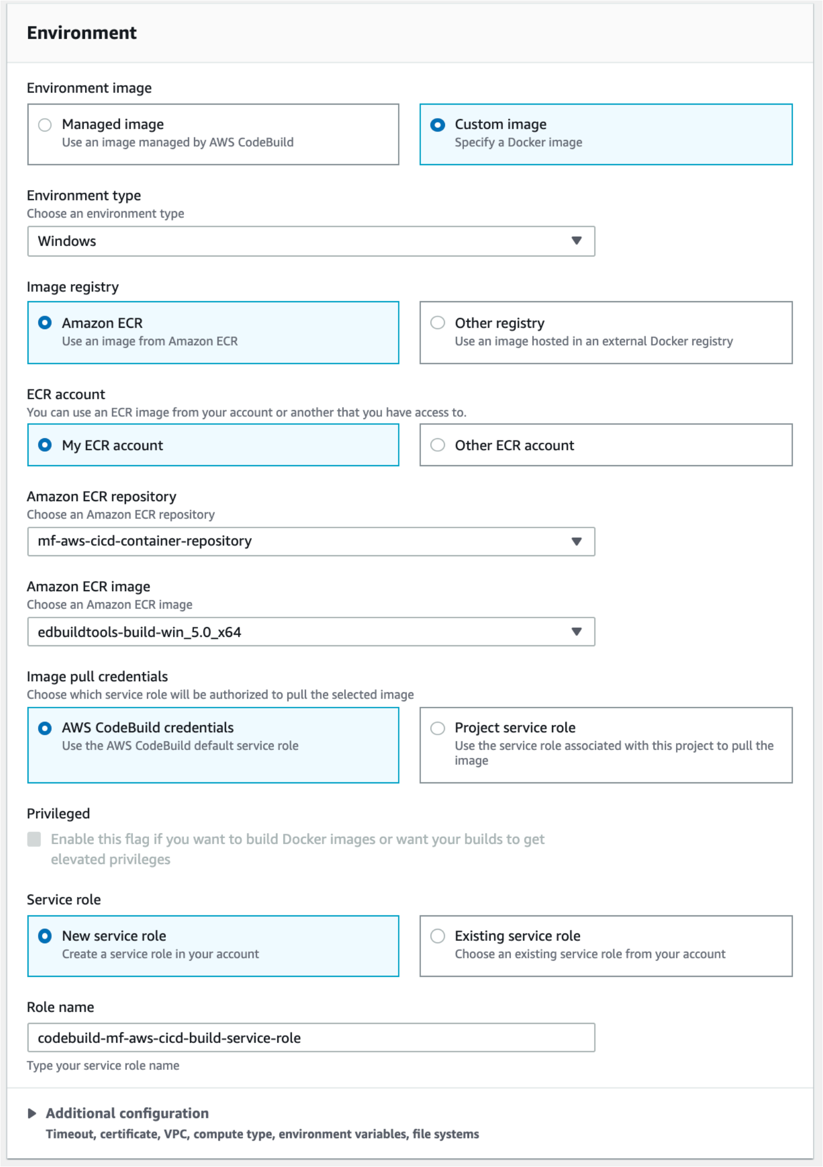
Source version Info

refs/heads/master

745795a8 New buildspec.yml

▶ **Additional configuration**
Git clone depth, Git submodules

Select CodeCommit provider, MF-AWS-CICD-SCM repository, master branch.



Environment

Environment image

○ Managed image
Use an image managed by AWS CodeBuild

● Custom image
Specify a Docker image

Environment type
Choose an environment type

Windows

Image registry

● Amazon ECR
Use an image from Amazon ECR

○ Other registry
Use an image hosted in an external Docker registry

ECR account
You can use an ECR image from your account or another that you have access to.

● My ECR account

○ Other ECR account

Amazon ECR repository
Choose an Amazon ECR repository

mf-aws-cicd-container-repository

Amazon ECR image
Choose an Amazon ECR image

edbuildtools-build-win_5.0_x64

Image pull credentials
Choose which service role will be authorized to pull the selected image

● AWS CodeBuild credentials
Use the AWS CodeBuild default service role

○ Project service role
Use the service role associated with this project to pull the image

Privileged

□ Enable this flag if you want to build Docker images or want your builds to get elevated privileges

Service role

● New service role
Create a service role in your account

○ Existing service role
Choose an existing service role from your account

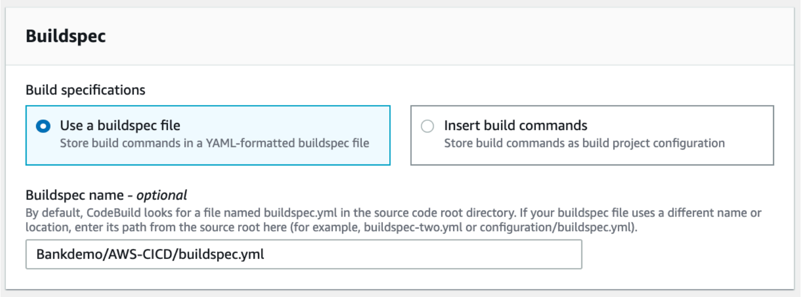
Role name

codebuild-mf-aws-cicd-build-service-role

Type your service role name

▶ **Additional configuration**
Timeout, certificate, VPC, compute type, environment variables, file systems

Select a Custom image (Docker image) of Windows type within the Amazon ECR registry in My ECR account within mf-aws-cicd-container-repository named edbuildtools-build-win_5.0_x64. We use AWS CodeBuild credentials and a New service role named codebuild-mf-aws-cicd-build-service-role.



Buildspec

Build specifications

● Use a buildspec file
Store build commands in a YAML-formatted buildspec file

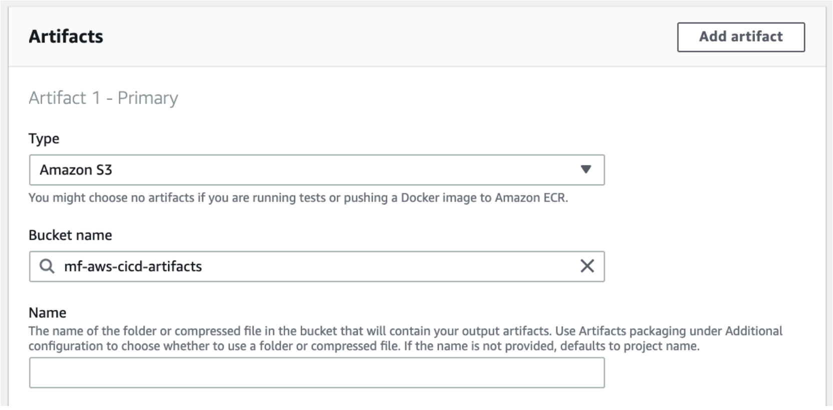
○ Insert build commands
Store build commands as build project configuration

Buildspec name - *optional*
By default, CodeBuild looks for a file named buildspec.yml in the source code root directory. If your buildspec file uses a different name or location, enter its path from the source root here (for example, buildspec-two.yml or configuration/buildspec.yml).

Bankdemo/AWS-CICD/buildspec.yml

We use a buildspec file in the following location: Bankdemo/AWS-CICD/buildspec.yml

Under Artifacts, choose the Amazon S3 and mf-aws-cicd-artifacts bucket.



Artifacts

Artifact 1 - Primary

Type

Amazon S3

You might choose no artifacts if you are running tests or pushing a Docker image to Amazon ECR.

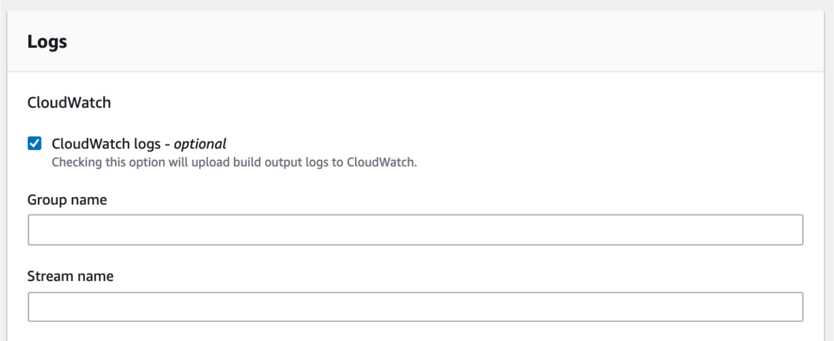
Bucket name

mf-aws-cicd-artifacts

Name

The name of the folder or compressed file in the bucket that will contain your output artifacts. Use Artifacts packaging under Additional configuration to choose whether to use a folder or compressed file. If the name is not provided, defaults to project name.

For the Logs, we store build output logs in CloudWatch.



Logs

CloudWatch

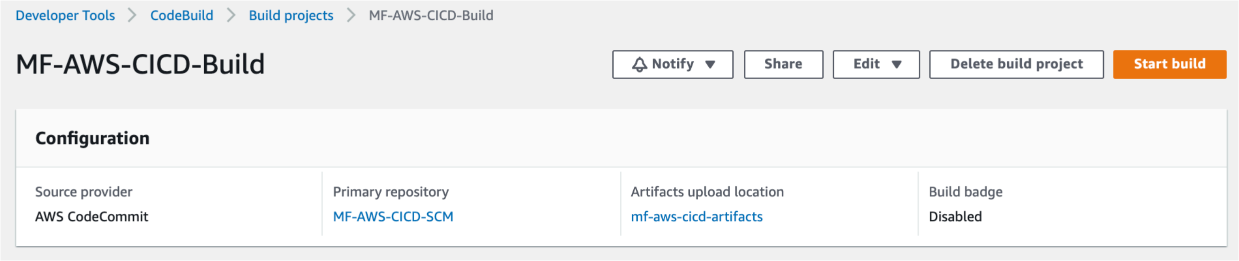
☑ CloudWatch logs - *optional*

Checking this option will upload build output logs to CloudWatch.

Group name

Stream name

Click Create build project.

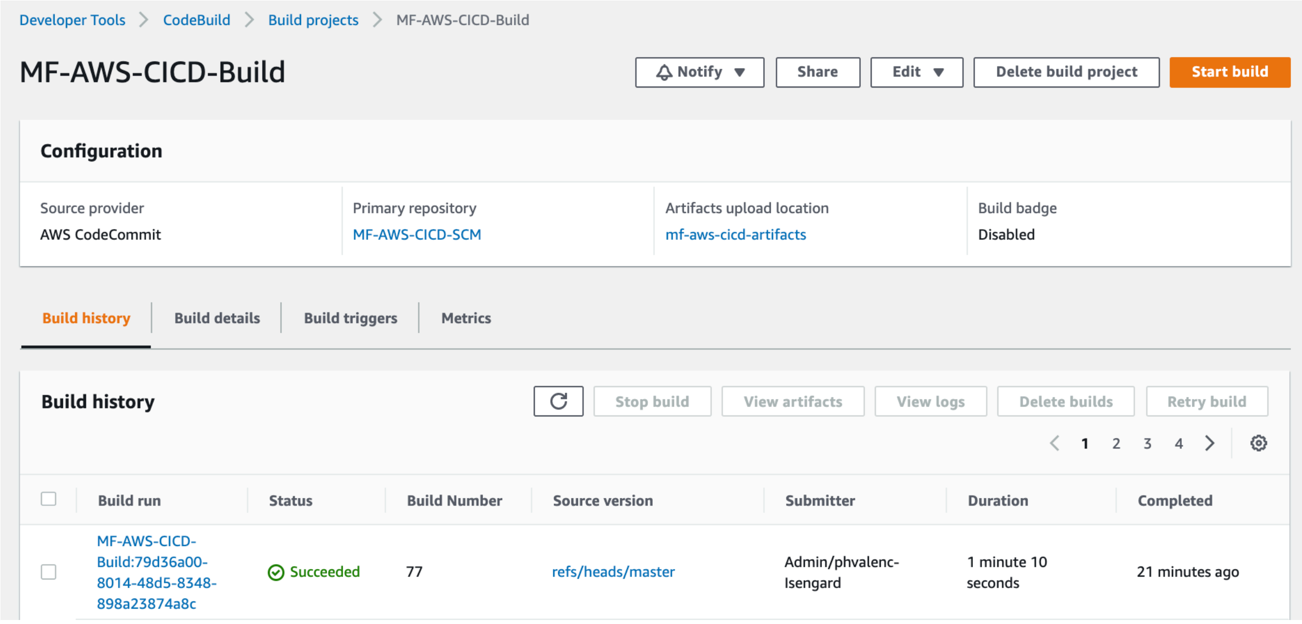

Developer Tools > CodeBuild > Build projects > MF-AWS-CICD-Build
Notify
Share
Edit
Delete build project
Start build

MF-AWS-CICD-Build

Configuration

Source provider	Primary repository	Artifacts upload location	Build badge
AWS CodeCommit	MF-AWS-CICD-SCM	mf-aws-cicd-artifacts	Disabled

Click Start build.



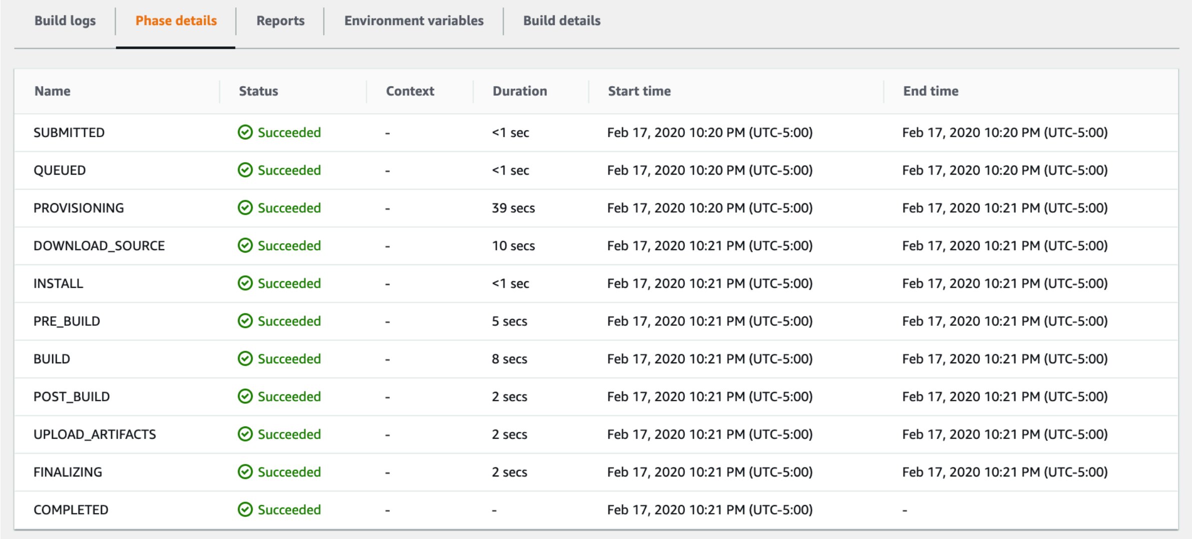
MF-AWS-CICD-Build

Configuration

Source provider	Primary repository	Artifacts upload location	Build badge
AWS CodeCommit	MF-AWS-CICD-SCM	mf-aws-cicd-artifacts	Disabled

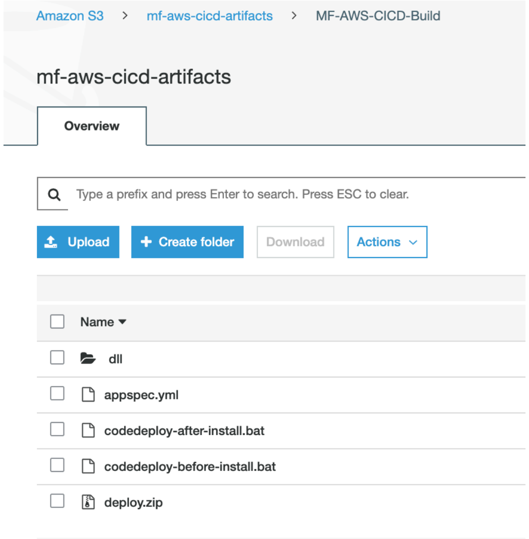
Build history

□	Build run	Status	Build Number	Source version	Submitter	Duration	Completed
□	MF-AWS-CICD-Build:79d36a00-8014-48d5-8348-898a23874a8c	✓ Succeeded	77	refs/heads/master	Admin/phvalenc-Isengard	1 minute 10 seconds	21 minutes ago



Name	Status	Context	Duration	Start time	End time
SUBMITTED	✓ Succeeded	-	<1 sec	Feb 17, 2020 10:20 PM (UTC-5:00)	Feb 17, 2020 10:20 PM (UTC-5:00)
QUEUED	✓ Succeeded	-	<1 sec	Feb 17, 2020 10:20 PM (UTC-5:00)	Feb 17, 2020 10:20 PM (UTC-5:00)
PROVISIONING	✓ Succeeded	-	39 secs	Feb 17, 2020 10:20 PM (UTC-5:00)	Feb 17, 2020 10:21 PM (UTC-5:00)
DOWNLOAD_SOURCE	✓ Succeeded	-	10 secs	Feb 17, 2020 10:21 PM (UTC-5:00)	Feb 17, 2020 10:21 PM (UTC-5:00)
INSTALL	✓ Succeeded	-	<1 sec	Feb 17, 2020 10:21 PM (UTC-5:00)	Feb 17, 2020 10:21 PM (UTC-5:00)
PRE_BUILD	✓ Succeeded	-	5 secs	Feb 17, 2020 10:21 PM (UTC-5:00)	Feb 17, 2020 10:21 PM (UTC-5:00)
BUILD	✓ Succeeded	-	8 secs	Feb 17, 2020 10:21 PM (UTC-5:00)	Feb 17, 2020 10:21 PM (UTC-5:00)
POST_BUILD	✓ Succeeded	-	2 secs	Feb 17, 2020 10:21 PM (UTC-5:00)	Feb 17, 2020 10:21 PM (UTC-5:00)
UPLOAD_ARTIFACTS	✓ Succeeded	-	2 secs	Feb 17, 2020 10:21 PM (UTC-5:00)	Feb 17, 2020 10:21 PM (UTC-5:00)
FINALIZING	✓ Succeeded	-	2 secs	Feb 17, 2020 10:21 PM (UTC-5:00)	Feb 17, 2020 10:21 PM (UTC-5:00)
COMPLETED	✓ Succeeded	-	-	Feb 17, 2020 10:21 PM (UTC-5:00)	-

With a successful build, the artifacts are created in S3.



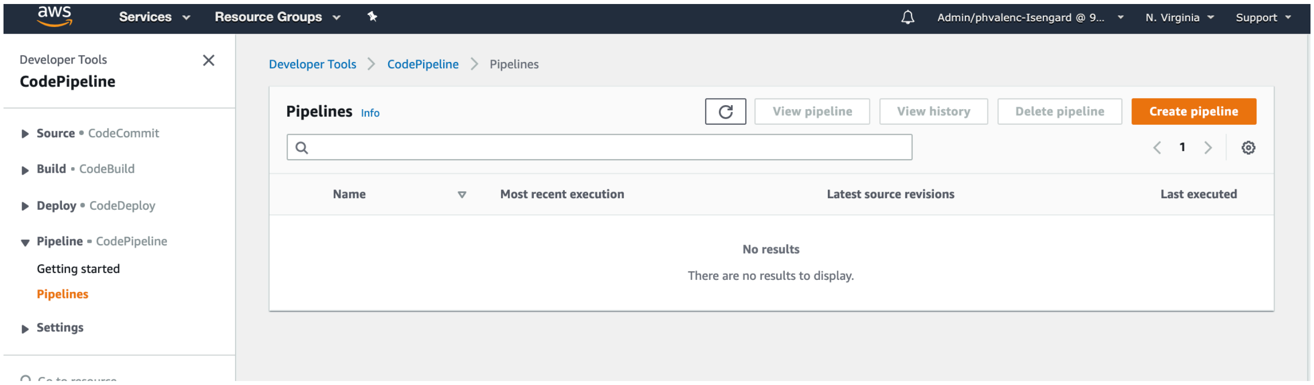
Amazon S3 > mf-aws-cicd-artifacts > MF-AWS-CICD-Build

mf-aws-cicd-artifacts

Overview
Type a prefix and press Enter to search. Press ESC to clear.
Upload
Create folder
Download
Actions

□	Name ▾
□	dll
□	appspec.yml
□	codedeploy-after-install.bat
□	codedeploy-before-install.bat
□	deploy.zip

4.3 BUILD – AWS CodePipeline configuration

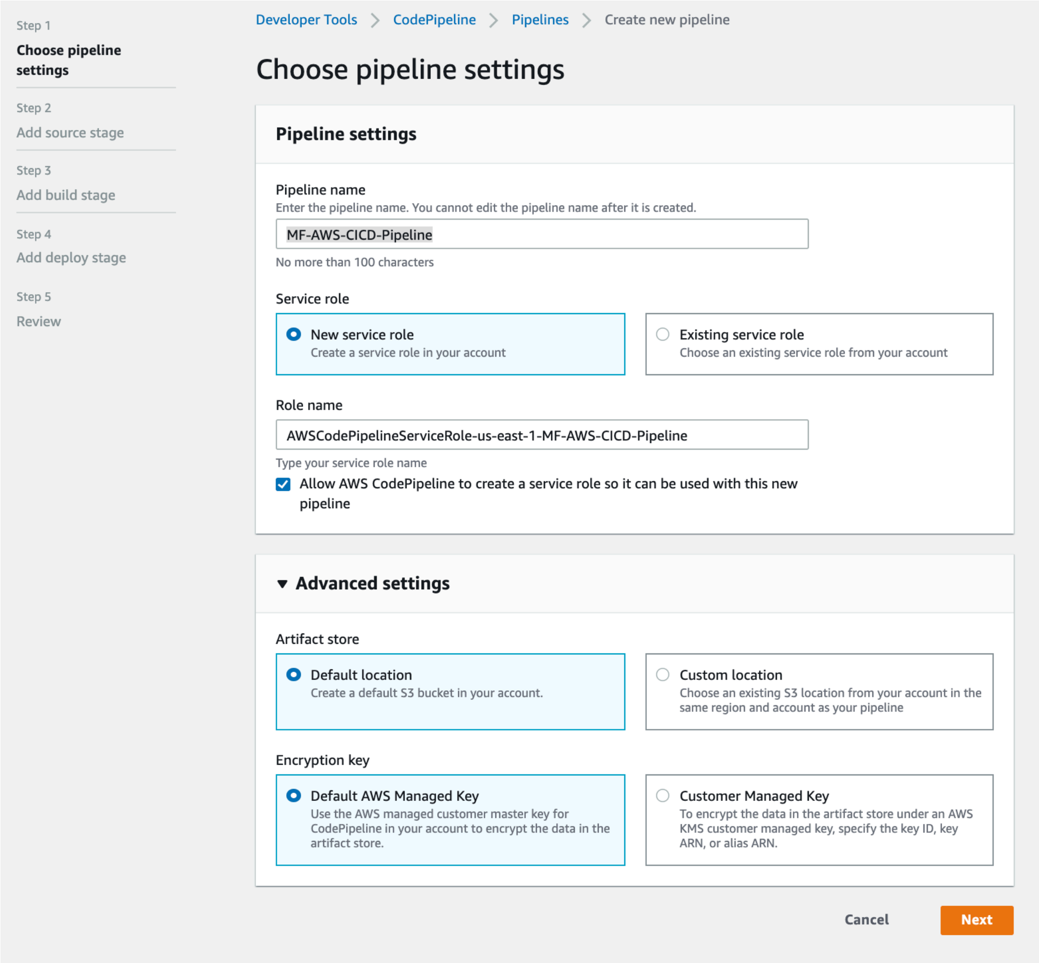


Name	Most recent execution	Latest source revisions	Last executed

No results

There are no results to display.

In CodePipeline, select Pipelines then click Create pipeline



Step 1
Choose pipeline settings
Step 2
Add source stage
Step 3
Add build stage
Step 4
Add deploy stage
Step 5
Review

Developer Tools > CodePipeline > Pipelines > Create new pipeline

Choose pipeline settings

Pipeline settings

Pipeline name
Enter the pipeline name. You cannot edit the pipeline name after it is created.
MF-AWS-CICD-Pipeline
No more than 100 characters

Service role
● New service role
Create a service role in your account
○ Existing service role
Choose an existing service role from your account

Role name
AWSCodePipelineServiceRole-us-east-1-MF-AWS-CICD-Pipeline
Type your service role name
☑ Allow AWS CodePipeline to create a service role so it can be used with this new pipeline

▼ Advanced settings

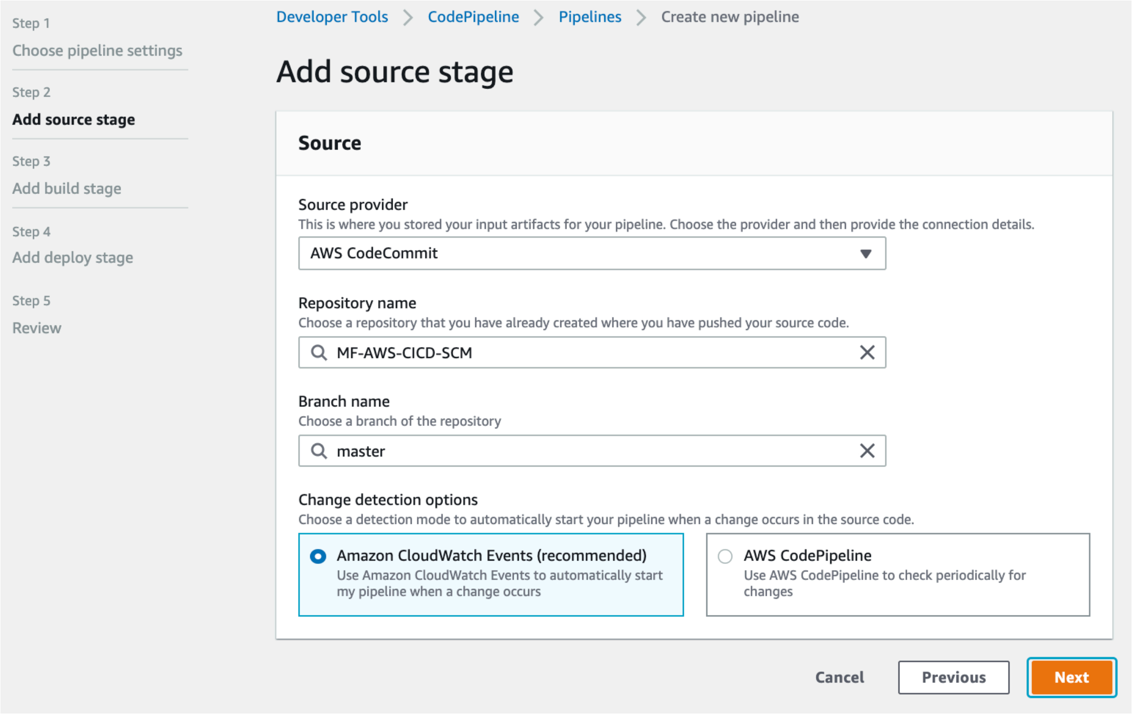
Artifact store
● Default location
Create a default S3 bucket in your account.
○ Custom location
Choose an existing S3 location from your account in the same region and account as your pipeline

Encryption key
● Default AWS Managed Key
Use the AWS managed customer master key for CodePipeline in your account to encrypt the data in the artifact store.
○ Customer Managed Key
To encrypt the data in the artifact store under an AWS KMS customer managed key, specify the key ID, key ARN, or alias ARN.

Enter the pipeline name: MF-AWS-CICD-Pipeline.

We select Default location for the artifact store, meaning we will not reuse the one created for CodeBuild and CodeDeploy previously but we’ll use one which is automatically generated by CodePipeline.

Click Next.



Add source stage

Source

Source provider
This is where you stored your input artifacts for your pipeline. Choose the provider and then provide the connection details.
AWS CodeCommit

Repository name
Choose a repository that you have already created where you have pushed your source code.
MF-AWS-CICD-SCM

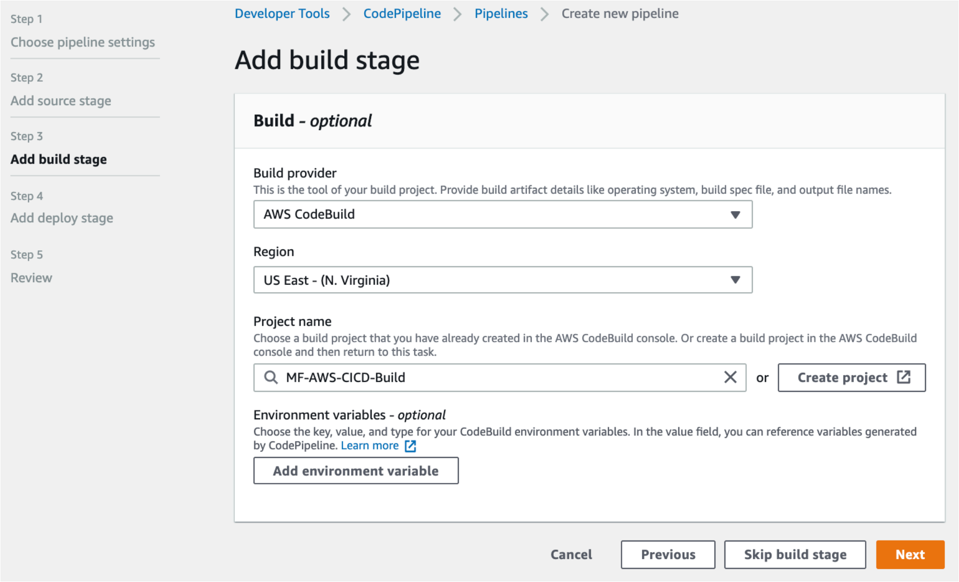
Branch name
Choose a branch of the repository
master

Change detection options
Choose a detection mode to automatically start your pipeline when a change occurs in the source code.

● Amazon CloudWatch Events (recommended)
Use Amazon CloudWatch Events to automatically start my pipeline when a change occurs

○ AWS CodePipeline
Use AWS CodePipeline to check periodically for changes

Select the CodeCommit repository and branch, then click Next.



Add build stage

Build - *optional*

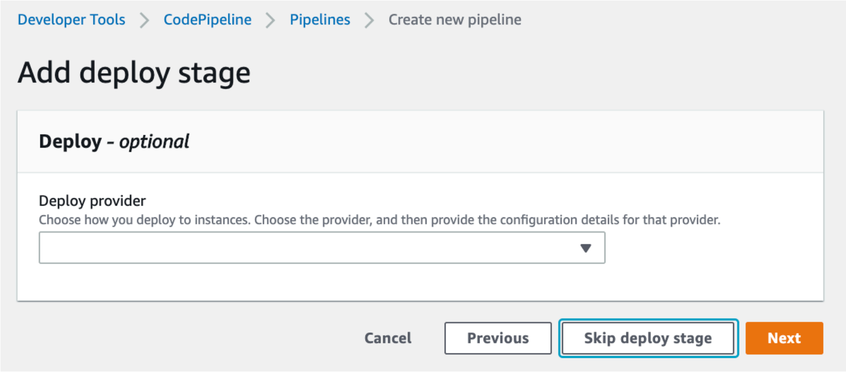
Build provider
This is the tool of your build project. Provide build artifact details like operating system, build spec file, and output file names.
AWS CodeBuild

Region
US East - (N. Virginia)

Project name
Choose a build project that you have already created in the AWS CodeBuild console. Or create a build project in the AWS CodeBuild console and then return to this task.
MF-AWS-CICD-Build or Create project

Environment variables - *optional*
Choose the key, value, and type for your CodeBuild environment variables. In the value field, you can reference variables generated by CodePipeline. Learn more

Click Next


Developer Tools > CodePipeline > Pipelines > Create new pipeline
Cancel
Previous
Skip deploy stage
Next

Add deploy stage

Deploy - *optional*

Deploy provider

Choose how you deploy to instances. Choose the provider, and then provide the configuration details for that provider.

Click Skip deploy stage.

Click Create pipeline.

5 DEPLOY to TEST stage

5.1 DEPLOY to TEST – MF ETS configuration for CodeDeploy

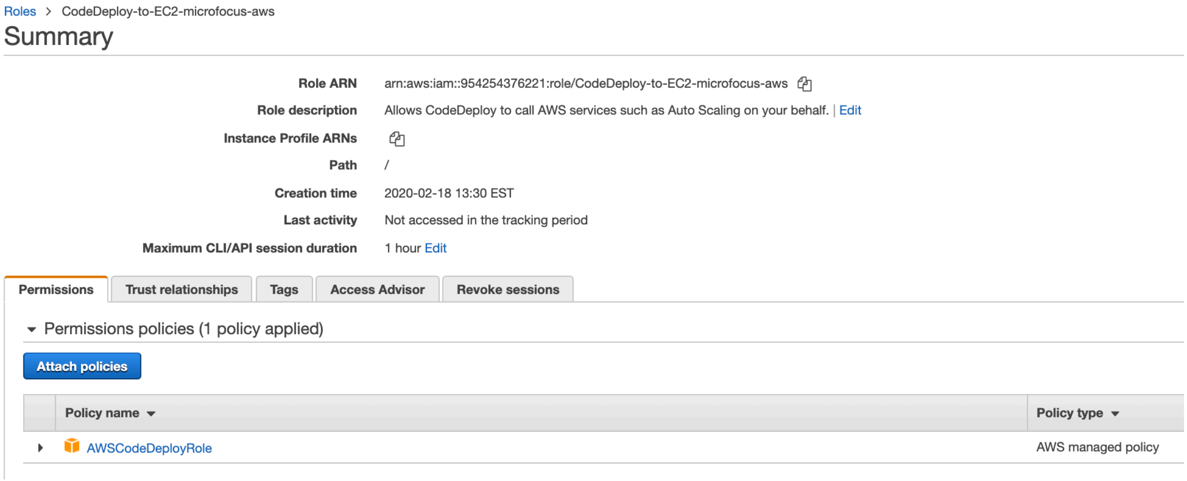
In AWS console, create an IAM role for CodeDeploy access.

You can find more help for these steps at this link:
https://docs.aws.amazon.com/codedeploy/latest/userguide/getting-started-create-iam-instance-profile.html

Create an EC2-to-S3-CodeDeploy-microfocus-aws-readonly IAM role with inline policy:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:Get*",
                "s3:List*"
            ],
            "Resource": [
                "arn:aws:s3:::mf-aws-cicd-artifacts/*",
                "arn:aws:s3:::aws-codedeploy-us-east-2/*",
                "arn:aws:s3:::aws-codedeploy-us-east-1/*",
                "arn:aws:s3:::aws-codedeploy-us-west-1/*",
                "arn:aws:s3:::aws-codedeploy-us-west-2/*",
                "arn:aws:s3:::aws-codedeploy-ca-central-1/*",
                "arn:aws:s3:::aws-codedeploy-eu-west-1/*",
                "arn:aws:s3:::aws-codedeploy-eu-west-2/*",
                "arn:aws:s3:::aws-codedeploy-eu-west-3/*",
                "arn:aws:s3:::aws-codedeploy-eu-central-1/*",
                "arn:aws:s3:::aws-codedeploy-ap-east-1/*",
                "arn:aws:s3:::aws-codedeploy-ap-northeast-1/*",
                "arn:aws:s3:::aws-codedeploy-ap-northeast-2/*",
                "arn:aws:s3:::aws-codedeploy-ap-southeast-1/*",
                "arn:aws:s3:::aws-codedeploy-ap-southeast-2/*",
                "arn:aws:s3:::aws-codedeploy-ap-south-1/*",
                "arn:aws:s3:::aws-codedeploy-sa-east-1/*",
                "arn:aws:s3:::codepipeline-us-east-2-*",
                "arn:aws:s3:::codepipeline-us-east-1-*",
                "arn:aws:s3:::codepipeline-us-west-1-*",
                "arn:aws:s3:::codepipeline-us-west-2-*",
                "arn:aws:s3:::codepipeline-ca-central-1-*",
                "arn:aws:s3:::codepipeline-eu-west-1-*",
                "arn:aws:s3:::codepipeline-eu-west-2-*",
                "arn:aws:s3:::codepipeline-eu-west-3-*",
                "arn:aws:s3:::codepipeline-eu-central-1-*",
                "arn:aws:s3:::codepipeline-ap-east-1-*",
                "arn:aws:s3:::codepipeline-ap-northeast-1-*",
                "arn:aws:s3:::codepipeline-ap-northeast-2-*",
                "arn:aws:s3:::codepipeline-ap-southeast-1-*",
                "arn:aws:s3:::codepipeline-ap-southeast-2-*",
                "arn:aws:s3:::codepipeline-ap-south-1-*",
                "arn:aws:s3:::codepipeline-sa-east-1-*"            ]
         }
        ]
}
```

Create CodeDeploy-to-EC2-microfocus-aws IAM role with the attached AWSCodeDeployRole policy.



Roles > CodeDeploy-to-EC2-microfocus-aws

Summary

Role ARN	arn:aws:iam::954254376221:role/CodeDeploy-to-EC2-microfocus-aws
Role description	Allows CodeDeploy to call AWS services such as Auto Scaling on your behalf. | Edit
Instance Profile ARNs	
Path	/
Creation time	2020-02-18 13:30 EST
Last activity	Not accessed in the tracking period
Maximum CLI/API session duration	1 hour Edit

Policy name	Policy type
AWSCodeDeployRole	AWS managed policy

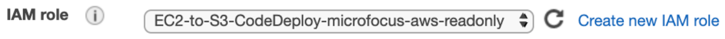
Copy the Role ARN for this role such as arn:aws:iam::954254376221:role/CodeDeploy-to-EC2-microfocus-aws

For getting access to Micro Focus software, please contact your Micro Focus representative or contact Micro Focus following this link: https://www.microfocus.com/en-us/contact/contactme

First you need to retrieve an AMI with Micro Focus Enterprise Test Server (ETS) or deploy the ETS software on an EC2 instance.

Select Micro Focus Enterprise Test Server (ETS) AMI and click Launch.

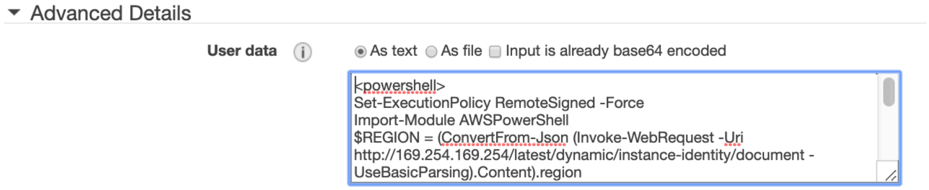
Under Configure Instance Details, choose the EC2-to-S3-CodeDeploy-microfocus-aws-readonly role.



IAM role: EC2-to-S3-CodeDeploy-microfocus-aws-readonly

Under Advanced Details User data, enter the following commands to install CodeDeploy agent:

```
<powershell>
Set-ExecutionPolicy RemoteSigned -Force
Import-Module AWSPowerShell
$REGION = (ConvertFrom-Json (Invoke-WebRequest -Uri http://169.254.169.254/latest/dynamic/instance-identity/document -UseBasicParsing).Content).region
New-Item -Path c:\temp -ItemType "directory" -Force
powershell.exe -Command Read-S3Object -BucketName aws-codedeploy-$REGION -Key latest/codedeploy-agent-updater.msi -File c:\temp\codedeploy-agent-updater.msi
// Start-Sleep -Seconds 30 *optional
c:\temp\codedeploy-agent-updater.msi /quiet /l c:\temp\host-agent-updater-log.txt
</powershell>
```

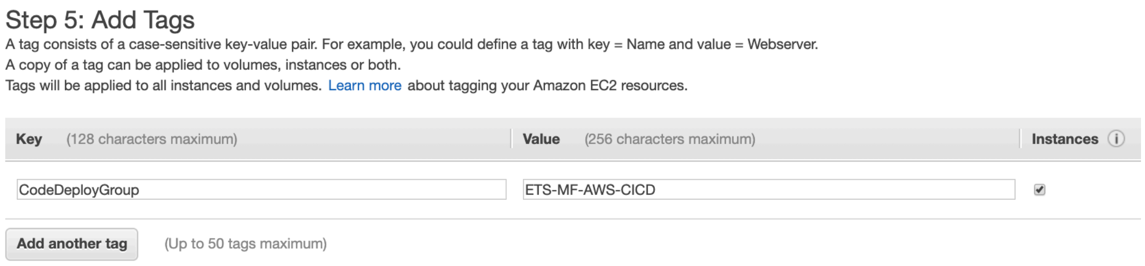


Advanced Details

User data: ● As text ○ As file □ Input is already base64 encoded

```
<powershell>
Set-ExecutionPolicy RemoteSigned -Force
Import-Module AWSPowerShell
$REGION = (ConvertFrom-Json (Invoke-WebRequest -Uri
http://169.254.169.254/latest/dynamic/instance-identity/document -
UseBasicParsing).Content).region
```

Add a tag with Key CodeDeployGroup and Value ETS-MF-AWS-CICD.



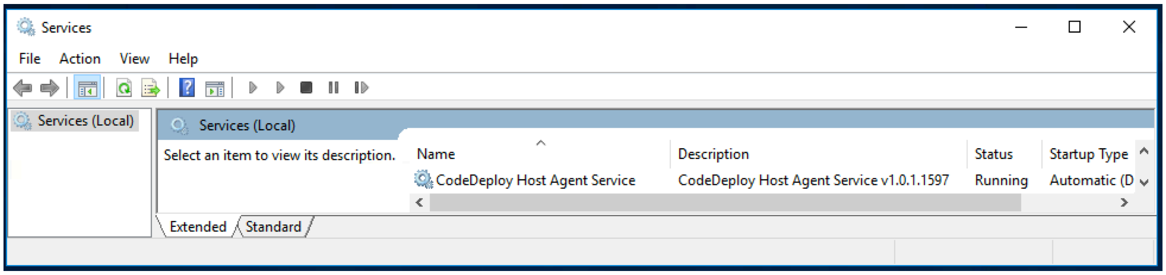
Step 5: Add Tags

A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver.
A copy of a tag can be applied to volumes, instances or both.
Tags will be applied to all instances and volumes. Learn more about tagging your Amazon EC2 resources.

Key (128 characters maximum)	Value (256 characters maximum)	Instances
CodeDeployGroup	ETS-MF-AWS-CICD	☑

Then Launch the EC2 instance.

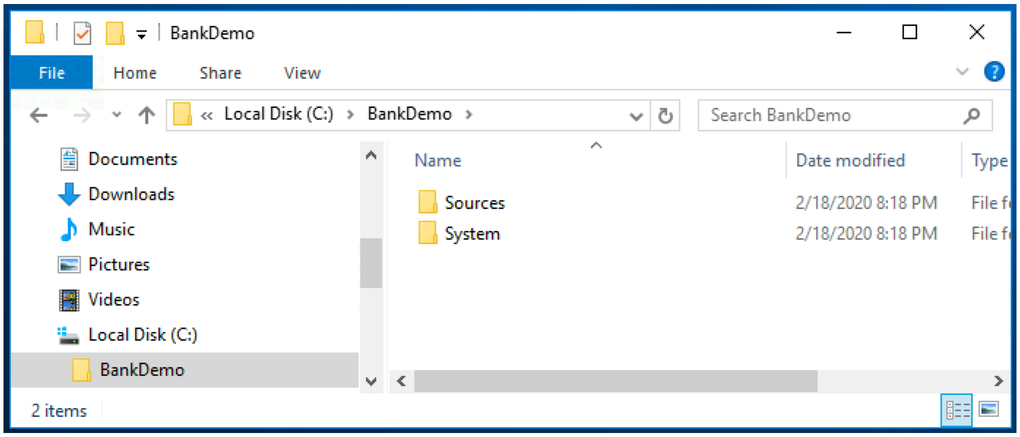
Connect to the launched instance and verify the CodeDeploy agent is installed and started:



Name	Description	Status	Startup Type
CodeDeploy Host Agent Service	CodeDeploy Host Agent Service v1.0.1.1597	Running	Automatic (D

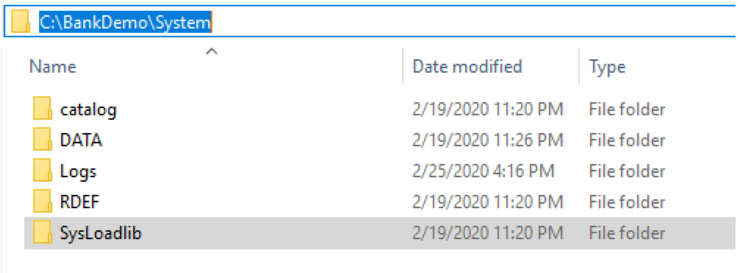
We’re now going to configure a BankDemo test server on ETS.

Zip and copy the BankDemo folder within C:\Users\Public\Documents\Micro Focus\Enterprise Developer\Samples\Mainframe\BankDemo\MFETDUSER from the EDz instance, and extract it on the ETS instance right under the root directory C:\. Be careful not to extract it under C:\BankDemo\BankDemo (folder duplicated).



Name	Date modified	Type
Sources	2/18/2020 8:18 PM	File f
System	2/18/2020 8:18 PM	File f

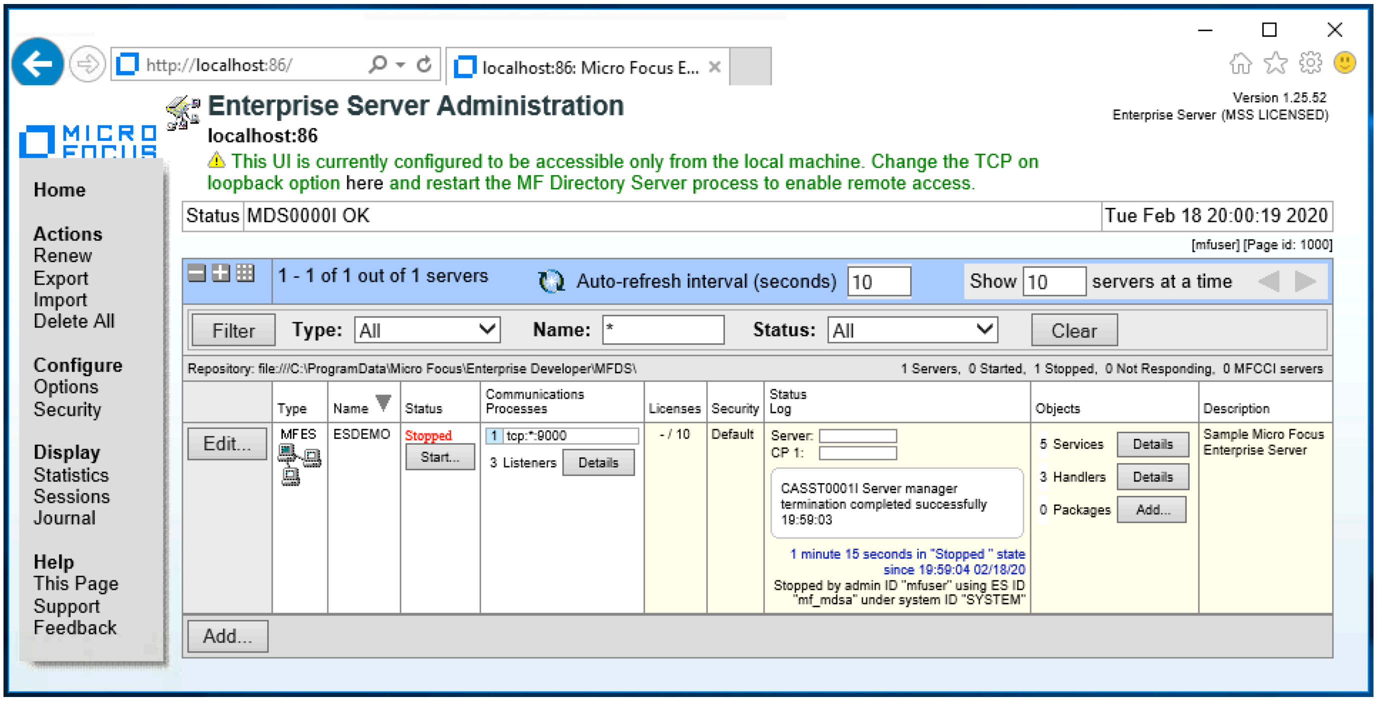
Verify the C:\BankDemo\System\SysLoadlib folder has the proper letters in upper-case (S and L).



C:\BankDemo\System

Name	Date modified	Type
catalog	2/19/2020 11:20 PM	File folder
DATA	2/19/2020 11:26 PM	File folder
Logs	2/25/2020 4:16 PM	File folder
RDEF	2/19/2020 11:20 PM	File folder
SysLoadlib	2/19/2020 11:20 PM	File folder

With a browser, go to the Enterprise Server Administration at http://localhost:86/



Enterprise Server Administration

localhost:86

Version 1.25.52
Enterprise Server (MSS LICENSED)

⚠ This UI is currently configured to be accessible only from the local machine. Change the TCP on loopback option here and restart the MF Directory Server process to enable remote access.

Status MDS0000I OK — Tue Feb 18 20:00:19 2020

[mfuser] [Page id: 1000]

1 - 1 of 1 out of 1 servers — Auto-refresh interval (seconds) 10 — Show 10 servers at a time

Filter — Type: All — Name: * — Status: All — Clear

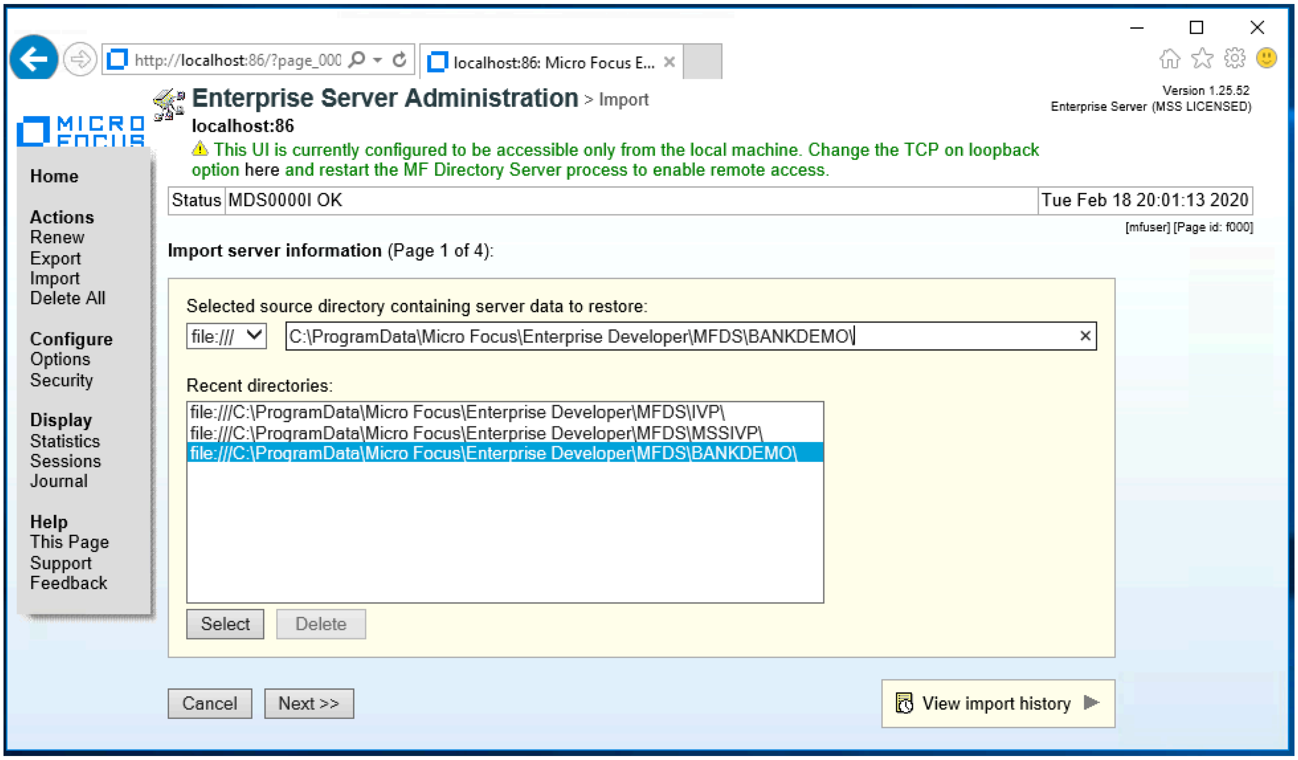
Repository: file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\ — 1 Servers, 0 Started, 1 Stopped, 0 Not Responding, 0 MFCCI servers

	Type	Name	Status	Communications Processes	Licenses	Security	Status Log	Objects	Description
Edit...	MFES	ESDEMO	Stopped Start...	1 tcp:*:9000 3 Listeners Details	- / 10	Default	Server: CP 1: CASST0001I Server manager termination completed successfully 19:59:03 1 minute 15 seconds in "Stopped " state since 19:59:04 02/18/20 Stopped by admin ID "mfuser" using ES ID "mf_mdsa" under system ID "SYSTEM"	5 Services Details 3 Handlers Details 0 Packages Add...	Sample Micro Focus Enterprise Server

Add...

Click Import in the left upper corner of Enterprise Server Administration.

On the Import server information page and under Recent directories click the directory for the BANKDEMO server.



Enterprise Server Administration > Import

localhost:86

Version 1.25.52
Enterprise Server (MSS LICENSED)

⚠ This UI is currently configured to be accessible only from the local machine. Change the TCP on loopback option here and restart the MF Directory Server process to enable remote access.

Status MDS0000I OK — Tue Feb 18 20:01:13 2020

[mfuser] [Page id: f000]

Import server information (Page 1 of 4):

Selected source directory containing server data to restore:

file:/// C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\BANKDEMO\

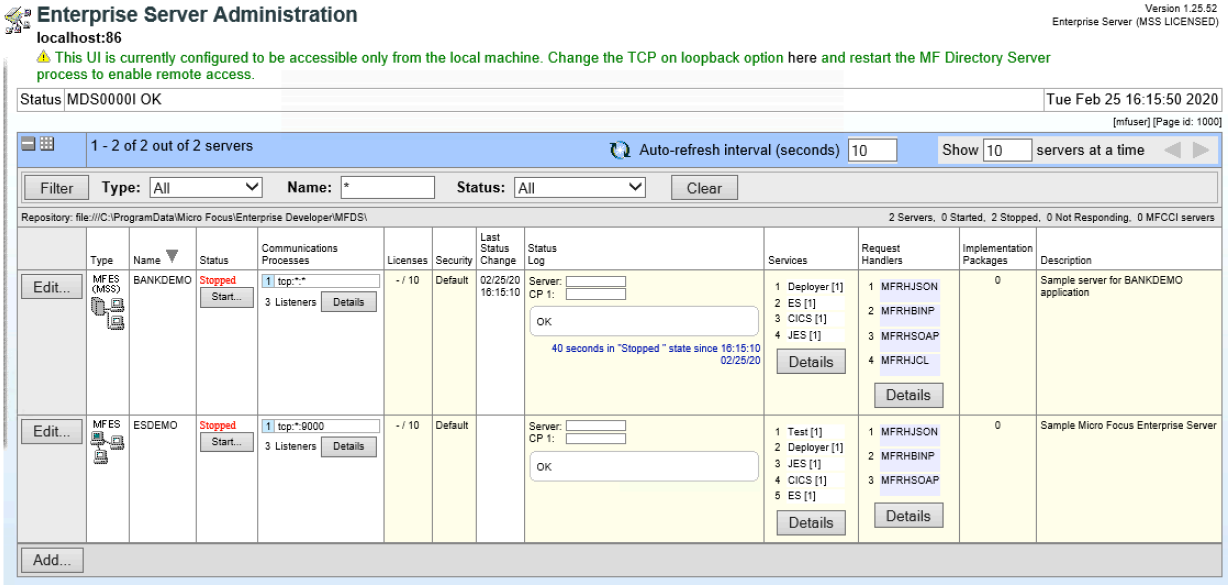
Recent directories:

file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\IVP\
file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\MSSIVP\
file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\BANKDEMO\

This adds the path to the Selected source directory containing server data to restore field.

Click Next 3 times and click OK to import the BankDemo server (keep the server in 32-bit).

The system returns to the main Enterprise Server Administration page.



Enterprise Server Administration

localhost:86

Version 1.25.52
Enterprise Server (MSS LICENSED)

⚠ This UI is currently configured to be accessible only from the local machine. Change the TCP on loopback option here and restart the MF Directory Server process to enable remote access.

Status MDS0000I OK — Tue Feb 25 16:15:50 2020

[mfuser] [Page id: 1000]

1 - 2 of 2 out of 2 servers — Auto-refresh interval (seconds) 10 — Show 10 servers at a time

Filter — Type: All — Name: * — Status: All — Clear

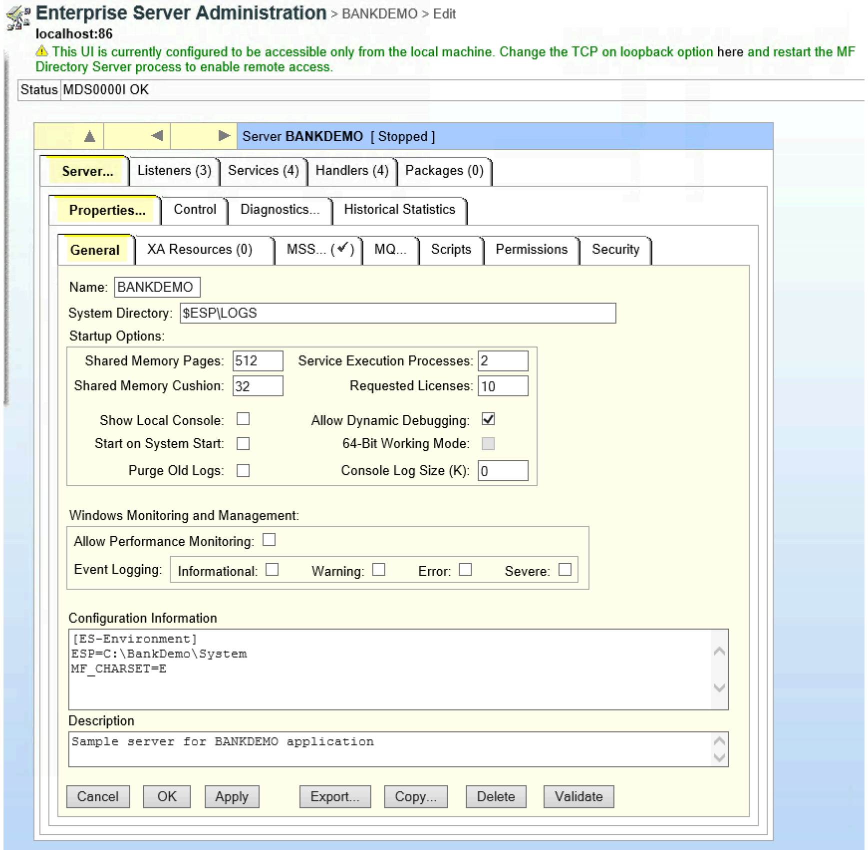
Repository: file:///C:\ProgramData\Micro Focus\Enterprise Developer\MFDS\

2 Servers, 0 Started, 2 Stopped, 0 Not Responding, 0 MFCCI servers

	Type	Name	Status	Communications Processes	Licenses	Security	Last Status Change	Status Log	Services	Request Handlers	Implementation Packages	Description
Edit...	MFES (MSS)	BANKDEMO	Stopped Start...	1 tcp:*:* 3 Listeners Details	- / 10	Default	02/25/20 16:15:10	Server: CP 1: OK 40 seconds in "Stopped " state since 16:15:10 02/25/20	1 Deployer [1] 2 ES [1] 3 CICS [1] 4 JES [1] Details	1 MFRHJSON 2 MFRHBINP 3 MFRHSOAP 4 MFRHJCL Details	0	Sample server for BANKDEMO application
Edit...	MFES	ESDEMO	Stopped Start...	1 tcp:*:9000 3 Listeners Details	- / 10	Default		Server: CP 1: OK	1 Test [1] 2 Deployer [1] 3 JES [1] 4 CICS [1] 5 ES [1] Details	1 MFRHJSON 2 MFRHBINP 3 MFRHSOAP Details	0	Sample Micro Focus Enterprise Server

You can see the Bankdemo server appears in the list of servers.

In front of the BANKDEMO server, select Edit…



Enterprise Server Administration > BANKDEMO > Edit

localhost:86

⚠ This UI is currently configured to be accessible only from the local machine. Change the TCP on loopback option here and restart the MF Directory Server process to enable remote access.

Status MDS0000I OK

Server BANKDEMO [Stopped]

Name: BANKDEMO

System Directory: $ESP\LOGS

Startup Options:

Shared Memory Pages:	512	Service Execution Processes:	2
Shared Memory Cushion:	32	Requested Licenses:	10
Show Local Console:	□	Allow Dynamic Debugging:	☑
Start on System Start:	□	64-Bit Working Mode:	□
Purge Old Logs:	□	Console Log Size (K):	0

Windows Monitoring and Management:

Allow Performance Monitoring: □

Event Logging: Informational: □ Warning: □ Error: □ Severe: □

Configuration Information

```
[ES-Environment]
ESP=C:\BankDemo\System
MF_CHARSET=E
```

Description

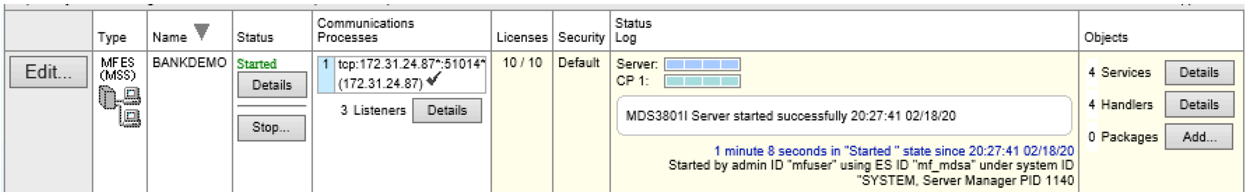
```
Sample server for BANKDEMO application
```

Under Configuration Information, update the ESP variable path to the actual location on ETS instance:

```
ESP=C:\BankDemo\System
```

Click OK to save.

Under the Enterprise Server Administration, click Start for the BANKDEMO server…

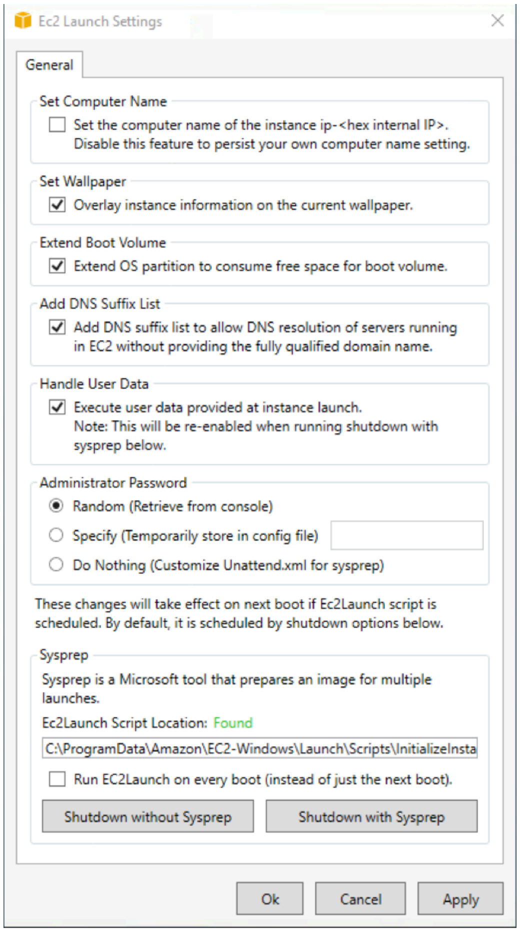


	Type	Name	Status	Communications Processes	Licenses	Security	Status Log	Objects
Edit...	MF ES (MSS)	BANKDEMO	Started Details Stop...	1 tcp:172.31.24.87*:51014* (172.31.24.87) ✓ 3 Listeners Details	10 / 10	Default	Server: CP 1: MDS3801I Server started successfully 20:27:41 02/18/20 1 minute 8 seconds in "Started " state since 20:27:41 02/18/20 Started by admin ID "mfuser" using ES ID "mf_mdsa" under system ID "SYSTEM, Server Manager PID 1140	4 Services Details 4 Handlers Details 0 Packages Add...

If any server start problem you can check the console log in C:\BankDemo\System\Logs\console.txt.

The BankDemo compiled dll files will go in C:\BankDemo\System\SysLoadlib

Run C:\ProgramData\Amazon\EC2-Windows\Launch\Settings\Ec2LaunchSettings.exe



Ec2 Launch Settings

General

Set Computer Name

□ Set the computer name of the instance ip-<hex internal IP>. Disable this feature to persist your own computer name setting.

Set Wallpaper

☑ Overlay instance information on the current wallpaper.

Extend Boot Volume

☑ Extend OS partition to consume free space for boot volume.

Add DNS Suffix List

☑ Add DNS suffix list to allow DNS resolution of servers running in EC2 without providing the fully qualified domain name.

Handle User Data

☑ Execute user data provided at instance launch. Note: This will be re-enabled when running shutdown with sysprep below.

Administrator Password

● Random (Retrieve from console)

○ Specify (Temporarily store in config file)

○ Do Nothing (Customize Unattend.xml for sysprep)

These changes will take effect on next boot if Ec2Launch script is scheduled. By default, it is scheduled by shutdown options below.

Sysprep

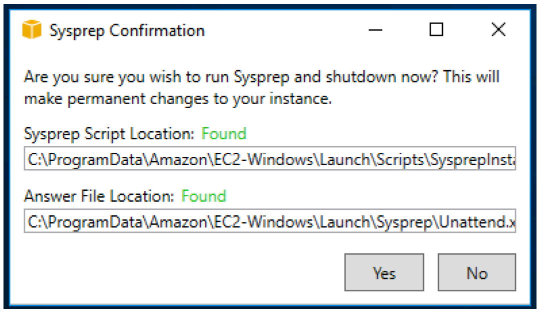
Sysprep is a Microsoft tool that prepares an image for multiple launches.

Ec2Launch Script Location: Found

C:\ProgramData\Amazon\EC2-Windows\Launch\Scripts\InitializeInsta

□ Run EC2Launch on every boot (instead of just the next boot).

Click Shutdown with Sysprep



Sysprep Confirmation

Are you sure you wish to run Sysprep and shutdown now? This will make permanent changes to your instance.

Sysprep Script Location: Found

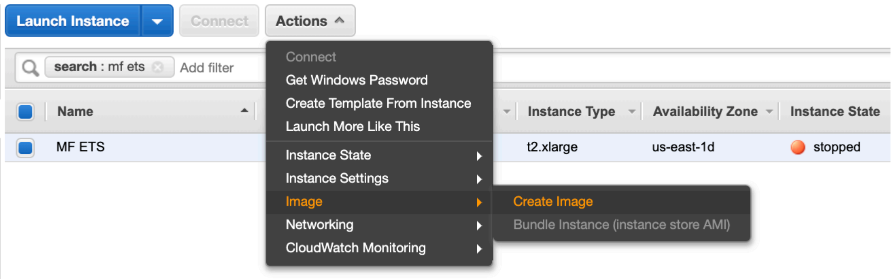
C:\ProgramData\Amazon\EC2-Windows\Launch\Scripts\SysprepInst

Answer File Location: Found

C:\ProgramData\Amazon\EC2-Windows\Launch\Sysprep\Unattend.x

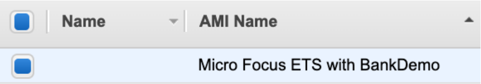
Click Yes.

Once the ETS instance is stopped (not terminated), create an AMI from it: Micro Focus ETS with BankDemo.



search : mf ets

Name	Instance Type	Availability Zone	Instance State
MF ETS	t2.xlarge	us-east-1d	stopped



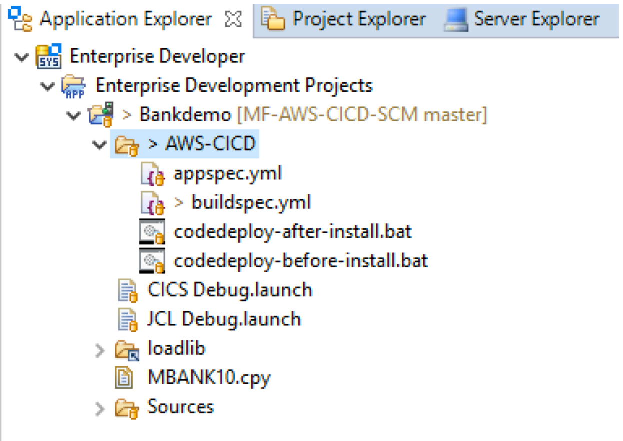
☐	Name	AMI Name
☐		Micro Focus ETS with BankDemo

This new AMI will be used in case you need to terminate and start new ETS instances with BankDemo server already configured.

Every time you start a new EC2 instance for ETS with BankDemo, verify you have the role EC2-to-S3-CodeDeploy-microfocus-aws-readonly configured under Configure Instance Details. Also verify you have a tag assigned with Key CodeDeployGroup and Value ETS-MF-AWS-CICD.

5.2 DEPLOY to TEST – AWS CodeDeploy configuration

In the EDz Bankdemo project, under AWS-CICD folder, create three files: appspec.yml, codedeploy-before-install.bat, codedeploy-after-install.bat



```
Enterprise Developer
  Enterprise Development Projects
    > Bankdemo [MF-AWS-CICD-SCM master]
      > AWS-CICD
          appspec.yml
          > buildspec.yml
          codedeploy-after-install.bat
          codedeploy-before-install.bat
        CICS Debug.launch
        JCL Debug.launch
        loadlib
        MBANK10.cpy
        Sources
```

appspec.yml content:

```
version: 0.0
os: windows
files:
  - source: .\dll
    destination: .\dll-staging
hooks:
  BeforeInstall:
    - location: \codedeploy-before-install.bat
      timeout: 120
  AfterInstall:
    - location: \codedeploy-after-install.bat
      timeout: 120
```

The application specification file (AppSpec file) is a YAML-formatted or JSON-formatted file used by CodeDeploy to manage a deployment. Documentation about it is available here:

https://docs.amazonaws.cn/en_us/codedeploy/latest/userguide/reference-appspec-file.html

codedeploy-before-install.bat content:

```
C:\"Program Files (x86)"\"Micro Focus"\"Enterprise Test Server"\bin\casstop /lBANKDEMO
mkdir .\dll-staging
ping 127.0.0.1 -n 30 -w 1000 > NUL
```

codedeploy-after-install.bat content:

```
copy  /b/v/y  .\dll-staging\*  C:\BankDemo\System\SysLoadlib
C:\"Program Files (x86)"\"Micro Focus"\"Enterprise Test Server"\bin\casstart /rBANKDEMO
ping 127.0.0.1 -n 30 -w 1000 > NUL
```

Then Commit and Push these file changes making sure the new files are staged.

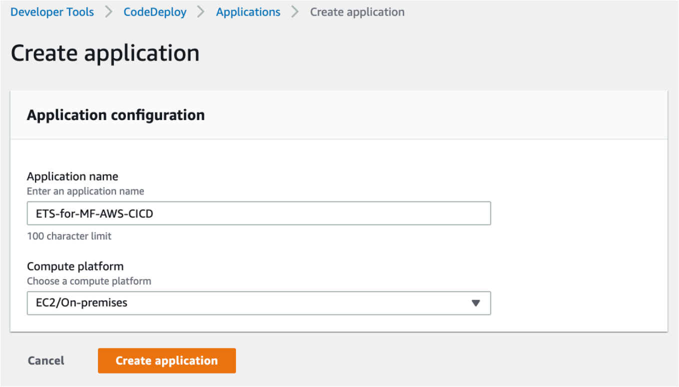
Then make a Build in CodeBuild to update the artifacts in S3.

From the AWS console, go to Developer Tools, CodeDeploy, then Applications.

Click Create application.

For the Application name, enter: ETS-for-MF-AWS-CICD.

For the Compute platform, select EC2/On-premises.


Developer Tools > CodeDeploy > Applications > Create application

Create application

Application configuration

Application name
Enter an application name
ETS-for-MF-AWS-CICD
100 character limit

Compute platform
Choose a compute platform
EC2/On-premises

Cancel
Create application

Click Create application.

Under the ETS-for-MF-AWS-CICD, select Create deployment group.

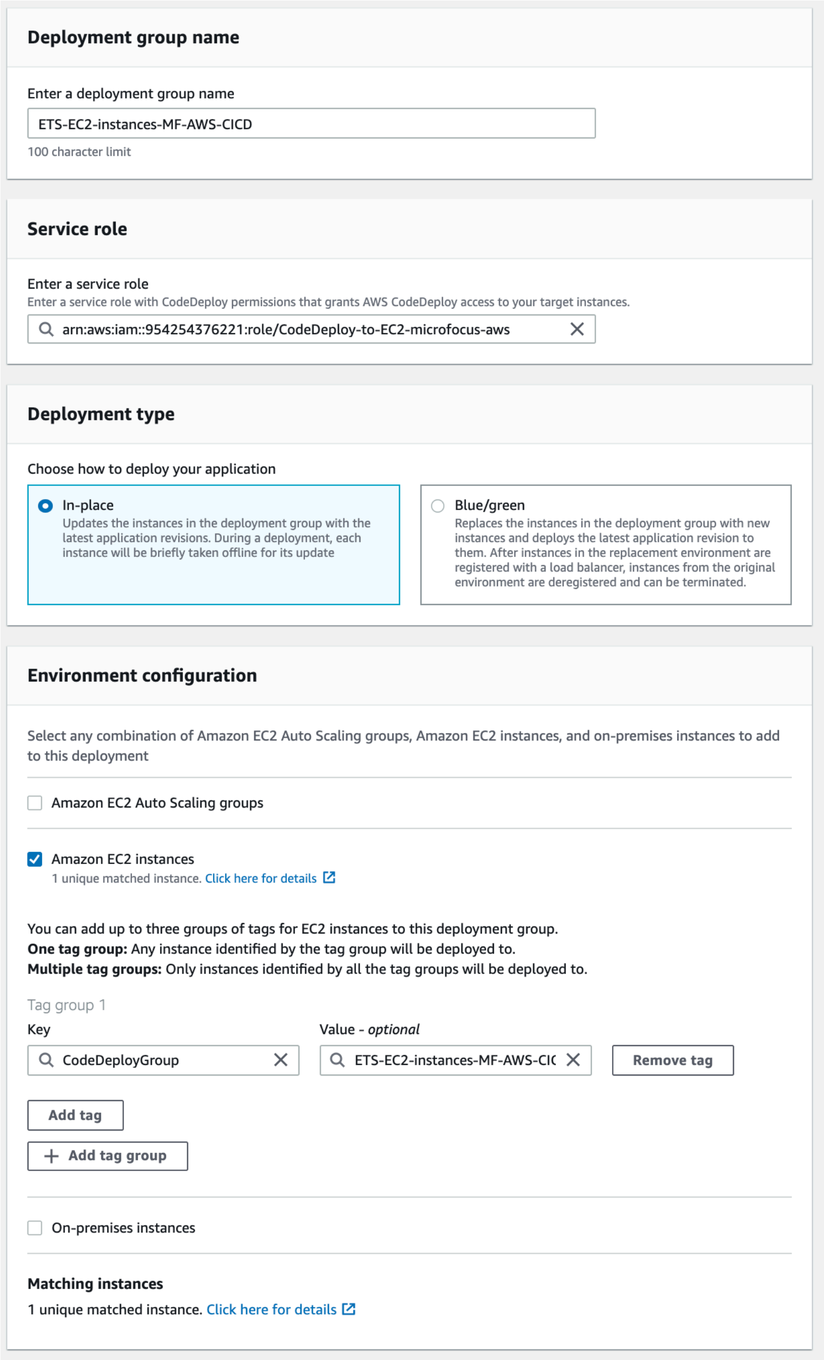
Enter deployment group name: ETS-EC2-instances-MF-AWS-CICD

Enter service role ARN previously created such as arn:aws:iam::954254376221:role/CodeDeploy-to-EC2-microfocus-aws

Deployment type is In-place.

Environment configuration is Amazon EC2 instances only.

For the tag, the Key is CodeDeployGroup and Value is ETS-EC2-instances-MF-AWS-CICD.



Deployment group name

Enter a deployment group name

ETS-EC2-instances-MF-AWS-CICD

100 character limit

Service role

Enter a service role

Enter a service role with CodeDeploy permissions that grants AWS CodeDeploy access to your target instances.

arn:aws:iam::954254376221:role/CodeDeploy-to-EC2-microfocus-aws

Deployment type

Choose how to deploy your application

● In-place
Updates the instances in the deployment group with the latest application revisions. During a deployment, each instance will be briefly taken offline for its update

○ Blue/green
Replaces the instances in the deployment group with new instances and deploys the latest application revision to them. After instances in the replacement environment are registered with a load balancer, instances from the original environment are deregistered and can be terminated.

Environment configuration

Select any combination of Amazon EC2 Auto Scaling groups, Amazon EC2 instances, and on-premises instances to add to this deployment

☐ Amazon EC2 Auto Scaling groups

☑ Amazon EC2 instances
1 unique matched instance. Click here for details

You can add up to three groups of tags for EC2 instances to this deployment group.
One tag group: Any instance identified by the tag group will be deployed to.
Multiple tag groups: Only instances identified by all the tag groups will be deployed to.

Tag group 1

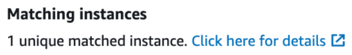
Key	Value - *optional*	
CodeDeployGroup	ETS-EC2-instances-MF-AWS-CI(	Remove tag

☐ On-premises instances

Matching instances

1 unique matched instance. Click here for details

You can verify it found the ETS instance accordingly:

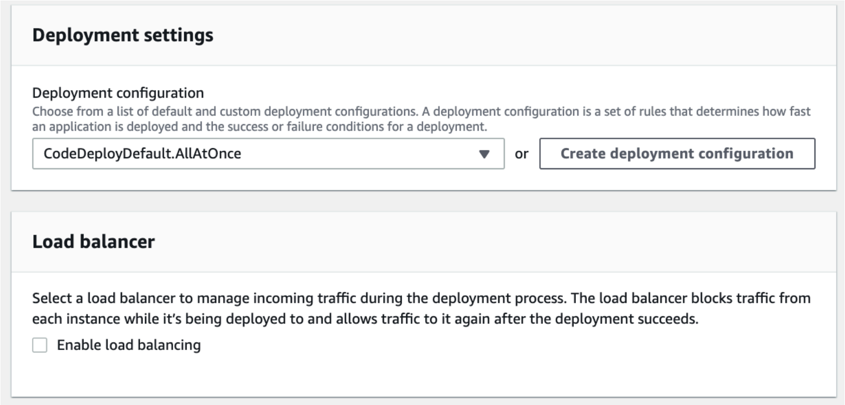


Matching instances

1 unique matched instance. Click here for details

Deployment settings is CodeDeployDefault.AllAtOnce.

Deselect Load balancer which are not used here.



Deployment settings

Deployment configuration
Choose from a list of default and custom deployment configurations. A deployment configuration is a set of rules that determines how fast an application is deployed and the success or failure conditions for a deployment.

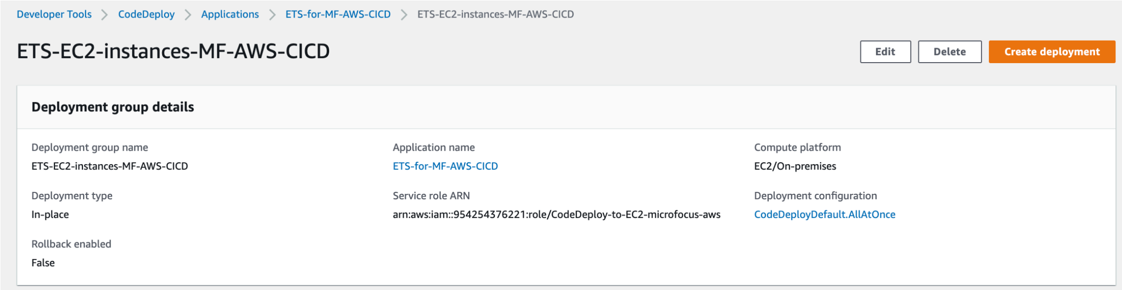
CodeDeployDefault.AllAtOnce ▼ or

Load balancer

Select a load balancer to manage incoming traffic during the deployment process. The load balancer blocks traffic from each instance while it's being deployed to and allows traffic to it again after the deployment succeeds.

□ Enable load balancing

Then click Create Deployment group.



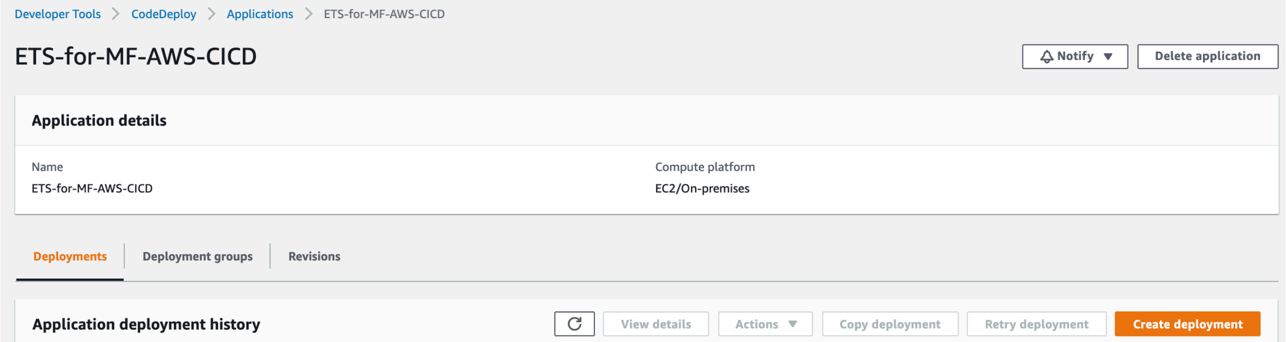
Developer Tools > CodeDeploy > Applications > ETS-for-MF-AWS-CICD > ETS-EC2-instances-MF-AWS-CICD
Edit
Delete
Create deployment

ETS-EC2-instances-MF-AWS-CICD

Deployment group details

Deployment group name ETS-EC2-instances-MF-AWS-CICD	Application name ETS-for-MF-AWS-CICD	Compute platform EC2/On-premises
Deployment type In-place	Service role ARN arn:aws:iam::954254376221:role/CodeDeploy-to-EC2-microfocus-aws	Deployment configuration CodeDeployDefault.AllAtOnce
Rollback enabled False		

Under CodeDeploy -> Applications -> Application -> ETS-for-MF-AWS-CICD select the Deployments tab, then click Create deployment.

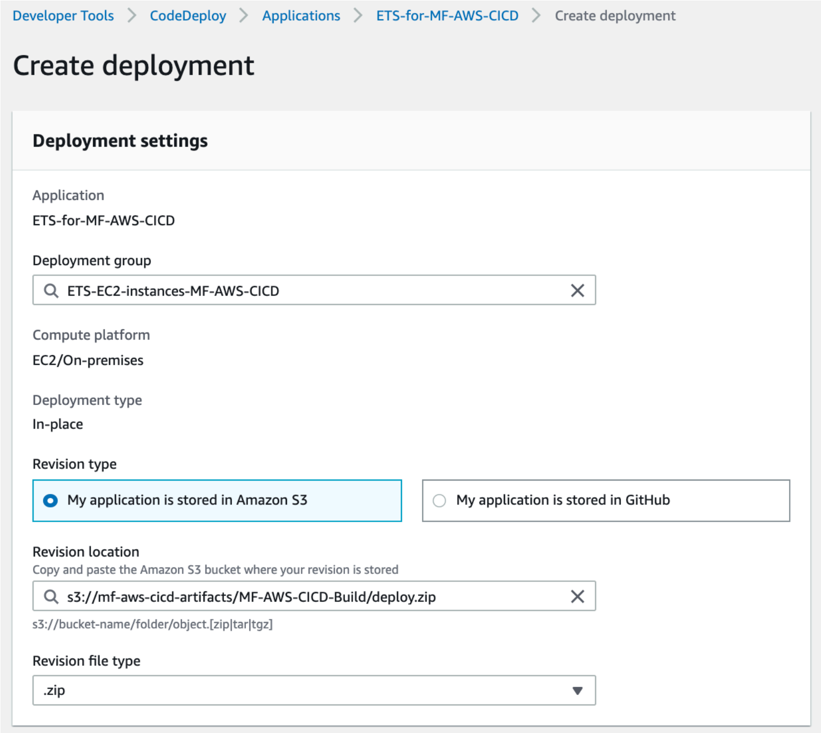


ETS-for-MF-AWS-CICD

Application details

Name ETS-for-MF-AWS-CICD	Compute platform EC2/On-premises

Application deployment history



Developer Tools > CodeDeploy > Applications > ETS-for-MF-AWS-CICD > Create deployment

Create deployment

Deployment settings

Application
ETS-for-MF-AWS-CICD

Deployment group
ETS-EC2-instances-MF-AWS-CICD

Compute platform
EC2/On-premises

Deployment type
In-place

Revision type
● My application is stored in Amazon S3
○ My application is stored in GitHub

Revision location
Copy and paste the Amazon S3 bucket where your revision is stored
s3://mf-aws-cicd-artifacts/MF-AWS-CICD-Build/deploy.zip
s3://bucket-name/folder/object.[zip|tar|tgz]

Revision file type
.zip

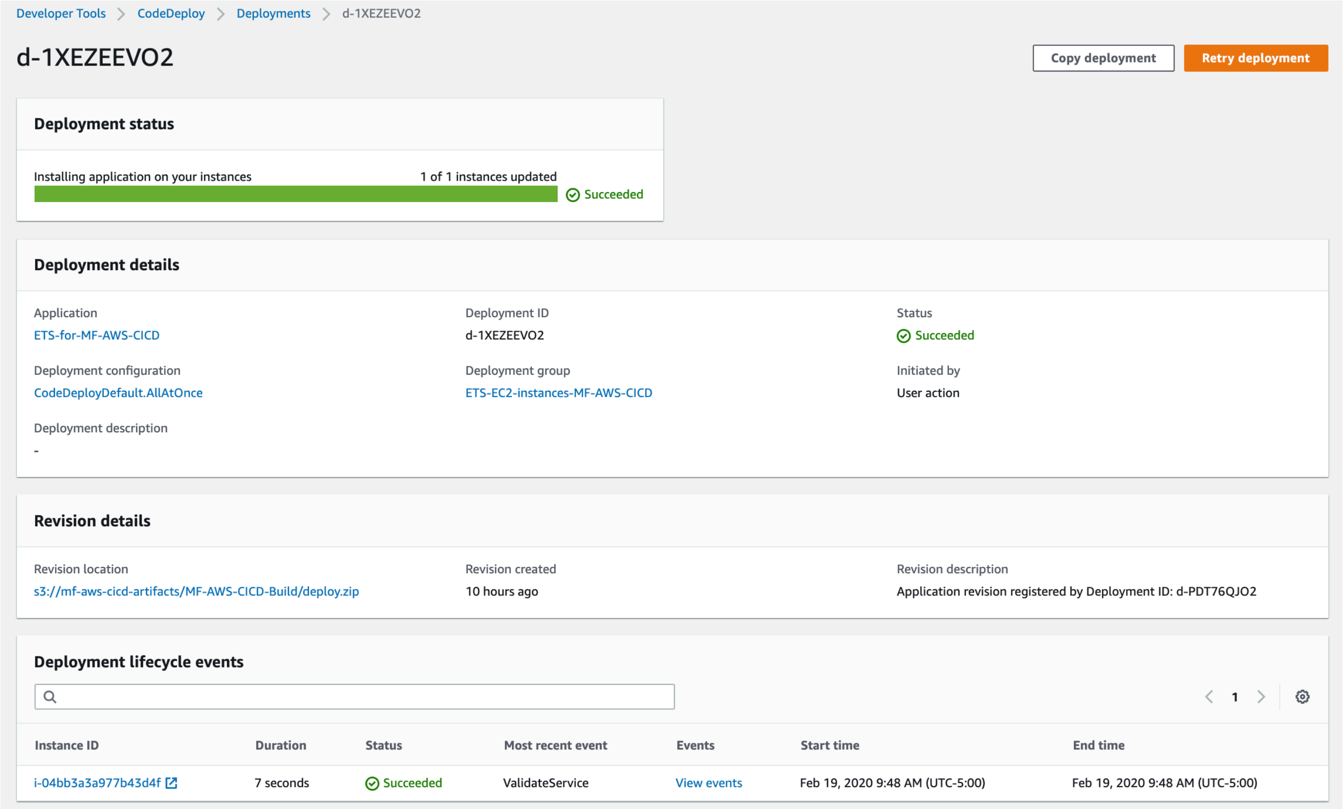
For Deployment group, choose: ETS-EC2-instances-MF-AWS-CICD

For Revision location, enter: s3://mf-aws-cicd-artifacts/MF-AWS-CICD-Build/deploy.zip

Revision file type is .zip

We don’t need to override the content because the codedeploy-after-install.bat script takes care of it.

Then click Create deployment.



d-1XEZEEVO2

Deployment status

Installing application on your instances — 1 of 1 instances updated — ✓ Succeeded

Deployment details

Application ETS-for-MF-AWS-CICD	Deployment ID d-1XEZEEVO2	Status ✓ Succeeded
Deployment configuration CodeDeployDefault.AllAtOnce	Deployment group ETS-EC2-instances-MF-AWS-CICD	Initiated by User action
Deployment description -		

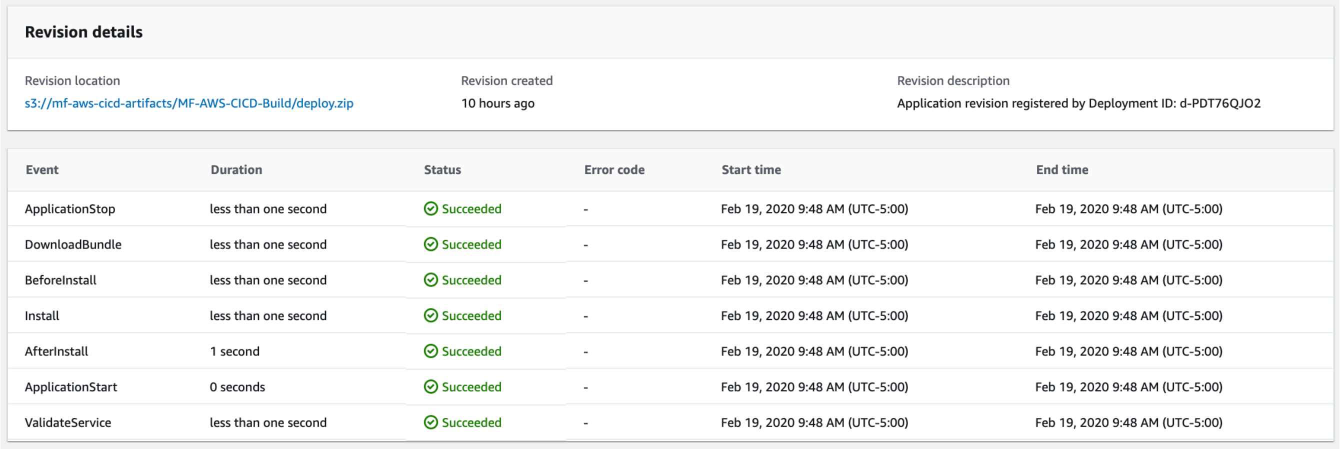
Revision details

Revision location	Revision created	Revision description
s3://mf-aws-cicd-artifacts/MF-AWS-CICD-Build/deploy.zip	10 hours ago	Application revision registered by Deployment ID: d-PDT76QJO2

Deployment lifecycle events

Instance ID	Duration	Status	Most recent event	Events	Start time	End time
i-04bb3a3a977b43d4f	7 seconds	✓ Succeeded	ValidateService	View events	Feb 19, 2020 9:48 AM (UTC-5:00)	Feb 19, 2020 9:48 AM (UTC-5:00)

Clicking View events, you can see the details of the deployment.



Revision details

Revision location	Revision created	Revision description
s3://mf-aws-cicd-artifacts/MF-AWS-CICD-Build/deploy.zip	10 hours ago	Application revision registered by Deployment ID: d-PDT76QJO2

Event	Duration	Status	Error code	Start time	End time
ApplicationStop	less than one second	✓ Succeeded	-	Feb 19, 2020 9:48 AM (UTC-5:00)	Feb 19, 2020 9:48 AM (UTC-5:00)
DownloadBundle	less than one second	✓ Succeeded	-	Feb 19, 2020 9:48 AM (UTC-5:00)	Feb 19, 2020 9:48 AM (UTC-5:00)
BeforeInstall	less than one second	✓ Succeeded	-	Feb 19, 2020 9:48 AM (UTC-5:00)	Feb 19, 2020 9:48 AM (UTC-5:00)
Install	less than one second	✓ Succeeded	-	Feb 19, 2020 9:48 AM (UTC-5:00)	Feb 19, 2020 9:48 AM (UTC-5:00)
AfterInstall	1 second	✓ Succeeded	-	Feb 19, 2020 9:48 AM (UTC-5:00)	Feb 19, 2020 9:48 AM (UTC-5:00)
ApplicationStart	0 seconds	✓ Succeeded	-	Feb 19, 2020 9:48 AM (UTC-5:00)	Feb 19, 2020 9:48 AM (UTC-5:00)
ValidateService	less than one second	✓ Succeeded	-	Feb 19, 2020 9:48 AM (UTC-5:00)	Feb 19, 2020 9:48 AM (UTC-5:00)

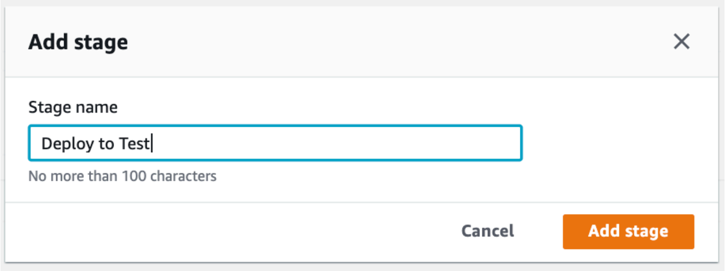
Then you can verify that the dll files have been updated in the ETS C:\BankDemo\System\SysLoadlib folder.

If you need to troubleshoot the CodeDeploy agent, the downloaded files and logs are under C:\ProgramData\Amazon\CodeDeploy.

5.3 DEPLOY to TEST – AWS CodePipeline configuration

In CodePipeline, select the MF-AWS-CICD-Pipeline and click Edit.

Click Add stage after the Build stage.



Add stage

Stage name

Deploy to Test

No more than 100 characters

Enter stage name: Deploy-to-Test

Click Add stage.

For this new stage, click Add action group.

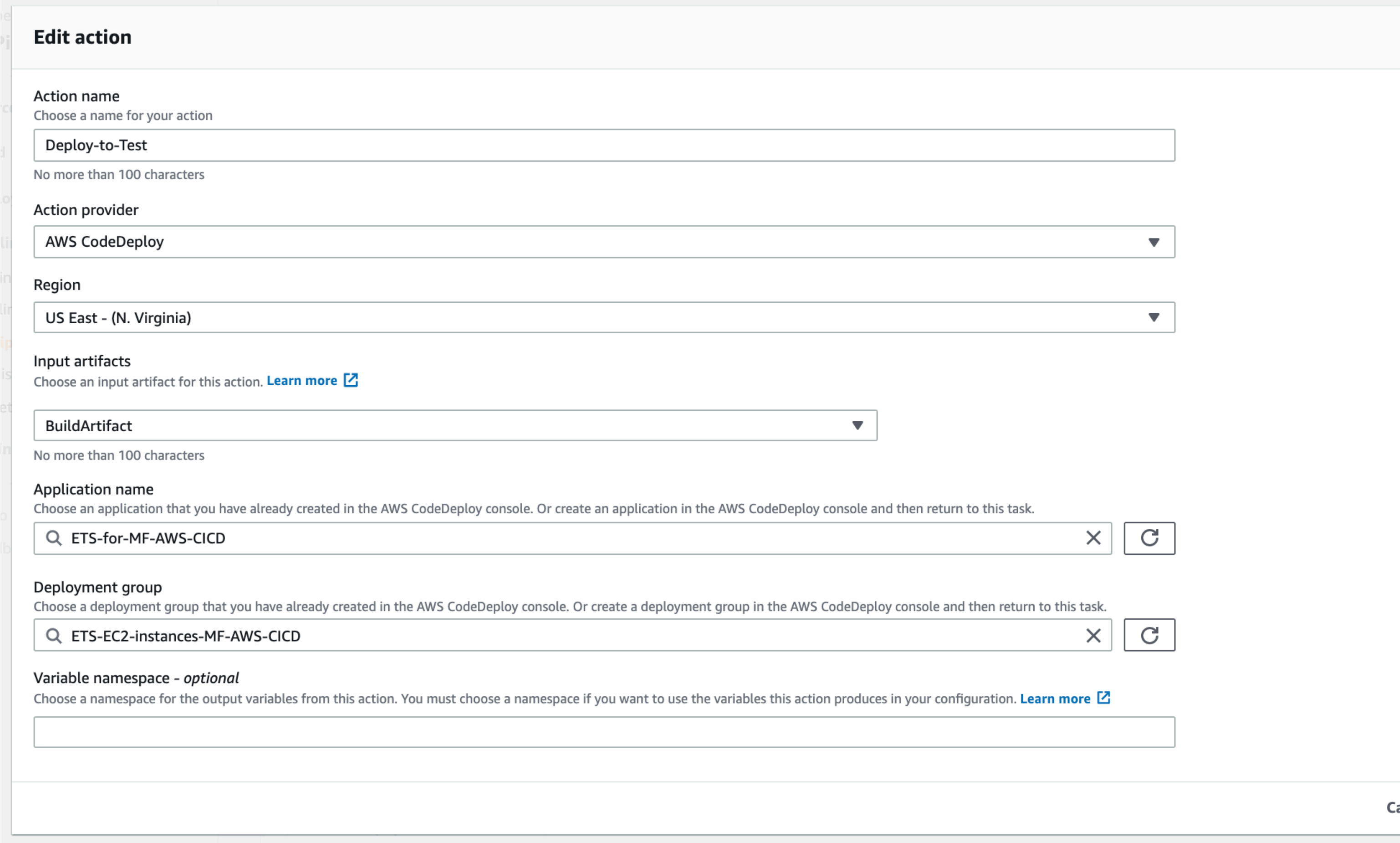
Enter action name: Deploy-to-Test

Select Deploy provider AWS CodeDeploy

Select Input artifacts: BuildArtifact

Select Application name ETS-for-MF-AWS-CICD

Select Deployment group ETS-EC2-instances-MF-AWS-CICD



Edit action

Action name

Choose a name for your action

Deploy-to-Test

No more than 100 characters

Action provider

AWS CodeDeploy

Region

US East - (N. Virginia)

Input artifacts

Choose an input artifact for this action. Learn more

BuildArtifact

No more than 100 characters

Application name

Choose an application that you have already created in the AWS CodeDeploy console. Or create an application in the AWS CodeDeploy console and then return to this task.

ETS-for-MF-AWS-CICD

Deployment group

Choose a deployment group that you have already created in the AWS CodeDeploy console. Or create a deployment group in the AWS CodeDeploy console and then return to this task.

ETS-EC2-instances-MF-AWS-CICD

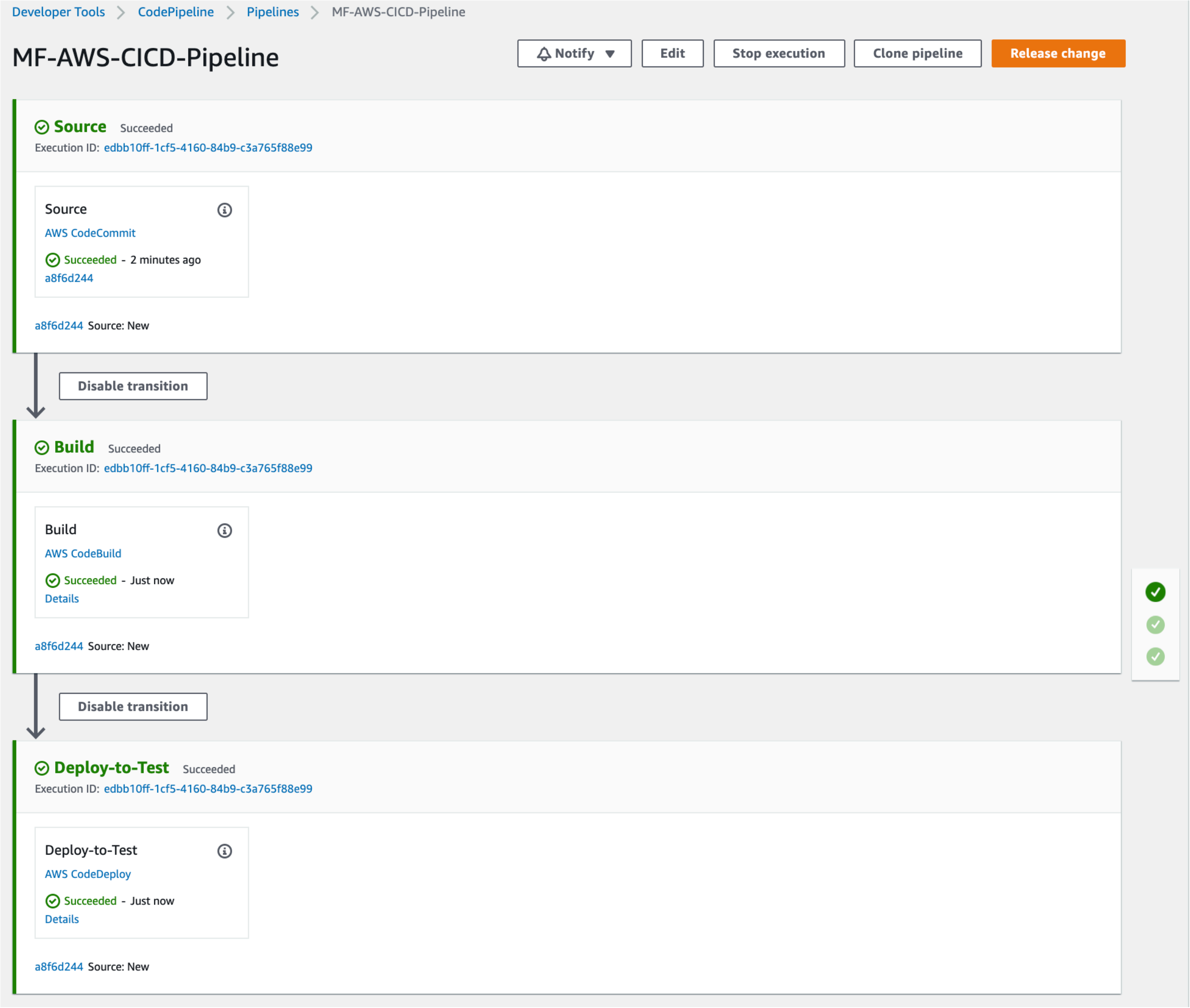
Variable namespace - *optional*

Choose a namespace for the output variables from this action. You must choose a namespace if you want to use the variables this action produces in your configuration. Learn more

Click Done

Save the modified pipeline.

As soon as there is a code change pushed into CodeCommit, the pipeline executes.



Developer Tools > CodePipeline > Pipelines > MF-AWS-CICD-Pipeline

MF-AWS-CICD-Pipeline

Source Succeeded
Execution ID: edbb10ff-1cf5-4160-84b9-c3a765f88e99

Source
AWS CodeCommit
Succeeded - 2 minutes ago
a8f6d244

a8f6d244 Source: New

Build Succeeded
Execution ID: edbb10ff-1cf5-4160-84b9-c3a765f88e99

Build
AWS CodeBuild
Succeeded - Just now
Details

a8f6d244 Source: New

Deploy-to-Test Succeeded
Execution ID: edbb10ff-1cf5-4160-84b9-c3a765f88e99

Deploy-to-Test
AWS CodeDeploy
Succeeded - Just now
Details

a8f6d244 Source: New

6 TEST stage

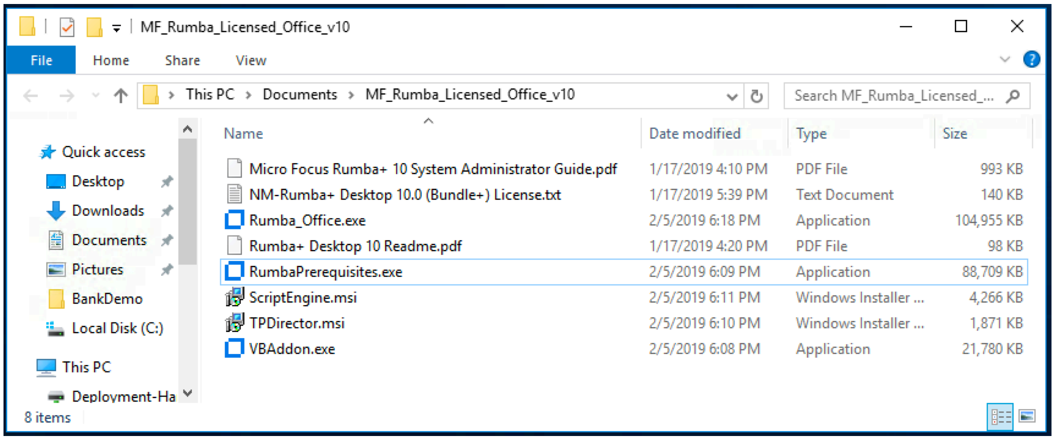
6.1 TEST – MF ETS configuration for automated tests

Tests are launched from this batch script: C:\BankDemo\Test\BankDemo-Tests.bat which will be called by CodePipeline, via Lambda and AWS Systems Manager (SSM).

For getting access to Micro Focus software, please contact your Micro Focus representative or contact Micro Focus following this link: https://www.microfocus.com/en-us/contact/contactme

First you need to retrieve Micro Focus Rumba+ Office and VB Add-on software installer.

If not already installed on ETS instance, install Rumba prerequisites, Rumba+ Desktop Office, and VB Add-on.



Name	Date modified	Type	Size
Micro Focus Rumba+ 10 System Administrator Guide.pdf	1/17/2019 4:10 PM	PDF File	993 KB
NM-Rumba+ Desktop 10.0 (Bundle+) License.txt	1/17/2019 5:39 PM	Text Document	140 KB
Rumba_Office.exe	2/5/2019 6:18 PM	Application	104,955 KB
Rumba+ Desktop 10 Readme.pdf	1/17/2019 4:20 PM	PDF File	98 KB
RumbaPrerequisites.exe	2/5/2019 6:09 PM	Application	88,709 KB
ScriptEngine.msi	2/5/2019 6:11 PM	Windows Installer ...	4,266 KB
TPDirector.msi	2/5/2019 6:10 PM	Windows Installer ...	1,871 KB
VBAddon.exe	2/5/2019 6:08 PM	Application	21,780 KB

Reboot ETS instance from AWS console.

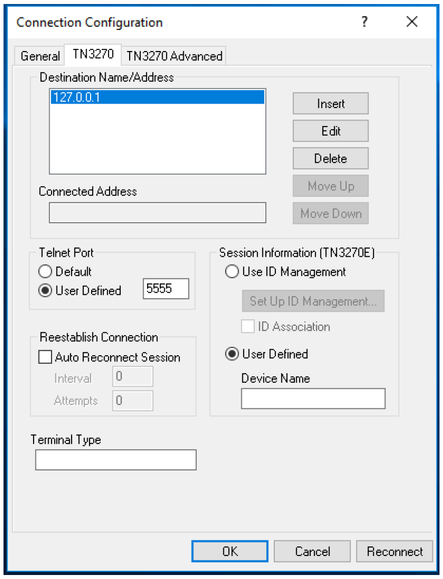
Start the BankDemo server:

```
        C:\"Program Files (x86)"\"Micro Focus"\"Enterprise Test Server"\bin\casstart /rBANKDEMO
```

If any server start problem you can check the console log in C:\BankDemo\System\Logs\console.txt.

Start Rumba+ Desktop.

Configure a TN3270 to IP address 127.0.0.1 and port 5555.



Connection Configuration

General | TN3270 | TN3270 Advanced

Destination Name/Address: 127.0.0.1

Connected Address:

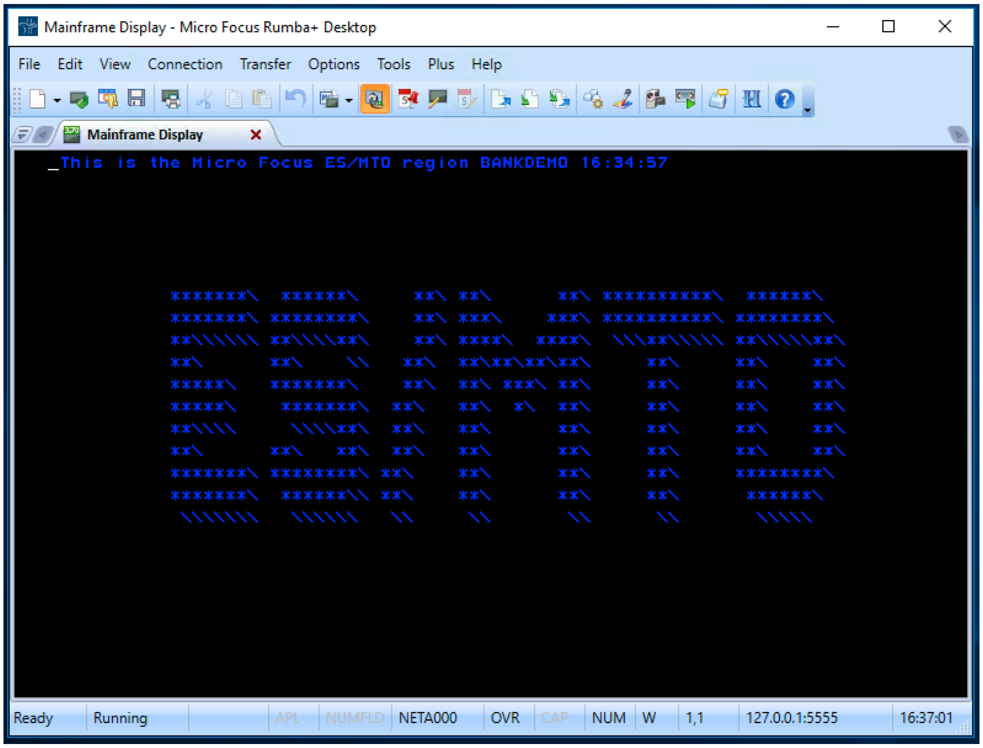
Telnet Port
○ Default
● User Defined 5555

Session Information (TN3270E)
○ Use ID Management
☐ ID Association
● User Defined
Device Name:

Reestablish Connection
☐ Auto Reconnect Session
Interval 0
Attempts 0

Terminal Type:

Then connect with this connection.



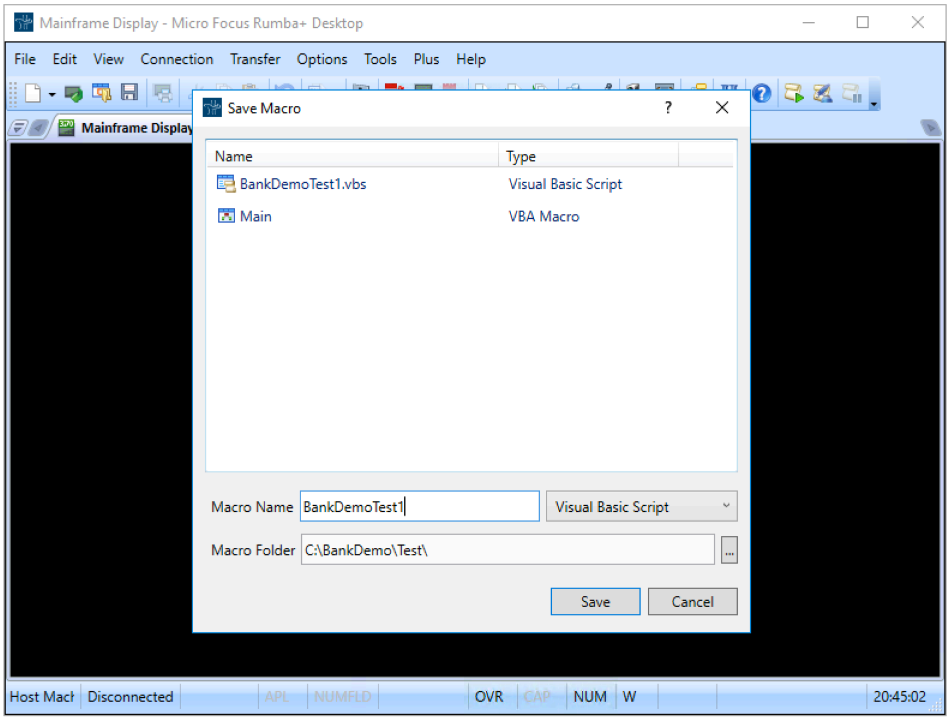
Mainframe Display - Micro Focus Rumba+ Desktop

```
_This is the Micro Focus ES/MTO region BANKDEMO 16:34:57
```

Ready | Running | NETA000 | OVR | NUM | W | 1,1 | 127.0.0.1:5555 | 16:37:01

Verify it connects successfully and that you can run manual tests.

If you need to record Rumba test script, record a macro and then save it under Visual Basic Script format in order to save it to a folder.


Mainframe Display - Micro Focus Rumba+ Desktop
File Edit View Connection Transfer Options Tools Plus Help
Mainframe Display
Save Macro
?
Save
Cancel
Host Mact
Disconnected
APL
NUMFLD
OVR
CAP
NUM
W
20:45:02

Name	Type
BankDemoTest1.vbs	Visual Basic Script
Main	VBA Macro

Macro Name: BankDemoTest1 — Visual Basic Script

Macro Folder: C:\BankDemo\Test\

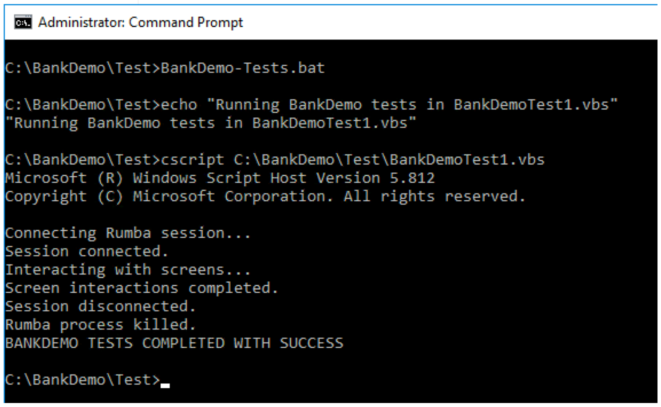
Create a test script in C:\BankDemo\Test\BankDemoTest1.vbs

```
WScript.StdOut.WriteLine "Connecting Rumba session..."
sessType = Conn_3270
Set app = CreateObject("MicroFocus.Rumba")
If app.GetSessionType(app.ActiveSessionID) = sessType Then
    Set session = app.GetSession(app.ActiveSessionID)
Else
    sessID = app.CreateSession(sessType)
    Set session = app.GetSession(sessID)
End if

session.HostName = "127.0.0.1"
session.Port = 5555
session.Connect()
WScript.StdOut.WriteLine "Session connected."

WScript.StdOut.WriteLine "Interacting with screens..."
WaitScreen "This is the Micro Focus ES/MTO region", DefaultConnectionTimeout, 1, 2, SearchOnlyAt, False, Empty, Empty
session.SendKey "Clear"
WaitScreenTimeout DefaultScreenTimeout
session.TypeText "bank"
session.SendKey "Enter"
WaitScreen "User id.....:", DefaultScreenDataTimeout, 10, 30, SearchOnlyAt, False, 10, 44
session.TypeText "b0001v"
session.SendKey "Enter"
WaitScreen "        **********************************            ", DefaultScreenDataTimeout, 2, 17, SearchOnlyAt, False, 8, 4
'WaitScreen "        MISMATCH************************            ", DefaultScreenDataTimeout, 2, 17, SearchOnlyAt, False, 8, 4
session.TypeText "/"
session.SendKey "Enter"
WaitScreen "450061494  ", DefaultScreenDataTimeout, 11, 8, SearchOnlyAt, False, 11, 3
session.TypeText "/"
session.SendKey "Enter"
WaitScreen "Scrn:", DefaultScreenDataTimeout, 1, 2, SearchOnlyAt, False, Empty, Empty
session.SendKey "PF4"
WaitScreen "450061494  ", DefaultScreenDataTimeout, 11, 8, SearchOnlyAt, False, Empty, Empty
session.SendKey "Tab"
session.TypeText "/"
session.SendKey "Enter"
WaitScreen "Scrn:", DefaultScreenDataTimeout, 1, 2, SearchOnlyAt, False, Empty, Empty
session.SendKey "PF4"
WaitScreen "450061494  ", DefaultScreenDataTimeout, 11, 8, SearchOnlyAt, False, Empty, Empty
session.SendKey "PF4"
WaitScreen "        **********************************            ", DefaultScreenDataTimeout, 2, 17, SearchOnlyAt, False, Empty,
Empty
session.SendKey "Tab"
session.SendKey "Tab"
session.SendKey "Tab"
session.TypeText "/"
session.SendKey "Enter"
WaitScreen "The amount you would like to borrow...:", DefaultScreenDataTimeout, 8, 6, SearchOnlyAt, False, 8, 46
session.TypeText "10000"
session.SendKey "Tab"
session.TypeText "4.25"
session.SendKey "Tab"
session.TypeText "24"
session.SendKey "Enter"
WaitScreen "The amount you would like to borrow...:", DefaultScreenDataTimeout, 8, 6, SearchOnlyAt, False, Empty, Empty
session.SendKey "PF4"
WaitScreen "        **********************************            ", DefaultScreenDataTimeout, 2, 17, SearchOnlyAt, False, Empty,
Empty
session.SendKey "PF4"
WaitScreen "User id.....:", DefaultScreenDataTimeout, 10, 30, SearchOnlyAt, False, Empty, Empty
session.SendKey "PF3"
WaitScreenTimeout DefaultScreenTimeout
WScript.StdOut.WriteLine "Screen interactions completed."

session.Disconnect()
WScript.StdOut.WriteLine "Session disconnected."

lResult = CreateObject("WScript.Shell").Run("taskkill /f /im RumbaPage.exe", 0, True)
WScript.StdOut.WriteLine "Rumba process killed."
WScript.StdOut.WriteLine "BANKDEMO TESTS COMPLETED WITH SUCCESS"

Const DefaultScreenTimeout = 3000
Const DefaultScreenDataTimeout = 10000
Const DefaultConnectionTimeout = 10000

Const SearchAnywhere = 0
Const SearchStartingAt = 1
Const SearchOnlyAt = 2

Const ErrorCodeScreenTimeout = 1
Const ErrorCodeSessionDisconnected = 2
Const ErrorCodeHostBusy = 3

Const Conn_3270 = 1
Const Conn_5250 = 2
Const Conn_VAX = 3
Const Conn_Other = 4

Function GetScreenPosition(row, column)
    Dim rows
    Dim columns
    session.GetScreenSize rows, columns
    GetScreenPosition = (columns*(row-1)) + column
End Function

Function ScreenMatch(textToSearch, row, column, searchCriteria, ignoreCase)
    screenPosition = 1
    If (searchCriteria = SearchStartingAt Or searchCriteria = SearchOnlyAt) And Not IsEmpty(row) And Not IsEmpty(column) Then
        screenPosition = GetScreenPosition(row, column)
    End if

    If (searchCriteria = SearchStartingAt Or searchCriteria = SearchOnlyAt) And (IsEmpty(row) Or IsEmpty(column)) Then
        Dim currentRow
        Dim currentColumn
        session.GetCursorPosition currentRow, currentColumn
        If (searchCriteria = SearchStartingAt) Then currentColumn = 1
        screenPosition = GetScreenPosition(currentRow, currentColumn)
    End if

    textToSearchTemp = textToSearch
    screenTextTemp = session.ScreenText
    If ignoreCase = True Then
        textToSearchTemp = UCase(textToSearchTemp)
        screenTextTemp = UCase(screenTextTemp)
    End if

    If searchCriteria = SearchOnlyAt Then
        ScreenMatch = Mid(screenTextTemp, screenPosition, Len(textToSearchTemp)) = textToSearchTemp
    Else
        ScreenMatch = InStr(screenPosition, screenTextTemp, textToSearchTemp) <> 0
    End if
End Function

Sub WaitScreen(textToSearch, timeout, row, column, searchCriteria, ignoreCase, cursorPosRowToWait, cursorPosColumnToWait)
    Dim timePassed
    Dim screenFound
    Dim cursorPosMatch
    Dim cursorRow, cursorColumn
    timePassed = 0

    Do
        WScript.Sleep 100
        timePassed = timePassed + 100
        screenFound = ScreenMatch(textToSearch, row, column, searchCriteria, ignoreCase)
        If IsEmpty(cursorPosRowToWait) Or IsEmpty(cursorPosColumnToWait) Then
            cursorPosMatch = True
        Else
            session.GetCursorPosition cursorRow, cursorColumn
            cursorPosMatch = (cursorRow = cursorPosRowToWait And cursorColumn = cursorPosColumnToWait)
        End If
    Loop Until (session.HostReady = True And screenFound = True And cursorPosMatch = True) Or timePassed >= timeout

    If session.Connected = False Then Call Quit(ErrorCodeSessionDisconnected)
    If session.HostReady = False Then Call Quit(ErrorCodeHostBusy)
    If screenFound = False Then Call Quit(ErrorCodeScreenTimeout)
End Sub

Sub WaitScreenTimeout(timeout)
    Dim timePassed
    timePassed = 0

    Do
        WScript.Sleep 100
        timePassed = timePassed + 100
    Loop Until timePassed >= timeout

    If session.Connected = False Then Call Quit(ErrorCodeSessionDisconnected)
    If session.HostReady = False Then Call Quit(ErrorCodeHostBusy)
End Sub

Function PromptForHiddenText(prompt, caption)
    Set objHiddenText = CreateObject( "MicroFocus.HiddenInput" )
    txt = objHiddenText.GetInput(prompt, caption)
    If txt = Empty Then WScript.Quit
    PromptForHiddenText = txt
End Function

Sub Quit(ErrorCode)
    If ErrorCode = ErrorCodeScreenTimeout Then WScript.StdErr.Write "ERROR - Screen timeout or screen mismatch."
    If ErrorCode = ErrorCodeSessionDisconnected Then WScript.StdErr.Write "ERROR - Session disconnected."
    If ErrorCode = ErrorCodeHostBusy Then WScript.StdErr.Write "ERROR - Host busy."

    WScript.Quit
End Sub
```

Create a batch file calling this script in C:\BankDemo\Test\BankDemo-Tests.bat

```
echo "Running BankDemo tests in BankDemoTest1.vbs"
cscript C:\BankDemo\Test\BankDemoTest1.vbs
```

Verify the test script runs successfully by running the BankDemo-Tests.bat file.



```
C:\BankDemo\Test>BankDemo-Tests.bat

C:\BankDemo\Test>echo "Running BankDemo tests in BankDemoTest1.vbs"
"Running BankDemo tests in BankDemoTest1.vbs"

C:\BankDemo\Test>cscript C:\BankDemo\Test\BankDemoTest1.vbs
Microsoft (R) Windows Script Host Version 5.812
Copyright (C) Microsoft Corporation. All rights reserved.

Connecting Rumba session...
Session connected.
Interacting with screens...
Screen interactions completed.
Session disconnected.
Rumba process killed.
BANKDEMO TESTS COMPLETED WITH SUCCESS

C:\BankDemo\Test>_
```

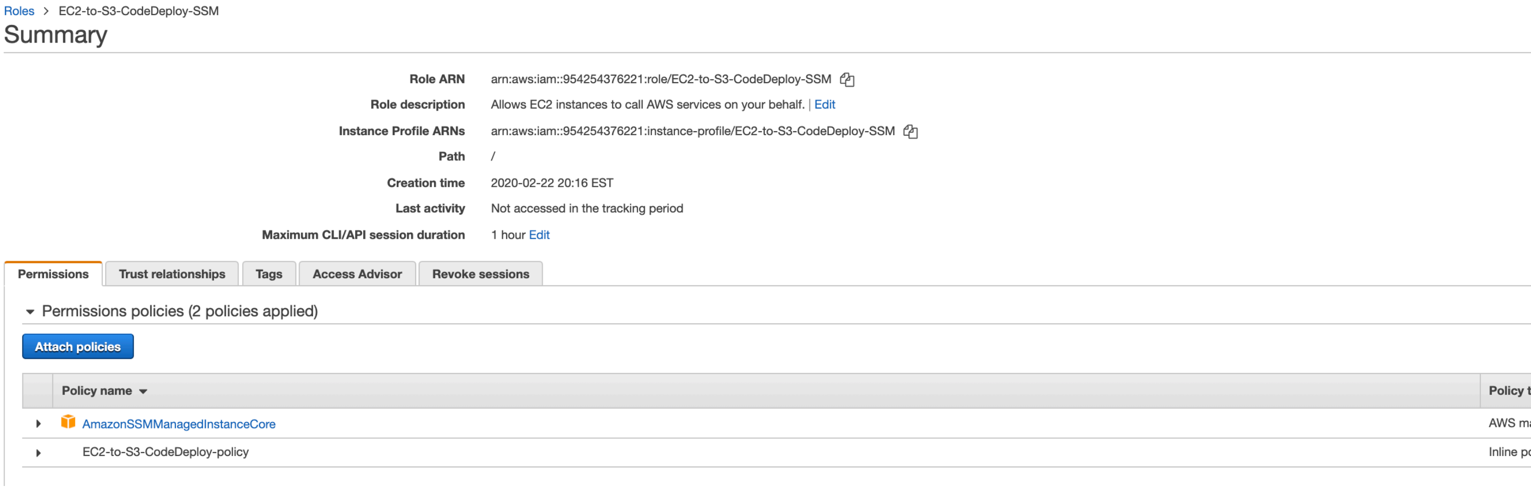
6.2 TEST – MF ETS configuration for SSM

AWS Lambda uses AWS Systems Manager (SSM) to launch the batch script on the ETS server. Hence we configure SSM first.

Create an IAM role named EC2-to-S3-CodeDeploy-SSM which contains an inline policy with this JSON:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "s3:Get*",
                "s3:List*"
            ],
            "Resource": [
                "arn:aws:s3:::mf-aws-cicd-artifacts/*",
                "arn:aws:s3:::aws-codedeploy-us-east-2/*",
                "arn:aws:s3:::aws-codedeploy-us-east-1/*",
                "arn:aws:s3:::aws-codedeploy-us-west-1/*",
                "arn:aws:s3:::aws-codedeploy-us-west-2/*",
                "arn:aws:s3:::aws-codedeploy-ca-central-1/*",
                "arn:aws:s3:::aws-codedeploy-eu-west-1/*",
                "arn:aws:s3:::aws-codedeploy-eu-west-2/*",
                "arn:aws:s3:::aws-codedeploy-eu-west-3/*",
                "arn:aws:s3:::aws-codedeploy-eu-central-1/*",
                "arn:aws:s3:::aws-codedeploy-ap-east-1/*",
                "arn:aws:s3:::aws-codedeploy-ap-northeast-1/*",
                "arn:aws:s3:::aws-codedeploy-ap-northeast-2/*",
                "arn:aws:s3:::aws-codedeploy-ap-southeast-1/*",
                "arn:aws:s3:::aws-codedeploy-ap-southeast-2/*",
                "arn:aws:s3:::aws-codedeploy-ap-south-1/*",
                "arn:aws:s3:::aws-codedeploy-sa-east-1/*",
                "arn:aws:s3:::codepipeline-us-east-2-*",
                "arn:aws:s3:::codepipeline-us-east-1-*",
                "arn:aws:s3:::codepipeline-us-west-1-*",
                "arn:aws:s3:::codepipeline-us-west-2-*",
                "arn:aws:s3:::codepipeline-ca-central-1-*",
                "arn:aws:s3:::codepipeline-eu-west-1-*",
                "arn:aws:s3:::codepipeline-eu-west-2-*",
                "arn:aws:s3:::codepipeline-eu-west-3-*",
                "arn:aws:s3:::codepipeline-eu-central-1-*",
                "arn:aws:s3:::codepipeline-ap-east-1-*",
                "arn:aws:s3:::codepipeline-ap-northeast-1-*",
                "arn:aws:s3:::codepipeline-ap-northeast-2-*",
                "arn:aws:s3:::codepipeline-ap-southeast-1-*",
                "arn:aws:s3:::codepipeline-ap-southeast-2-*",
                "arn:aws:s3:::codepipeline-ap-south-1-*",
                "arn:aws:s3:::codepipeline-sa-east-1-*"
            ]
        }
    ]
}
```

Also attach the **AmazonSSMManagedInstanceCore** managed policy to this role.



Role ARN arn:aws:iam::954254376221:role/EC2-to-S3-CodeDeploy-SSM

Role description Allows EC2 instances to call AWS services on your behalf. | Edit

Instance Profile ARNs arn:aws:iam::954254376221:instance-profile/EC2-to-S3-CodeDeploy-SSM

Path /

Creation time 2020-02-22 20:16 EST

Last activity Not accessed in the tracking period

Maximum CLI/API session duration 1 hour Edit

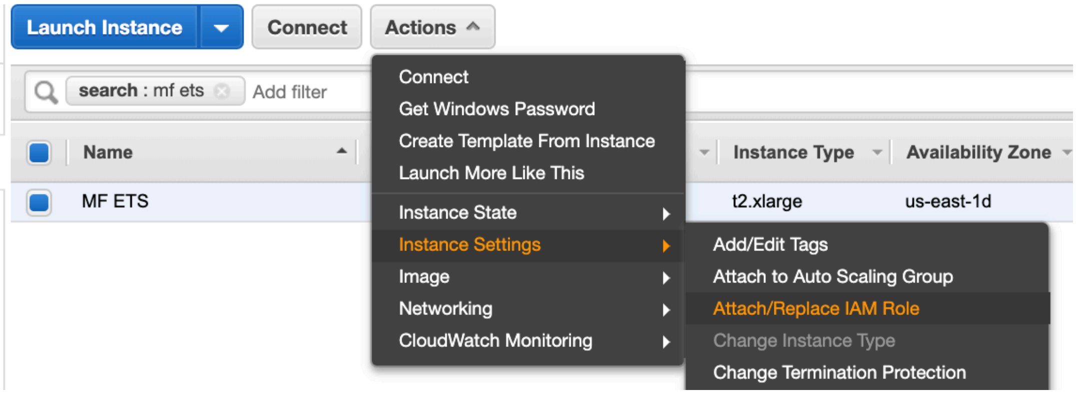
Permissions policies (2 policies applied)

Policy name	Policy t
AmazonSSMManagedInstanceCore	AWS ma
EC2-to-S3-CodeDeploy-policy	Inline po

Check if the SSM agent is running on the ETS instance by checking of you see activity in the agent logs in C:\ProgramData\Amazon\SSM\Logs. If no log, follow the instructions to install the SSM agent on Windows:

https://docs.aws.amazon.com/systems-manager/latest/userguide/sysman-install-win.html

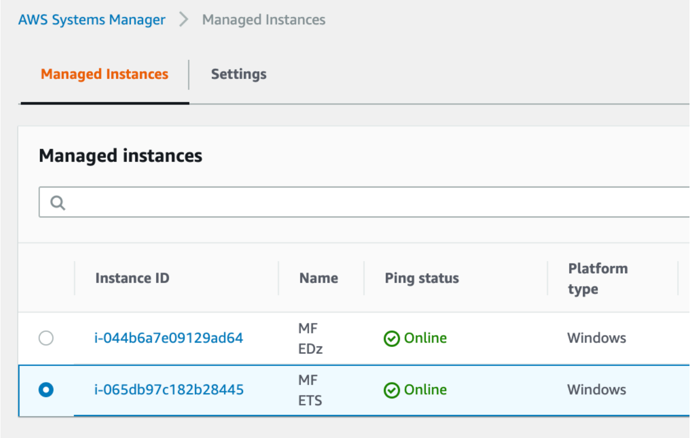
Either launch the ETS instance and attach the role EC2-to-S3-CodeDeploy-SSM, or change the IAM role for the running instance under Instance Settings -> Attach/Replace IAM Role, selecting EC2-to-S3-CodeDeploy-SSM and Apply.



Verify the ETS instance has the tag with key CodeDeployGroup and value ETS-EC2-instances-MF-AWS-CICD.

Stop and Start the ETS instance with the SSM agent.

Verify that the ETS instance shows up under AWS Systems Manager => Instances and Nodes => Managed Instances:

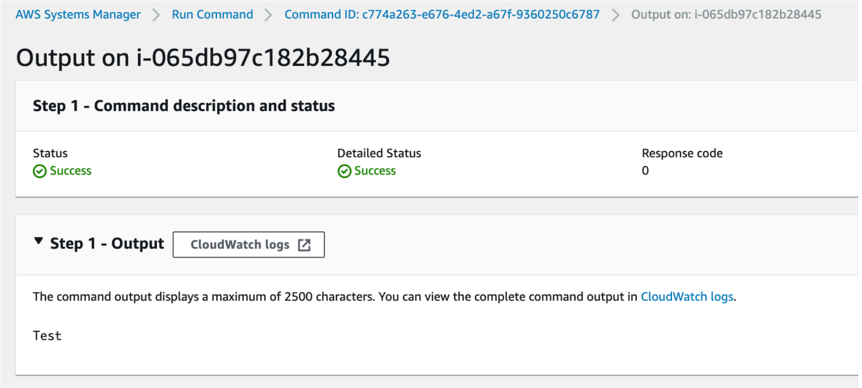


	Instance ID	Name	Ping status	Platform type
○	i-044b6a7e09129ad64	MF EDz	Online	Windows
●	i-065db97c182b28445	MF ETS	Online	Windows

Test the SSM configuration with such AWS CLI command:

```
aws ssm send-command --document-name "AWS-RunPowerShellScript" --document-version "1" --
targets '[{"Key":"tag:CodeDeployGroup","Values":["ETS-EC2-instances-MF-AWS-CICD"]}]' --
parameters '{"commands":["echo Test"],"workingDirectory":[""],"executionTimeout":["3600"]}' -
-timeout-seconds 600 --max-concurrency "50" --max-errors "0" --cloud-watch-output-config
'{"CloudWatchOutputEnabled":true}' --region us-east-1
```

You can verify the successful completion of this command on the instance via AWS Systems Manager => Run Command => Command history, and then selection the command that was run and the instance.


AWS Systems Manager > Run Command > Command ID: c774a263-e676-4ed2-a67f-9360250c6787 > Output on: i-065db97c182b28445

Output on i-065db97c182b28445

Step 1 - Command description and status

Status: Success
Detailed Status: Success
Response code: 0

Step 1 - Output

The command output displays a maximum of 2500 characters. You can view the complete command output in CloudWatch logs.

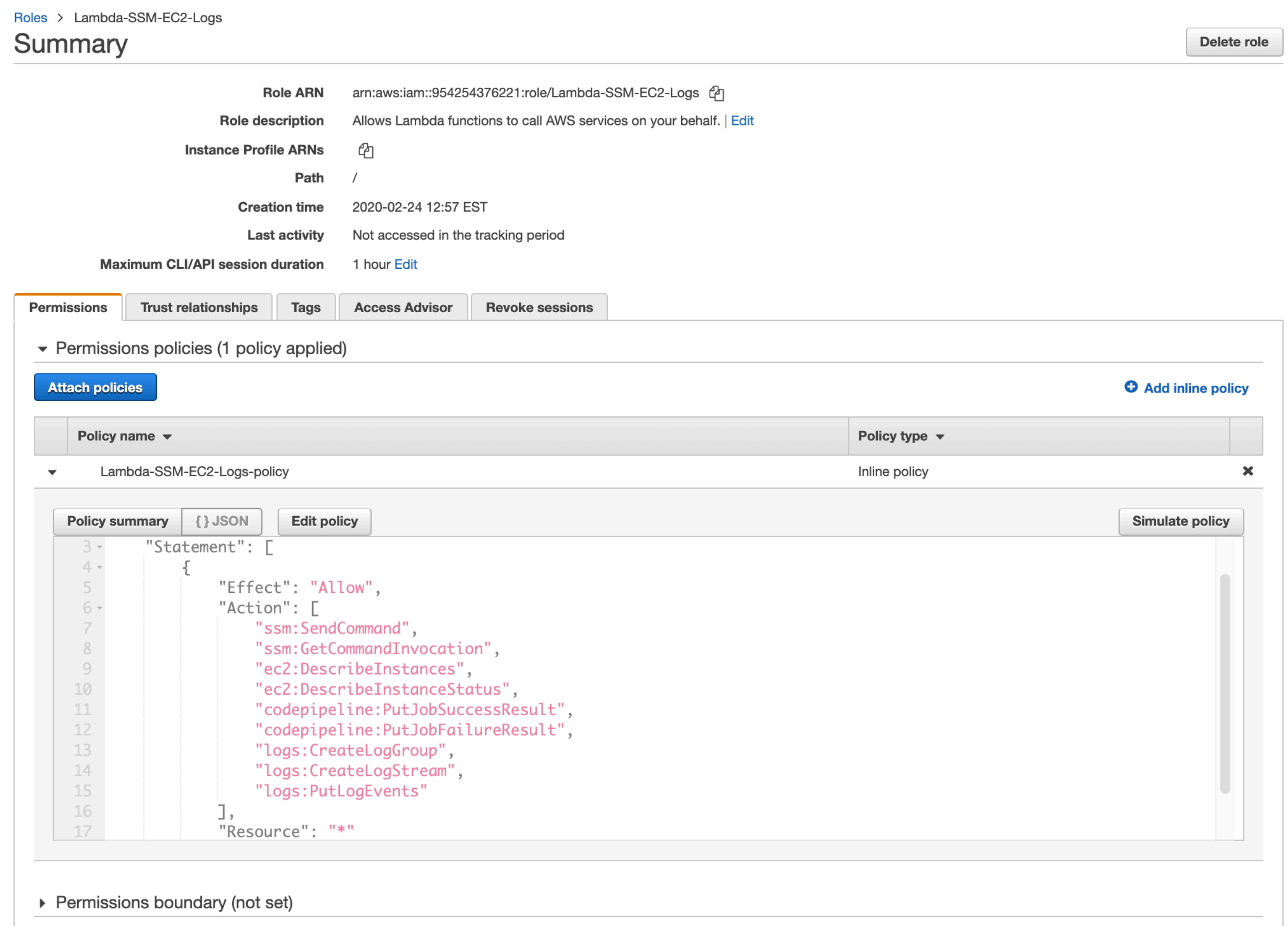
```
Test
```

6.3 TEST – AWS Lambda configuration

We now create a Lambda function to execute a command on an EC2 instance.

In IAM, create an IAM role named Lambda-SSM-EC2-Logs which contains an inline policy with this JSON:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "ssm:SendCommand",
                "ssm:GetCommandInvocation",
                "ec2:DescribeInstances",
                "ec2:DescribeInstanceStatus",
                "codepipeline:PutJobSuccessResult",
                "codepipeline:PutJobFailureResult",
                "logs:CreateLogGroup",
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": "*"
        }
    ]
}
```



Summary

Role ARN	arn:aws:iam::954254376221:role/Lambda-SSM-EC2-Logs
Role description	Allows Lambda functions to call AWS services on your behalf. | Edit
Instance Profile ARNs	
Path	/
Creation time	2020-02-24 12:57 EST
Last activity	Not accessed in the tracking period
Maximum CLI/API session duration	1 hour Edit

Permissions policies (1 policy applied)

Policy name	Policy type
Lambda-SSM-EC2-Logs-policy	Inline policy

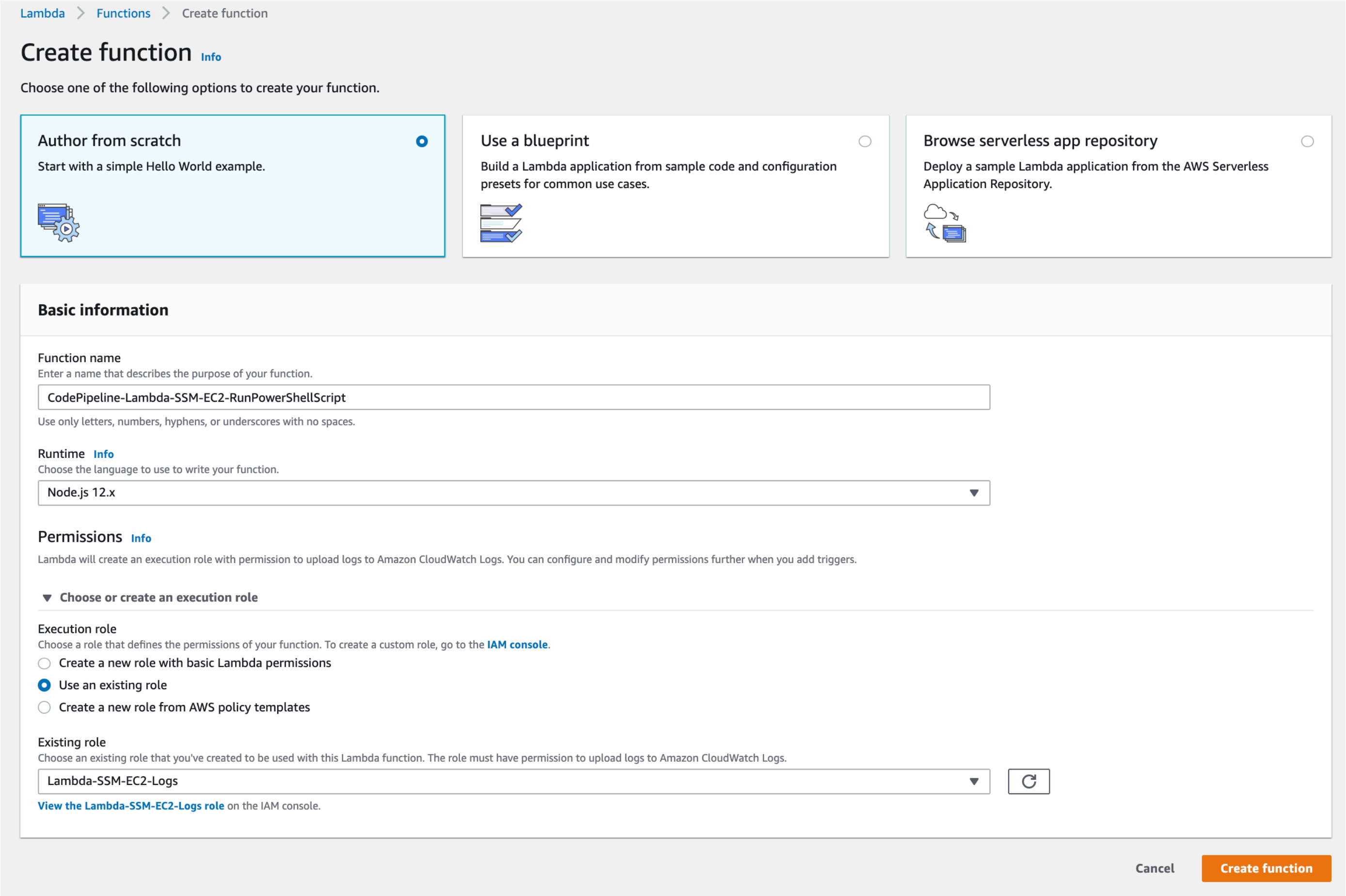
```
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "ssm:SendCommand",
                "ssm:GetCommandInvocation",
                "ec2:DescribeInstances",
                "ec2:DescribeInstanceStatus",
                "codepipeline:PutJobSuccessResult",
                "codepipeline:PutJobFailureResult",
                "logs:CreateLogGroup",
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": "*"
```

Permissions boundary (not set)

In Lambda, create a Lambda function named CodePipeline-Lambda-SSM-EC2-RunPowerShellScript.

Select Runtime Node.js 12.x.

Select the Lambda-SSM-EC2-Logs existing role.



Create function Info

Choose one of the following options to create your function.

● Author from scratch
Start with a simple Hello World example.

○ Use a blueprint
Build a Lambda application from sample code and configuration presets for common use cases.

○ Browse serverless app repository
Deploy a sample Lambda application from the AWS Serverless Application Repository.

Basic information

Function name
Enter a name that describes the purpose of your function.
CodePipeline-Lambda-SSM-EC2-RunPowerShellScript
Use only letters, numbers, hyphens, or underscores with no spaces.

Runtime Info
Choose the language to use to write your function.
Node.js 12.x

Permissions Info
Lambda will create an execution role with permission to upload logs to Amazon CloudWatch Logs. You can configure and modify permissions further when you add triggers.

▼ **Choose or create an execution role**

Execution role
Choose a role that defines the permissions of your function. To create a custom role, go to the **IAM console**.
○ Create a new role with basic Lambda permissions
● Use an existing role
○ Create a new role from AWS policy templates

Existing role
Choose an existing role that you've created to be used with this Lambda function. The role must have permission to upload logs to Amazon CloudWatch Logs.
Lambda-SSM-EC2-Logs
View the Lambda-SSM-EC2-Logs role on the IAM console.

Click Create function.

Enter code inline index.js:

```
const AWS = require('aws-sdk');
const ssm = new AWS.SSM();
const ec2 = new AWS.EC2();
const waitInterval = 1
const timeoutSSM = 300
var jobId
var jobUserParameters

exports.handler = async (event, context) => {
    const instanceIds = [];
    var instanceTagKey = 'CodeDeployGroup'
    var instanceTagValue = 'ETS-EC2-instances-MF-AWS-CICD'
    var command = "& C:\\BankDemo\\Test\\BankDemo-Tests.bat"
    var instanceId
    var codepipeline = new AWS.CodePipeline()
    var runEc2CommandOneSuccess = false

    console.log('Received event ', JSON.stringify(event))
    try {
        jobId = event["CodePipeline.job"].id
        console.log('Found CodePipeline job with ID: ', jobId)
        jobUserParameters = JSON.parse(event["CodePipeline.job"].data.actionConfiguration.configuration.UserParameters)
        console.log('Found CodePipeline job with parameters: ', jobUserParameters)
        instanceTagKey = jobUserParameters.Ec2TagKey
        instanceTagValue = jobUserParameters.Ec2TagValue
        command = jobUserParameters.Ec2Command
        if ((!instanceTagKey) || (!instanceTagValue) || (!command)) { console.error('Error trying to retrieve CodePipeline user parameters. In
CodePipeline, the User Parameters must be in JSON format following {"Ec2TagKey": "myTagKey", "Ec2TagValue": "myTagValue", "Ec2Command": "&
C:\\myPath\\myCommand.bat"}.') }
    } catch (error) {
        console.error('Error trying to retrieve CodePipeline parameters. In CodePipeline, the User Parameters must be in JSON format following
{"Ec2TagKey": "myTagKey", "Ec2TagValue": "myTagValue", "Ec2Command": "& C:\\myPath\\myCommand.bat"}. Continuing with default Lambda function values.
Catched error: ', error.toString())
    }
    try {

            var tagFilter = { Filters: [ { Name: 'tag:' + instanceTagKey, Values: [ instanceTagValue ] } ] };
            const instancesData = await ec2.describeInstances(tagFilter).promise();
            instancesData.Reservations.forEach(reservation => {
                reservation.Instances.forEach(instance => {
                    //console.log('Looking at instance: ', instance.InstanceId)
                    if (instance.State.Code === 16) {
                        // 0: pending, 16: running, 32: shutting-down, 48: terminated, 64: stopping, 80: stopped
                        instanceIds.push(instance.InstanceId);
                        console.log('Instance found running with tag { ' + instanceTagKey + ': ' + instanceTagValue + ' } :', instance.InstanceId)
                    }
```

```
                 });
            });
            //console.log('instanceIds: ', instanceIds)
            if (instanceIds.length == 0) {
                 console.error('No instance found with status Running and tag { ', instanceTagKey, ': ', instanceTagValue , ' }')
            } else {

                for (instanceId of instanceIds) {
                    // Send command to EC2 instance via SSM
                    const sendCommandPromise = ssm.sendCommand({
                           DocumentName: "AWS-RunPowerShellScript",
                           InstanceIds: [ instanceId ],
                           Parameters: {  "commands": [ command ], "workingDirectory": [  "" ] },
                           TimeoutSeconds: timeoutSSM
                           }).promise();
                    console.log(instanceId, ' - SSM command sent to instance')
                    console.log(instanceId, ' - PowerShell command sent: ', command)
                    const sendCommandResult = await sendCommandPromise
                    const commandId = sendCommandResult.Command.CommandId

                    var commandStatus = ''
                    var getCommandInvocationResult
                    do {
                        console.log(instanceId, ' - Waiting for SSM response...')
                        await new Promise(resolve => setTimeout(resolve, waitInterval * 1000));
                        const getCommandInvocationPromise = ssm.getCommandInvocation({ CommandId: commandId, InstanceId: instanceId}).promise();
                        getCommandInvocationResult = await getCommandInvocationPromise
                        //console.log('getCommandInvocationResult: ', getCommandInvocationResult)
                        commandStatus = getCommandInvocationResult.Status
                        console.log(instanceId, ' - SSM command status: ', commandStatus)
                        //if (commandStatus == 'Success') { console.log('getCommandInvocationResult: ', getCommandInvocationResult) }
                    } while ((commandStatus != 'Success') && (commandStatus != 'Cancelled') && (commandStatus != 'TimedOut') && (commandStatus !=
'Failed'));
                    if (commandStatus == 'Success') {
                        if (getCommandInvocationResult.StandardErrorContent.length == 0) {
                            runEc2CommandOneSuccess = true
                            console.log(instanceId, ' - Command successfully executed via SSM.')
                            console.log(instanceId, ' - Command StdOut: ', getCommandInvocationResult.StandardOutputContent)
                            console.log(instanceId, ' - Command StdErr: ', getCommandInvocationResult.StandardErrorContent)
                        } else {
                            console.error(instanceId, ' - Command executed via SSM, but generated an error.')
                            console.error(instanceId, ' - Command StdOut: ', getCommandInvocationResult.StandardOutputContent)
                            console.error(instanceId, ' - Command StdErr: ', getCommandInvocationResult.StandardErrorContent)
                        }
                    } else {
                        console.error(instanceId, ' - SSM command failed.')
                        console.error(instanceId, ' - SSM ResponseCode: ', getCommandInvocationResult.ResponseCode)
                        console.error(instanceId, ' - SSM Status: ', getCommandInvocationResult.Status)
                        console.error(instanceId, ' - SSM StatusDetails: ', getCommandInvocationResult.StatusDetails)
                    }
                }
            }

        if (runEc2CommandOneSuccess) {
            console.log('One command execution on an EC2 instance was successful.')
            if (jobId) {
                console.log('Sending putJobSuccessResult to CodePipeline.')
                await codepipeline.putJobSuccessResult({ jobId }).promise()
            }
        } else {
            console.error('Command execution on EC2 instance(s) was unsuccessful.')
            if (jobId) {
                console.log('Sending putJobFailureResult to CodePipeline.')
                await codepipeline.putJobFailureResult({jobId, failureDetails: {message: 'Script error. See Command StdErr for details', type:
'JobFailed', externalExecutionId: context.invokeid}}).promise()
            }
        }

    } catch (error) {
        console.error('Error caught during Lambda function execution:', error.toString())
        if (jobId) {
                   console.log('Sending putJobFailureResult to CodePipeline.')
                   await codepipeline.putJobFailureResult({jobId, failureDetails: {message: error.toString(), type: 'JobFailed', externalExecutionId:
context.invokeid}}).promise()
        } else {
           throw error
        }
    }
}
```

Tailor the instanceTagKey, instanceTagValue, command variables to your specific environment.

For the Execution role, verify the existing role Lambda-SSM-EC2-Logs is selected.

Edit the Basic setting timeout, select 5 min 30 sec.

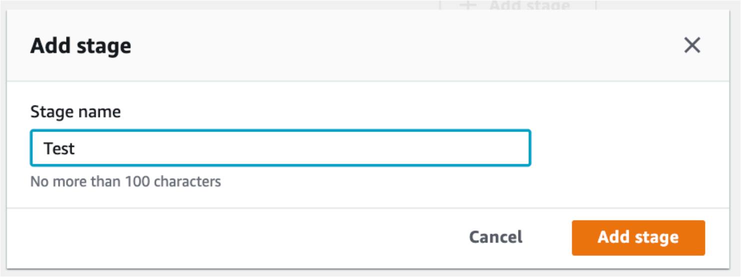
Save the function.

Click Test to run this new function. Verify it runs successfully.

6.4 TEST – AWS CodePipeline configuration

In CodePipeline, go to the MF-AWS-CICD-Pipeline and click Edit.

Add a stage after the Deploy stage.



Add stage

Stage name

Test

No more than 100 characters

For this new Test stage, click Add action group.

Action name is: Test

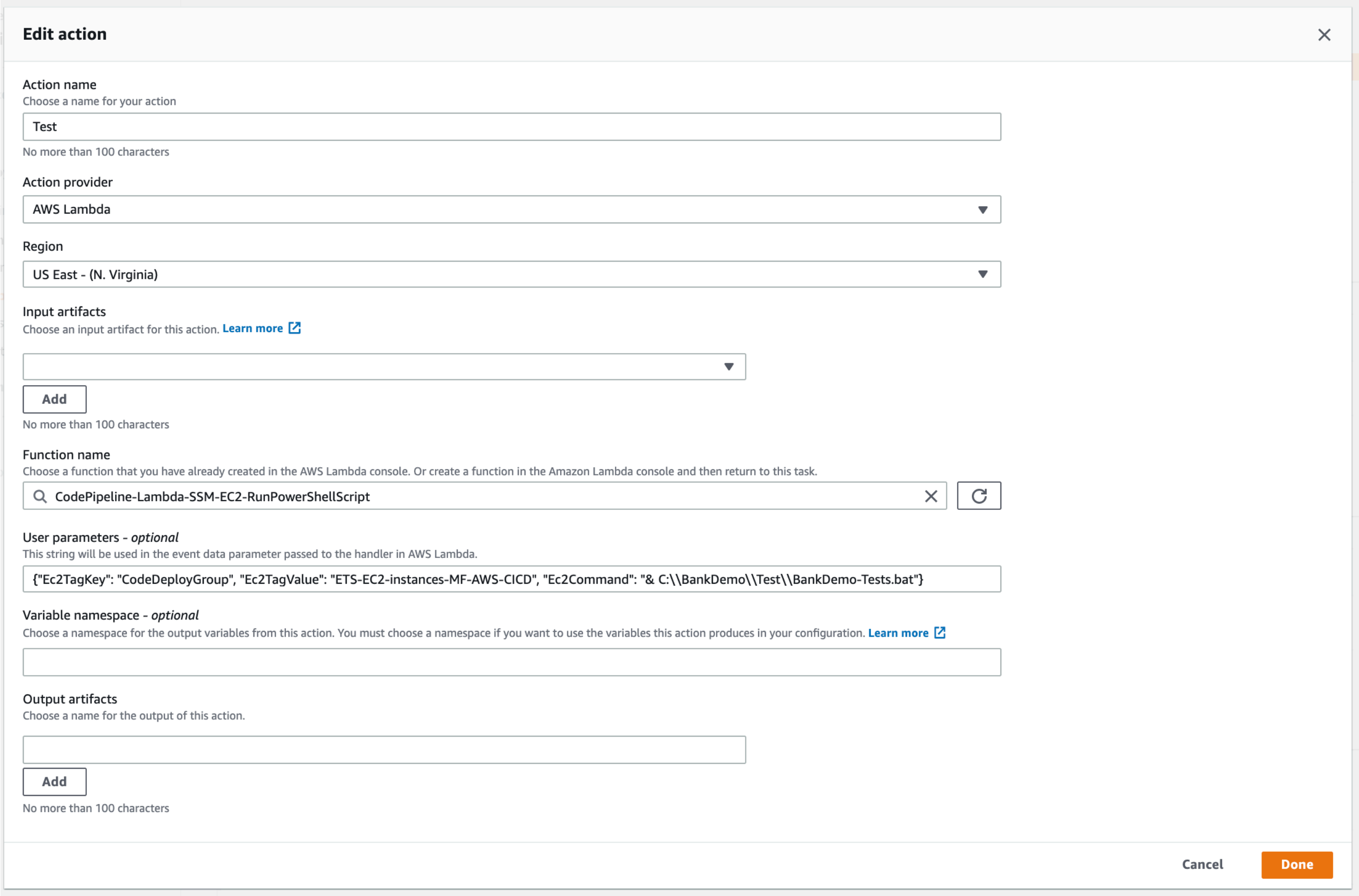
Action provider is: AWS Lambda

Region is the region used for the ETS EC2 instance.

Function name is: CodePipeline-Lambda-SSM-EC2-RunPowerShellScript

Under User parameters, enter the JSON string specifying the tag and the test command:

```
{"Ec2TagKey": "CodeDeployGroup", "Ec2TagValue": "ETS-EC2-instances-MF-AWS-CICD",
"Ec2Command": "& C:\\BankDemo\\Test\\BankDemo-Tests.bat"}
```



Edit action

Action name
Choose a name for your action

Test

No more than 100 characters

Action provider

AWS Lambda

Region

US East - (N. Virginia)

Input artifacts
Choose an input artifact for this action. Learn more

No more than 100 characters

Function name
Choose a function that you have already created in the AWS Lambda console. Or create a function in the Amazon Lambda console and then return to this task.

CodePipeline-Lambda-SSM-EC2-RunPowerShellScript

User parameters - *optional*
This string will be used in the event data parameter passed to the handler in AWS Lambda.

{"Ec2TagKey": "CodeDeployGroup", "Ec2TagValue": "ETS-EC2-instances-MF-AWS-CICD", "Ec2Command": "& C:\\BankDemo\\Test\\BankDemo-Tests.bat"}

Variable namespace - *optional*
Choose a namespace for the output variables from this action. You must choose a namespace if you want to use the variables this action produces in your configuration. Learn more

Output artifacts
Choose a name for the output of this action.

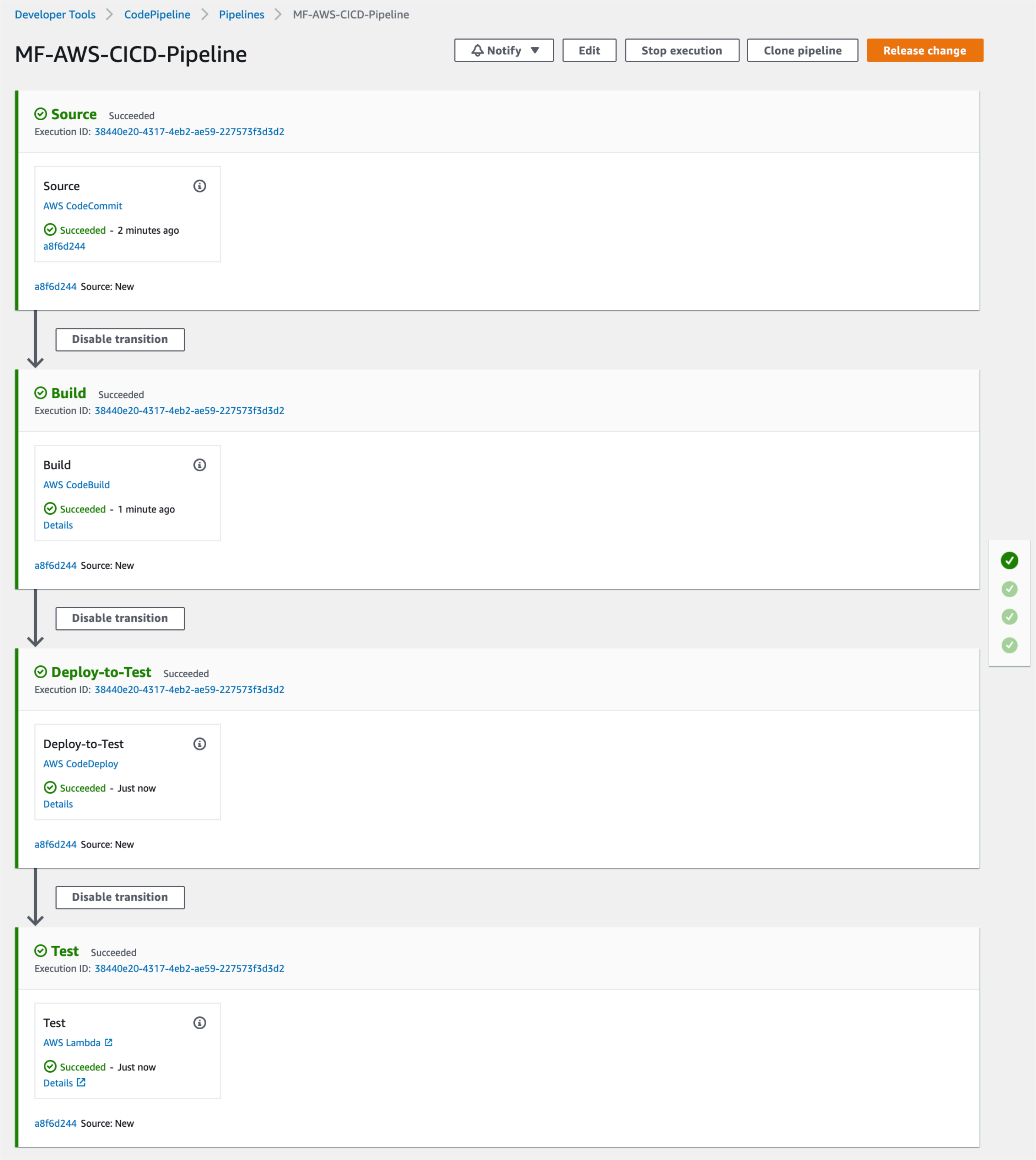
No more than 100 characters

Click Done.

Click Done for the Stage.

Click Save for the pipeline.

Click Release change to re-run the last code change through the pipeline with the new Test stage.



Developer Tools > CodePipeline > Pipelines > MF-AWS-CICD-Pipeline

MF-AWS-CICD-Pipeline

Source Succeeded
Execution ID: 38440e20-4317-4eb2-ae59-227573f3d3d2

Source
AWS CodeCommit
Succeeded - 2 minutes ago
a8f6d244

a8f6d244 Source: New

Build Succeeded
Execution ID: 38440e20-4317-4eb2-ae59-227573f3d3d2

Build
AWS CodeBuild
Succeeded - 1 minute ago
Details

a8f6d244 Source: New

Deploy-to-Test Succeeded
Execution ID: 38440e20-4317-4eb2-ae59-227573f3d3d2

Deploy-to-Test
AWS CodeDeploy
Succeeded - Just now
Details

a8f6d244 Source: New

Test Succeeded
Execution ID: 38440e20-4317-4eb2-ae59-227573f3d3d2

Test
AWS Lambda
Succeeded - Just now
Details

a8f6d244 Source: New

7 DEPLOY to PROD stage

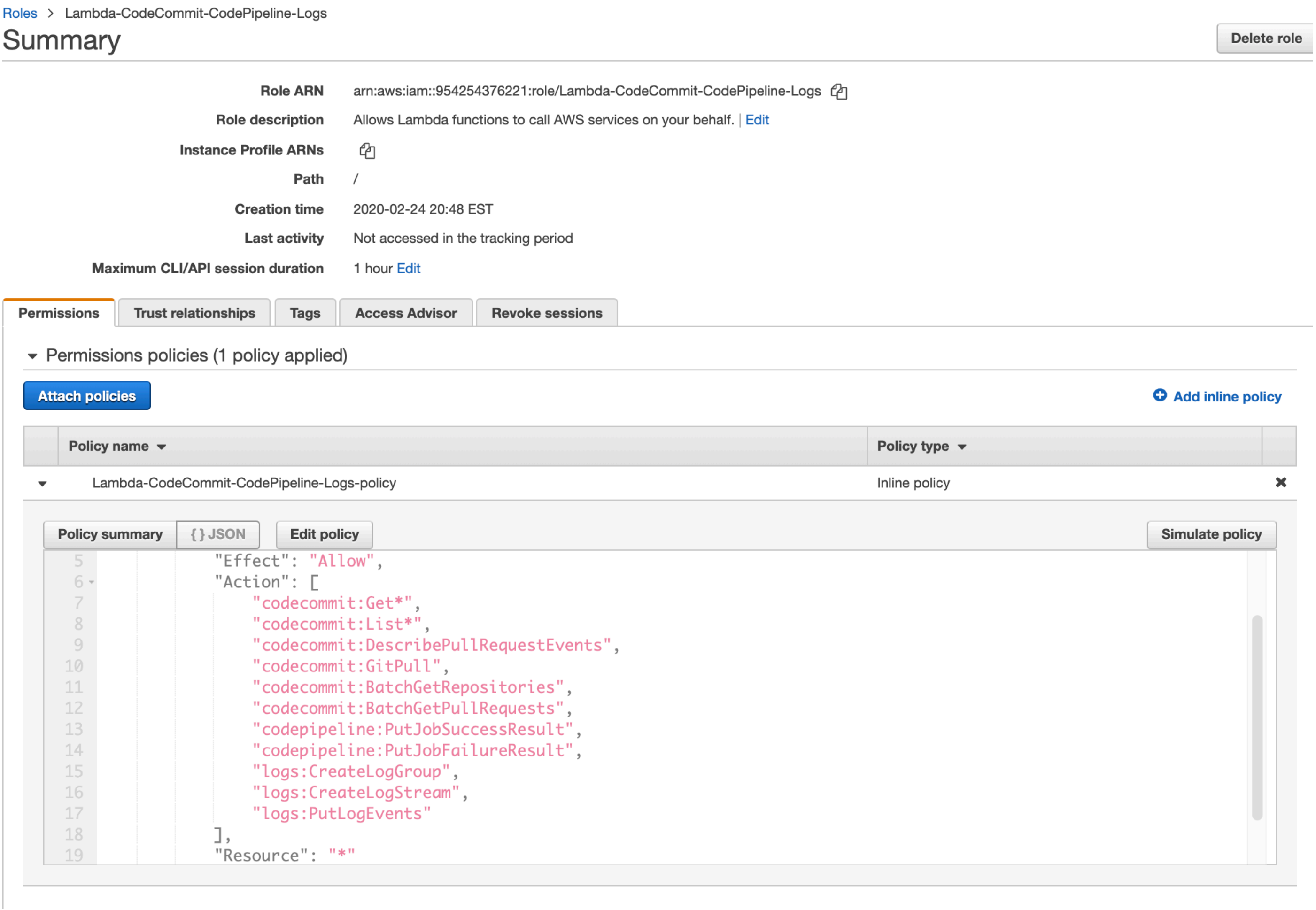
7.1 DEPLOY to PROD – AWS Lambda configuration

We now create a Lambda function to pull the changed files from CodeCommit and process them for deployment to production.

This section allows developing custom code in the Lambda function to deploy the code to production. In case you want to upload the source code files to z/OS via the z/OS FTP server, please refer to the next section.

In IAM, create an IAM role named Lambda-CodeCommit-CodePipeline-Logs which contains an inline policy with this JSON:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "codecommit:Get*",
                "codecommit:List*",
                "codecommit:DescribePullRequestEvents",
                "codecommit:GitPull",
                "codecommit:BatchGetRepositories",
                "codecommit:BatchGetPullRequests",
                "codepipeline:PutJobSuccessResult",
                "codepipeline:PutJobFailureResult",
                "logs:CreateLogGroup",
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": "*"
        }
    ]
}
```



Summary

Role ARN arn:aws:iam::954254376221:role/Lambda-CodeCommit-CodePipeline-Logs

Role description Allows Lambda functions to call AWS services on your behalf. | Edit

Instance Profile ARNs

Path /

Creation time 2020-02-24 20:48 EST

Last activity Not accessed in the tracking period

Maximum CLI/API session duration 1 hour Edit

Permissions policies (1 policy applied)

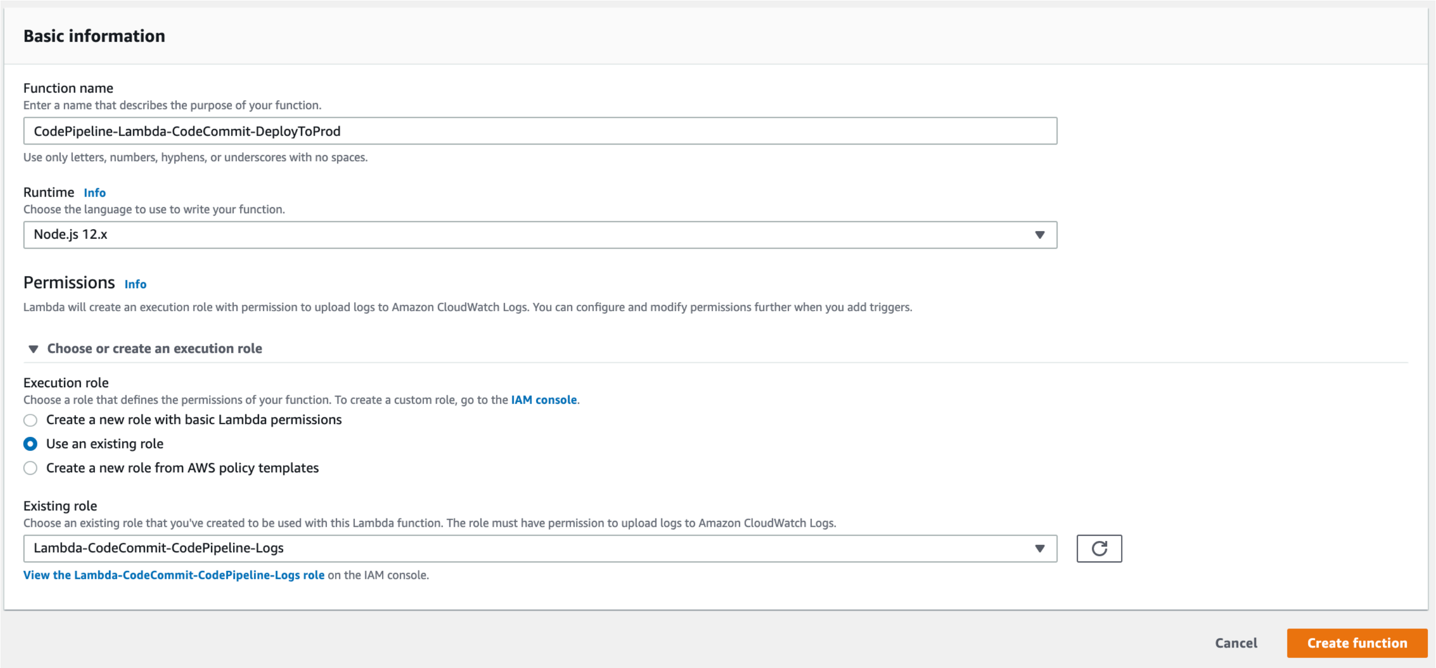
Policy name	Policy type
Lambda-CodeCommit-CodePipeline-Logs-policy	Inline policy

```
            "Effect": "Allow",
            "Action": [
                "codecommit:Get*",
                "codecommit:List*",
                "codecommit:DescribePullRequestEvents",
                "codecommit:GitPull",
                "codecommit:BatchGetRepositories",
                "codecommit:BatchGetPullRequests",
                "codepipeline:PutJobSuccessResult",
                "codepipeline:PutJobFailureResult",
                "logs:CreateLogGroup",
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": "*"
```

In Lambda, create a Lambda function named CodePipeline-Lambda-CodeCommit-DeployToProd.

Select Runtime Node.js 12.x.

Select the Lambda-CodeCommit-CodePipeline-Logs existing role.



Basic information

Function name
Enter a name that describes the purpose of your function.
CodePipeline-Lambda-CodeCommit-DeployToProd
Use only letters, numbers, hyphens, or underscores with no spaces.

Runtime Info
Choose the language to use to write your function.
Node.js 12.x ▼

Permissions Info
Lambda will create an execution role with permission to upload logs to Amazon CloudWatch Logs. You can configure and modify permissions further when you add triggers.

▼ Choose or create an execution role

Execution role
Choose a role that defines the permissions of your function. To create a custom role, go to the IAM console.
○ Create a new role with basic Lambda permissions
● Use an existing role
○ Create a new role from AWS policy templates

Existing role
Choose an existing role that you've created to be used with this Lambda function. The role must have permission to upload logs to Amazon CloudWatch Logs.
Lambda-CodeCommit-CodePipeline-Logs ▼
View the Lambda-CodeCommit-CodePipeline-Logs role on the IAM console.

Click Create function.

Enter code inline index.js:

```
const AWS = require('aws-sdk');
var jobId
var commitId = '4aae84ccb0c0d59d9aa133dc85f076357993822c'
var repositoryName = 'MF-AWS-CICD-SCM'
var jobUserParameters
var differencesData
var difference


exports.handler = async (event, context) => {
    var codepipeline = new AWS.CodePipeline()
    var codecommit = new AWS.CodeCommit()

    console.log('Received event ', JSON.stringify(event))
    try {
        jobId = event["CodePipeline.job"].id
        console.log('Found CodePipeline job with ID: ', jobId)
        jobUserParameters = JSON.parse(event["CodePipeline.job"].data.actionConfiguration.configuration.UserParameters)
        console.log('Found CodePipeline job with parameters: ', jobUserParameters)
        commitId = jobUserParameters.commitId
        console.log('Found CodeCommit CommitId: ', commitId)
        repositoryName = jobUserParameters.repositoryName
        console.log('Found CodeCommit RepositoryName: ', repositoryName)
        if ((!commitId) || (!repositoryName) ) { console.error('Error trying to retrieve CodePipeline user parameters. In
CodePipeline, the User Parameters must be { "commitId": "#{SourceVariables.CommitId}", "repositoryName":
"#{SourceVariables.RepositoryName}" }.') }
    } catch (error) {
        console.error('Error trying to retrieve CodePipeline parameters. In CodePipeline, the User Parameters must be {
"commitId": "#{SourceVariables.CommitId}", "repositoryName": "#{SourceVariables.RepositoryName}" }. Continuing with default
Lambda function values. Catched error: ', error.toString())
    }

    try {

        console.log('commitId:', commitId)
        const commitData = await codecommit.getCommit({ commitId: commitId, repositoryName: repositoryName }).promise()
        //console.log(commitData)
        console.log('Commit message:', commitData.commit.message)
        if (commitData.commit.parents[0].length > 0) {
            const priorCommitId = commitData.commit.parents[0]
            console.log('priorCommitId:', priorCommitId)
            differencesData = await codecommit.getDifferences({ repositoryName: repositoryName, afterCommitSpecifier: commitId,
beforeCommitSpecifier: priorCommitId }).promise()
        } else {
            differencesData = await codecommit.getDifferences({ repositoryName: repositoryName, afterCommitSpecifier: commitId
}).promise()
        }
        //console.log('differencesData:', differencesData)

        for (difference of differencesData.differences) {
            //console.log('Processing difference:', difference)
            if (difference.changeType == 'A') {
                console.log('Processing DeployToProd file add:', difference.afterBlob.path )
                console.log('Processing DeployToProd file add with blobId:', difference.afterBlob.blobId )
                const blobData = await codecommit.getBlob({ blobId: difference.afterBlob.blobId, repositoryName: repositoryName
}).promise()
                const blobContent = blobData.content
                console.log('blobContent:', blobContent)
                // Add your code addition logic here

            } else if (difference.changeType == 'M') {
                console.log('Processing DeployToProd file modify:', difference.afterBlob.path )
                console.log('Processing DeployToProd file modify with blobId:', difference.afterBlob.blobId )
                const blobData = await codecommit.getBlob({ blobId: difference.afterBlob.blobId, repositoryName: repositoryName
}).promise()
                const blobContent = blobData.content
                console.log('blobContent:', blobContent)
                // Add your code modification logic here

            } else if (difference.changeType == 'D') {
                console.log('Processing DeployToProd file delete:', difference.afterBlob.path )
                console.log('Processing DeployToProd file delete with blobId:', difference.afterBlob.blobId )
                // Add your code deletion logic here

            } else {
                console.log('changeTyoe not processed: ', difference.changeType)
            }
        }


        if (jobId) {
            console.log('Sending putJobSuccessResult to CodePipeline.')
            await codepipeline.putJobSuccessResult({ jobId }).promise()
        }

    } catch (error) {
        console.error('Error caught during Lambda function execution:', error.toString())
        if (jobId) {
                    console.log('Sending putJobFailureResult to CodePipeline.')
                    await codepipeline.putJobFailureResult({jobId, failureDetails: {message: error.toString(), type: 'JobFailed',
externalExecutionId: context.invokeid}}).promise()
        } else {
           throw error
        }
    }
}
```

Edit the Basic setting timeout, select 1min.

Save the function.

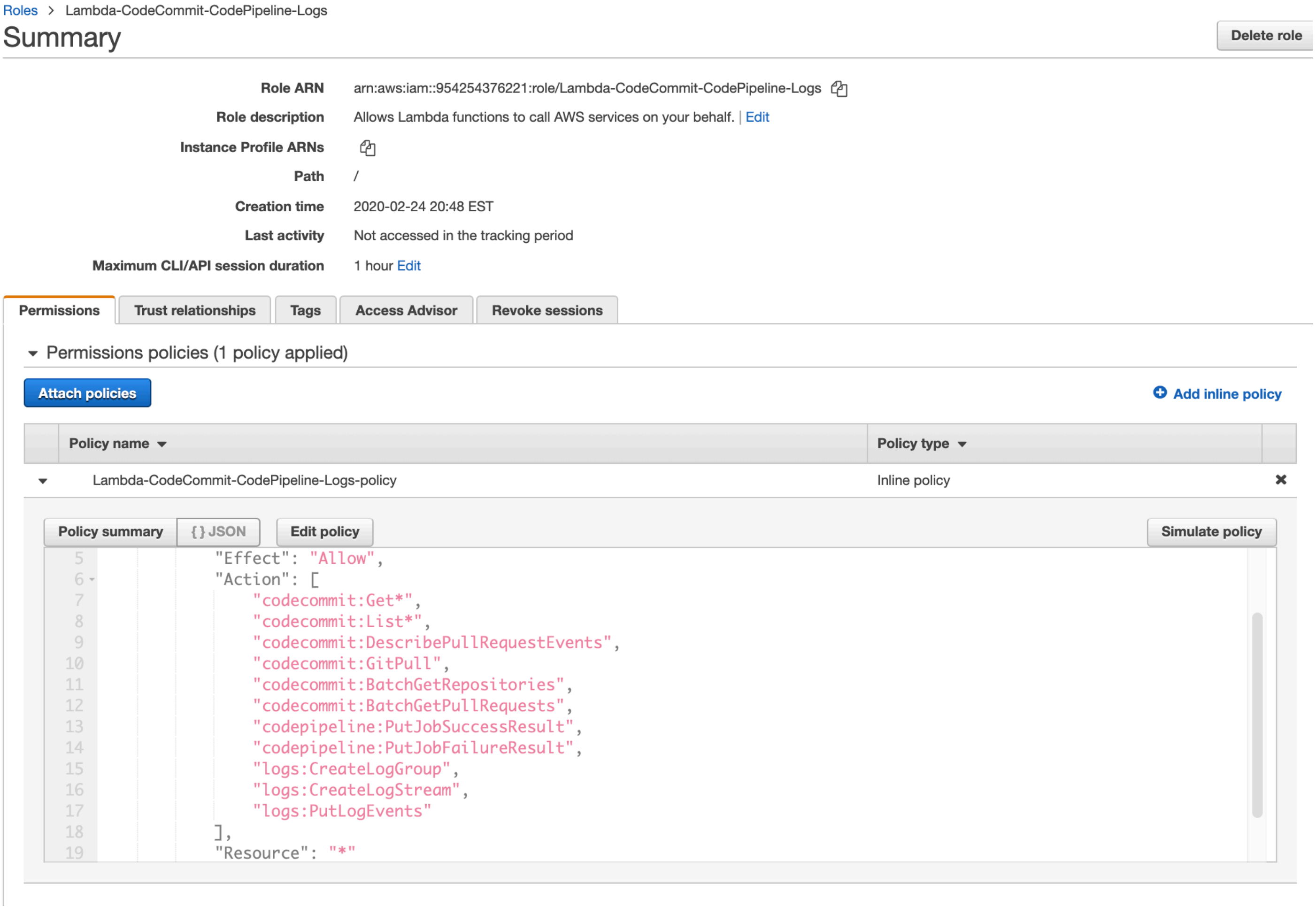
Click Test to run this new function. Verify it runs successfully

7.2 DEPLOY to PROD via z/OS FTP – AWS Lambda configuration

In this section we describe how to configure the Lambda function for uploading the source code to z/OS via the z/OS FTP server which comes with z/OS Communication Server.

In IAM, create an IAM role named Lambda-CodeCommit-CodePipeline-Logs which contains an inline policy with this JSON:

```
{
    "Version": "2012-10-17",
    "Statement": [
        {
            "Effect": "Allow",
            "Action": [
                "codecommit:Get*",
                "codecommit:List*",
                "codecommit:DescribePullRequestEvents",
                "codecommit:GitPull",
                "codecommit:BatchGetRepositories",
                "codecommit:BatchGetPullRequests",
                "codepipeline:PutJobSuccessResult",
                "codepipeline:PutJobFailureResult",
                "logs:CreateLogGroup",
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": "*"
        }
    ]
}
```



Roles > Lambda-CodeCommit-CodePipeline-Logs

Summary

Role ARN arn:aws:iam::954254376221:role/Lambda-CodeCommit-CodePipeline-Logs

Role description Allows Lambda functions to call AWS services on your behalf. | Edit

Instance Profile ARNs

Path /

Creation time 2020-02-24 20:48 EST

Last activity Not accessed in the tracking period

Maximum CLI/API session duration 1 hour Edit

Permissions policies (1 policy applied)

Policy name	Policy type
Lambda-CodeCommit-CodePipeline-Logs-policy	Inline policy

```
            "Effect": "Allow",
            "Action": [
                "codecommit:Get*",
                "codecommit:List*",
                "codecommit:DescribePullRequestEvents",
                "codecommit:GitPull",
                "codecommit:BatchGetRepositories",
                "codecommit:BatchGetPullRequests",
                "codepipeline:PutJobSuccessResult",
                "codepipeline:PutJobFailureResult",
                "logs:CreateLogGroup",
                "logs:CreateLogStream",
                "logs:PutLogEvents"
            ],
            "Resource": "*"
```

Now we prepare the ftp client node.js module we will use with the Lambda function.

On a Linux/Unix/Mac terminal, package the promise-ftp module with the following commands:

```
mkdir lambda-layer-promise-ftp
cd lambda-layer-promise-ftp
mkdir nodejs
cd nodejs
npm init
npm install --save promise-ftp
```

There is a bug (documented here) in this promise-ftp module we need to fix. Open the node_modules@icetee\ftp\lib\connection.js file and replace this statement:

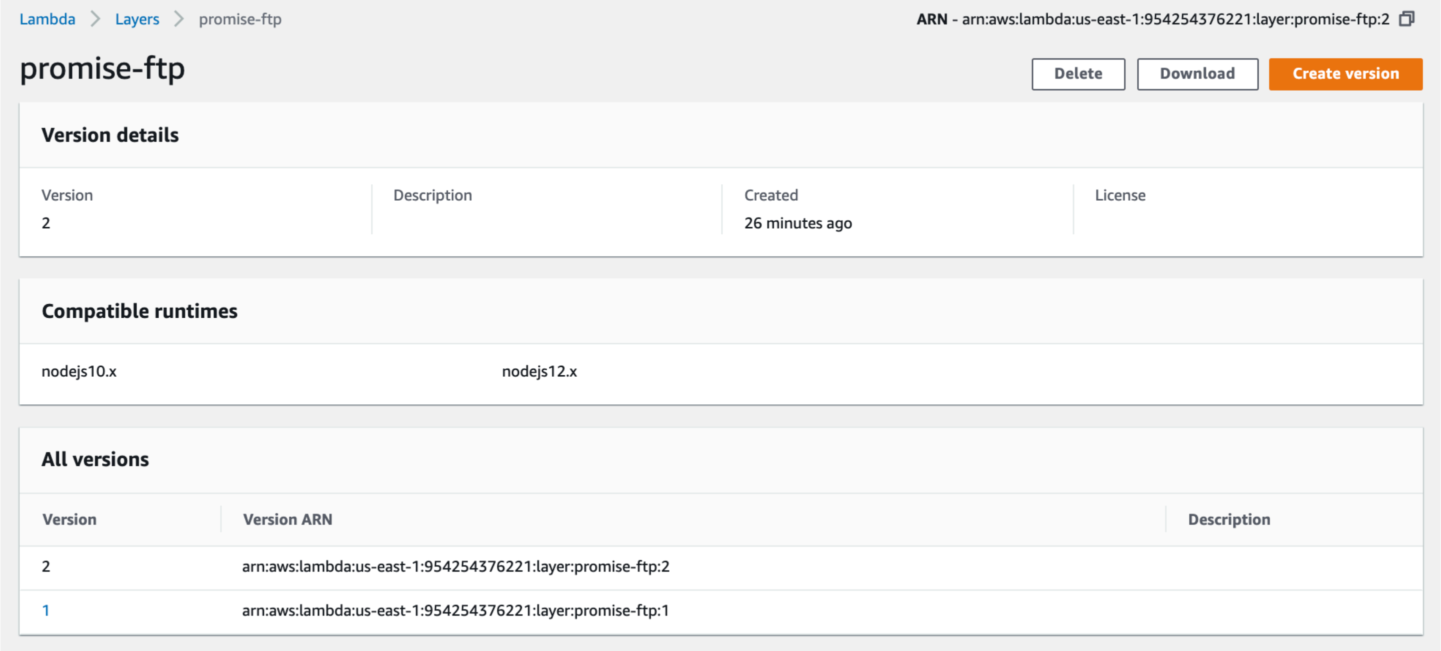
```
this._send(pasvCmd, function (err, text) {
```

With this statement:

```
this._send(pasvCmd, function reentry(err, text) {
```

Once this is done, compress/zip the nodejs folder creating a nodejs.zip archive.

Back into AWS console, within Lambda, create a Lambda Layer for the promise-ftp module with compatible runtimes for nodejs10.x and nodejs12.x.



ARN - arn:aws:lambda:us-east-1:954254376221:layer:promise-ftp:2

promise-ftp

Version details

Version	Description	Created	License
2		26 minutes ago	

Compatible runtimes

nodejs10.x   nodejs12.x

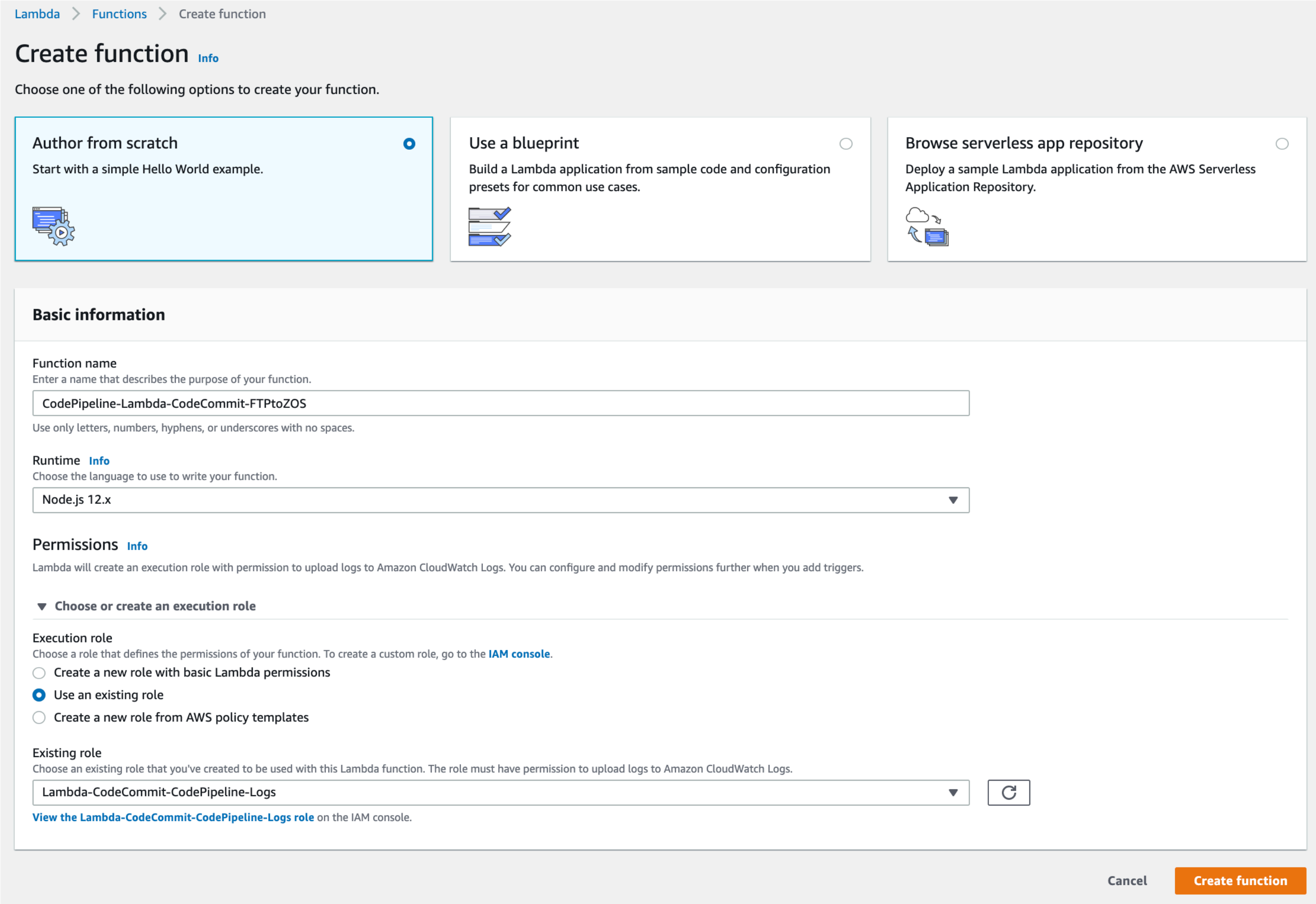
All versions

Version	Version ARN	Description
2	arn:aws:lambda:us-east-1:954254376221:layer:promise-ftp:2	
1	arn:aws:lambda:us-east-1:954254376221:layer:promise-ftp:1	

In Lambda, create a Lambda function named CodePipeline-Lambda-CodeCommit-FTPtoZOS.

Select Runtime Node.js 12.x.

Select the Lambda-CodeCommit-CodePipeline-Logs existing role.



Lambda > Functions > Create function

Create function Info

Choose one of the following options to create your function.

● Author from scratch
Start with a simple Hello World example.

○ Use a blueprint
Build a Lambda application from sample code and configuration presets for common use cases.

○ Browse serverless app repository
Deploy a sample Lambda application from the AWS Serverless Application Repository.

Basic information

Function name
Enter a name that describes the purpose of your function.
CodePipeline-Lambda-CodeCommit-FTPtoZOS
Use only letters, numbers, hyphens, or underscores with no spaces.

Runtime Info
Choose the language to use to write your function.
Node.js 12.x

Permissions Info
Lambda will create an execution role with permission to upload logs to Amazon CloudWatch Logs. You can configure and modify permissions further when you add triggers.

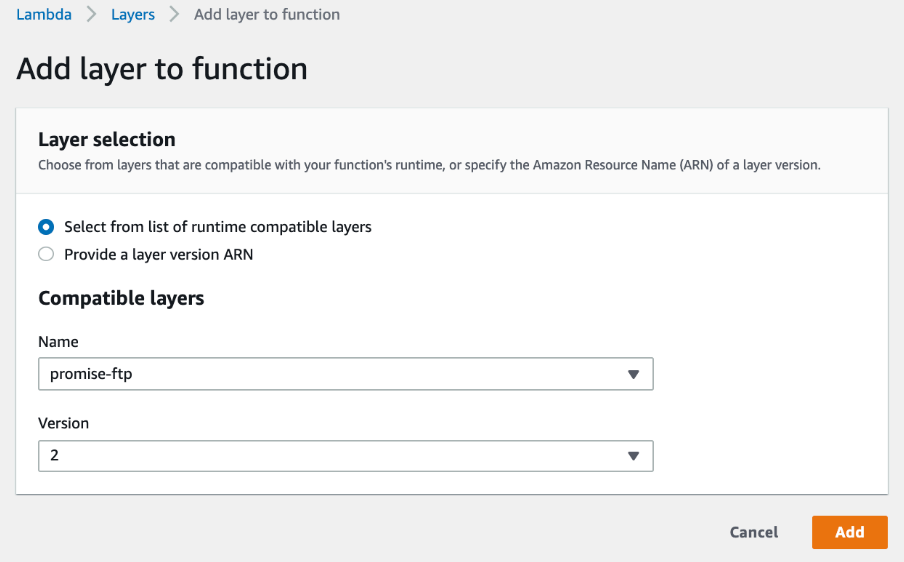
▼ Choose or create an execution role

Execution role
Choose a role that defines the permissions of your function. To create a custom role, go to the IAM console.
○ Create a new role with basic Lambda permissions
● Use an existing role
○ Create a new role from AWS policy templates

Existing role
Choose an existing role that you've created to be used with this Lambda function. The role must have permission to upload logs to Amazon CloudWatch Logs.
Lambda-CodeCommit-CodePipeline-Logs
View the Lambda-CodeCommit-CodePipeline-Logs role on the IAM console.

Click Create function.

Under the Designer tab, click Layers, then Add a layer.



Lambda > Layers > Add layer to function

Add layer to function

Layer selection
Choose from layers that are compatible with your function's runtime, or specify the Amazon Resource Name (ARN) of a layer version.

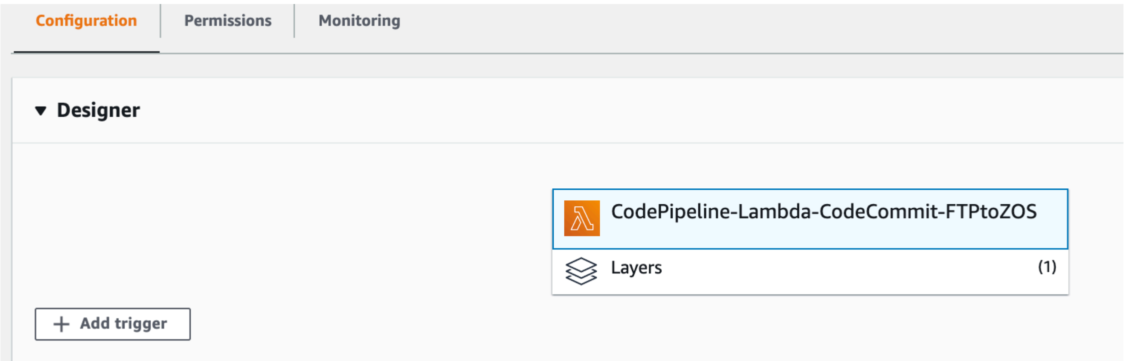
● Select from list of runtime compatible layers
○ Provide a layer version ARN

Compatible layers

Name
promise-ftp

Version
2

Select the promise-ftp layer and click Add.



The 1 layer then appears next to the Lambda function name.

Enter code inline index.js:

```
const AWS = require('aws-sdk');
const path = require('path');
var promiseFtp = require("promise-ftp");
var jobId
var commitId = '4aae84ccb0c0d59d9aa133dc85f0763579xxxxxx'
var repositoryName = 'MF-AWS-CICD-SCM'
var jobUserParameters
var differencesData
var difference
var zOShostname = "x.xxx.xxx.xx";
var zOSusername = "USERID";
var zOSpassword = "password";
var zOSdataset = "'USERID.CICD.SRC'";


exports.handler = async (event, context) => {
    var codepipeline = new AWS.CodePipeline()
    var codecommit = new AWS.CodeCommit()

    console.log('Received event ', JSON.stringify(event))
    try {
        jobId = event["CodePipeline.job"].id
        console.log('Found CodePipeline job with ID: ', jobId)
        jobUserParameters =
JSON.parse(event["CodePipeline.job"].data.actionConfiguration.configuration.UserParameters)
        console.log('Found CodePipeline job with parameters: ', jobUserParameters)
        commitId = jobUserParameters.commitId
        console.log('Found CodeCommit CommitId: ', commitId)
        repositoryName = jobUserParameters.repositoryName
        console.log('Found CodeCommit RepositoryName: ', repositoryName)
        if ((!commitId) || (!repositoryName) ) { console.error('Error trying to retrieve CodePipeline user
parameters. In CodePipeline, the User Parameters must be { "commitId": "#{SourceVariables.CommitId}",
"repositoryName": "#{SourceVariables.RepositoryName}" }.') }
    } catch (error) {
        console.error('Error trying to retrieve CodePipeline parameters. In CodePipeline, the User Parameters
must be { "commitId": "#{SourceVariables.CommitId}", "repositoryName": "#{SourceVariables.RepositoryName}" }.
Continuing with default Lambda function values. Catched error: ', error.toString())
    }

    try {

        console.log('commitId:', commitId)
        const commitData = await codecommit.getCommit({ commitId: commitId, repositoryName: repositoryName
}).promise()
        //console.log(commitData)
        console.log('Commit message:', commitData.commit.message)
        if (commitData.commit.parents[0].length > 0) {
            const priorCommitId = commitData.commit.parents[0]
            console.log('priorCommitId:', priorCommitId)
            differencesData = await codecommit.getDifferences({ repositoryName: repositoryName,
afterCommitSpecifier: commitId, beforeCommitSpecifier: priorCommitId }).promise()
        } else {
            differencesData = await codecommit.getDifferences({ repositoryName: repositoryName,
afterCommitSpecifier: commitId }).promise()
        }
        //console.log('differencesData:', differencesData)

        // Connect to z/OS FTP server
        var ftp = new promiseFtp()
            var serverMessage = await ftp.connect({
            host: zOShostname,
            user: zOSusername,
            password: zOSpassword,
            connTimeout: 5000,
            pasvTimeout: 1000,
            keepalive: 10000
        });
        console.log('Connection message: '+serverMessage);
        var asciiResponse = await ftp.ascii();
        console.log('Ascii response: '+asciiResponse)
        var cwdResponse = await ftp.cwd(zOSdataset);
        console.log('Change working directory response: '+cwdResponse)


        for (difference of differencesData.differences) {
            //console.log('Processing difference:', difference)
            if (difference.changeType == 'A') {
                console.log('Processing DeployToProd file add:', difference.afterBlob.path )
                console.log('Processing DeployToProd file add with blobId:', difference.afterBlob.blobId )
                const blobData = await codecommit.getBlob({ blobId: difference.afterBlob.blobId,
repositoryName: repositoryName }).promise()
                const blobContent = blobData.content
                console.log('blobContent:', blobContent)
                const fileText = new Buffer.from(blobContent, 'base64').toString('ascii');
                //console.log('File text:', fileText)
                const zosDatasetMemberName = path.basename(difference.afterBlob.path,
path.extname(difference.afterBlob.path)).substring(0,8).toUpperCase();
                console.log('Destination z/OS dataset member name: ', zosDatasetMemberName);
                await ftp.put(fileText, zosDatasetMemberName);

            } else if (difference.changeType == 'M') {
                console.log('Processing DeployToProd file modify:', difference.afterBlob.path )
                console.log('Processing DeployToProd file modify with blobId:', difference.afterBlob.blobId )
                const blobData = await codecommit.getBlob({ blobId: difference.afterBlob.blobId,
repositoryName: repositoryName }).promise()
                const blobContent = blobData.content
                console.log('blobContent:', blobContent)
                const fileText = new Buffer.from(blobContent, 'base64').toString('ascii');
                //console.log('File text:', fileText)
                const zosDatasetMemberName = path.basename(difference.afterBlob.path,
path.extname(difference.afterBlob.path)).substring(0,8).toUpperCase();
                console.log('Destination z/OS dataset member name: ', zosDatasetMemberName);
                await ftp.put(fileText, zosDatasetMemberName);

            } else if (difference.changeType == 'D') {
                console.log('Processing DeployToProd file delete:', difference.afterBlob.path )
                console.log('Processing DeployToProd file delete with blobId:', difference.afterBlob.blobId )
                const zosDatasetMemberName = path.basename(difference.afterBlob.path,
path.extname(difference.afterBlob.path)).substring(0,8).toUpperCase();
                console.log('Destination z/OS dataset member name: ', zosDatasetMemberName);
                await ftp.delete(zosDatasetMemberName);

            } else {
                console.log('changeTyoe not processed: ', difference.changeType)
            }
        }

        //var list = await ftp.list();
        //console.log('Directory listing:'+list);
        var endResponse = await ftp.end();
        console.log('End message: '+endResponse);

        if (jobId) {
            console.log('Sending putJobSuccessResult to CodePipeline.')
            await codepipeline.putJobSuccessResult({ jobId }).promise()
        }

    } catch (error) {
        console.error('Error caught during Lambda function execution:', error.toString())
        if (jobId) {
                   console.log('Sending putJobFailureResult to CodePipeline.')
                   await codepipeline.putJobFailureResult({jobId, failureDetails: {message: error.toString(),
type: 'JobFailed', externalExecutionId: context.invokeid}}).promise()
        } else {
           throw error
        }
    }
}
```

Customize the zOS variables for your specific z/OS FTP server and target PDS dataset.

For security reasons, the password can be stored in AWS Secrets Manager and retrieved via AWS Secrets Manager SDK.

Edit the Basic setting timeout, select 1min.

Save the function.

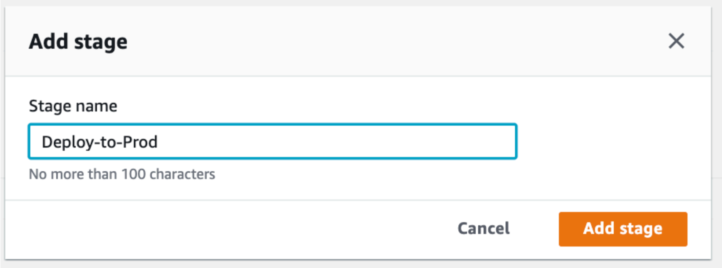
Click Test to run this new function. Verify it runs successfully

7.3 DEPLOY to PROD – AWS CodePipeline configuration

In CodePipeline, we're now going to add the new stage to deploy the code to the production environment. In CodePipeline, then Pipelines, then Pipeline, select MF-AWS-CICD-Pipeline.

Click Edit.

After the last stage, at the bottom, click Add stage.



Add stage

Stage name: Deploy-to-Prod

No more than 100 characters

Click Add action group.

The Action name is: Deploy-to-Prod

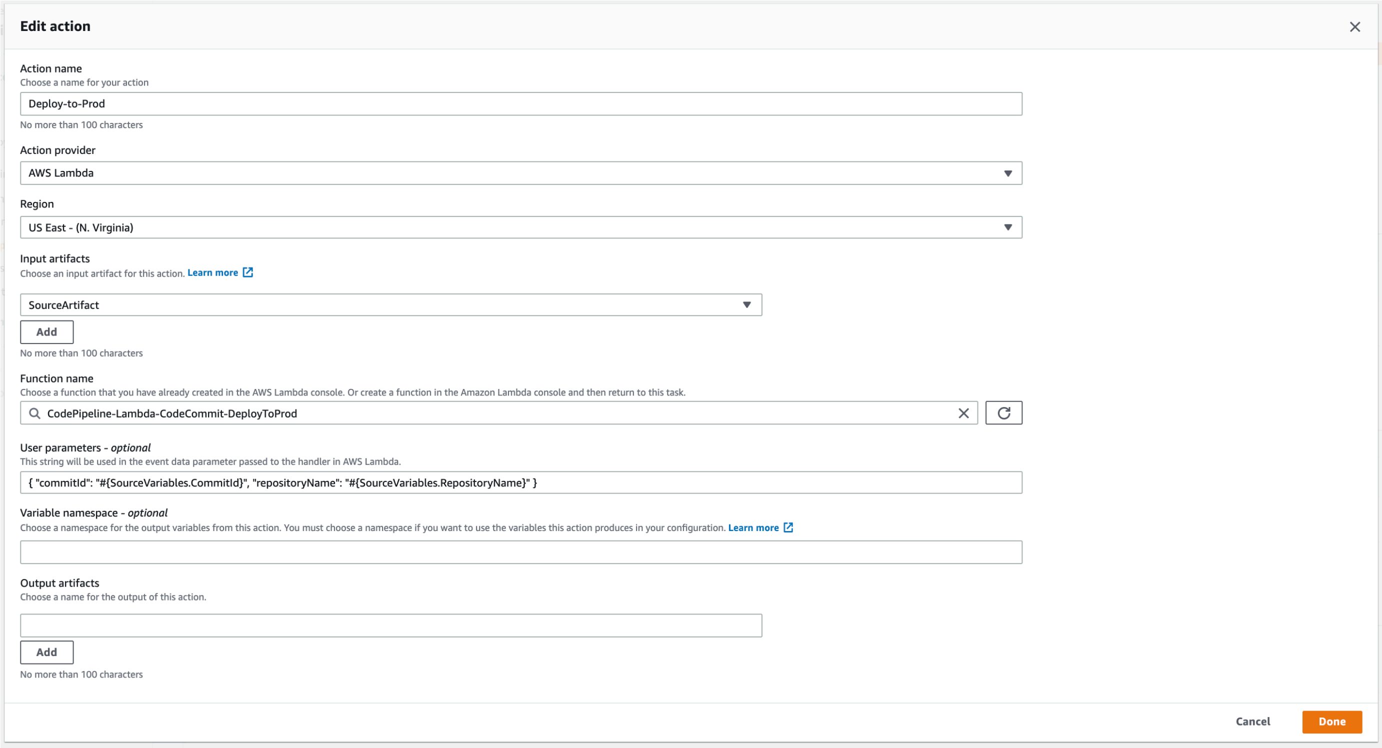
The Action provider is: AWS Lambda

Select the proper region for your environment.

Input artifacts is SourceArtifact

Function name is: CodePipeline-Lambda-CodeCommit-DeployToProd or CodePipeline-Lambda-CodeCommit-FTPtoZOS

User parameters is: { "commitId": "#{SourceVariables.CommitId}", "repositoryName": "#{SourceVariables.RepositoryName}" }



Edit action

Action name
Choose a name for your action
Deploy-to-Prod
No more than 100 characters

Action provider
AWS Lambda

Region
US East - (N. Virginia)

Input artifacts
Choose an input artifact for this action. Learn more
SourceArtifact
No more than 100 characters

Function name
Choose a function that you have already created in the AWS Lambda console. Or create a function in the Amazon Lambda console and then return to this task.
CodePipeline-Lambda-CodeCommit-DeployToProd

User parameters - *optional*
This string will be used in the event data parameter passed to the handler in AWS Lambda.

```
{ "commitId": "#{SourceVariables.CommitId}", "repositoryName": "#{SourceVariables.RepositoryName}" }
```

Variable namespace - *optional*
Choose a namespace for the output variables from this action. You must choose a namespace if you want to use the variables this action produces in your configuration. Learn more

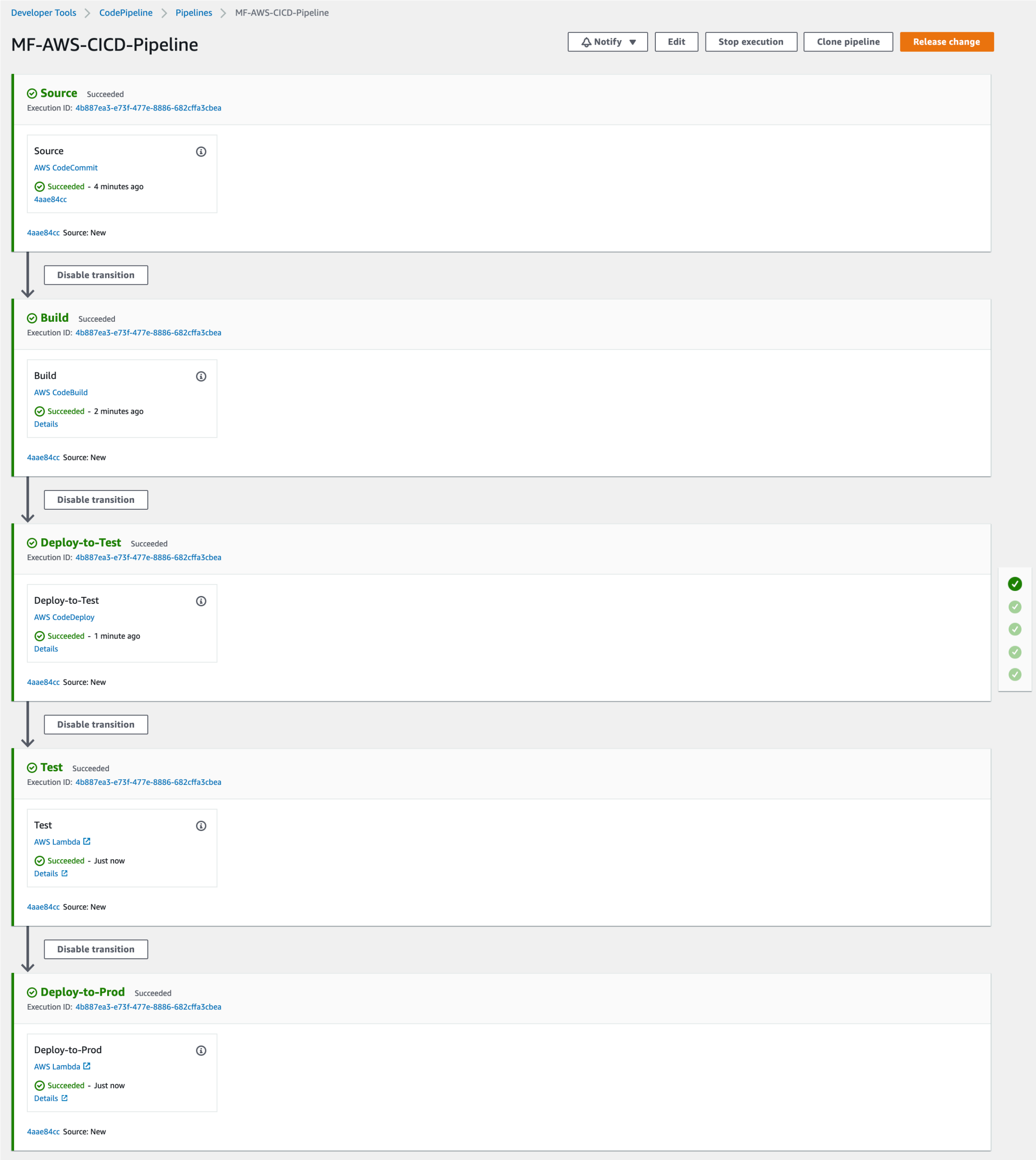
Output artifacts
Choose a name for the output of this action.
No more than 100 characters

Click Done.

Click Done to save the new stage.

Click Save to save the changed pipeline.

In order to test, you can either commit and push to upstream a new change from EDz, or click Release change on the pipeline itself.



MF-AWS-CICD-Pipeline

✓ Source Succeeded
Execution ID: 4b887ea3-e73f-477e-8886-682cffa3cbea

Source
AWS CodeCommit
✓ Succeeded - 4 minutes ago
4aae84cc

4aae84cc Source: New

✓ Build Succeeded
Execution ID: 4b887ea3-e73f-477e-8886-682cffa3cbea

Build
AWS CodeBuild
✓ Succeeded - 2 minutes ago
Details

4aae84cc Source: New

✓ Deploy-to-Test Succeeded
Execution ID: 4b887ea3-e73f-477e-8886-682cffa3cbea

Deploy-to-Test
AWS CodeDeploy
✓ Succeeded - 1 minute ago
Details

4aae84cc Source: New

✓ Test Succeeded
Execution ID: 4b887ea3-e73f-477e-8886-682cffa3cbea

Test
AWS Lambda
✓ Succeeded - Just now
Details

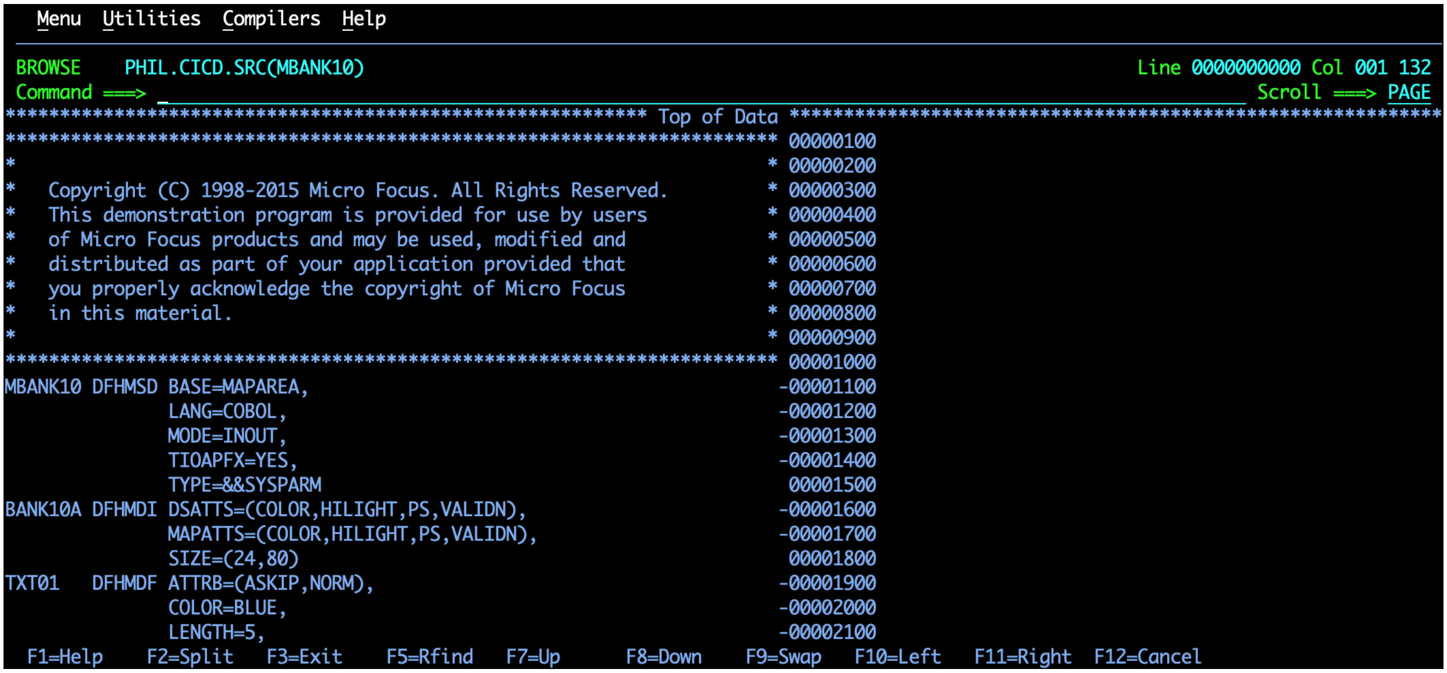
4aae84cc Source: New

✓ Deploy-to-Prod Succeeded
Execution ID: 4b887ea3-e73f-477e-8886-682cffa3cbea

Deploy-to-Prod
AWS Lambda
✓ Succeeded - Just now
Details

4aae84cc Source: New

Once the pipeline completes, we can verify the changes are pushed onto z/OS.



```
 BROWSE    PHIL.CICD.SRC(MBANK10)                                        Line 0000000000 Col 001 132
 Command ===> _                                                                     Scroll ===> PAGE
************************************************************ Top of Data *************************************************************
************************************************************************ 00000100
*                                                                      * 00000200
*   Copyright (C) 1998-2015 Micro Focus. All Rights Reserved.          * 00000300
*   This demonstration program is provided for use by users            * 00000400
*   of Micro Focus products and may be used, modified and              * 00000500
*   distributed as part of your application provided that              * 00000600
*   you properly acknowledge the copyright of Micro Focus              * 00000700
*   in this material.                                                  * 00000800
*                                                                      * 00000900
************************************************************************ 00001000
MBANK10 DFHMSD BASE=MAPAREA,                                            -00001100
               LANG=COBOL,                                              -00001200
               MODE=INOUT,                                              -00001300
               TIOAPFX=YES,                                             -00001400
               TYPE=&&SYSPARM                                            00001500
BANK10A DFHMDI DSATTS=(COLOR,HILIGHT,PS,VALIDN),                        -00001600
               MAPATTS=(COLOR,HILIGHT,PS,VALIDN),                       -00001700
               SIZE=(24,80)                                              00001800
TXT01   DFHMDF ATTRB=(ASKIP,NORM),                                      -00001900
               COLOR=BLUE,                                              -00002000
               LENGTH=5,                                                -00002100
```

F1=Help   F2=Split   F3=Exit   F5=Rfind   F7=Up   F8=Down   F9=Swap   F10=Left   F11=Right   F12=Cancel

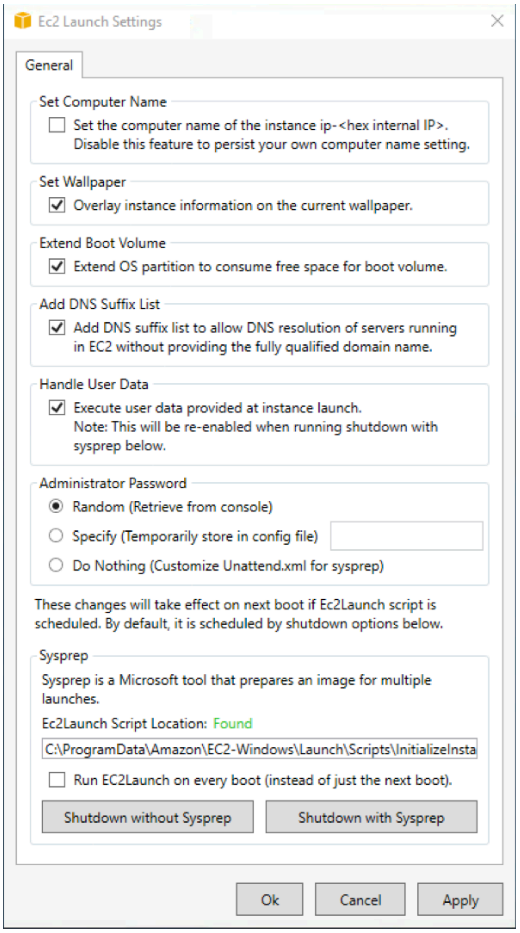
8 Appendix

8.1 Configure instance for new Administrator random password

C:\ProgramData\Amazon\EC2-Windows\Launch\Config\LaunchConfig.json

```
{
  "SetComputerName": false,
  "SetMonitorAlwaysOn": true,
  "SetWallpaper": true,
  "AddDnsSuffixList": true,
  "ExtendBootVolumeSize": true,
  "HandleUserData": true,
  "AdminPasswordType": "Random",
  "AdminPassword": ""
}
```

C:\ProgramData\Amazon\EC2-Windows\Launch\Settings\Ec2LaunchSettings.exe



Ec2 Launch Settings

General

Set Computer Name
☐ Set the computer name of the instance ip-<hex internal IP>. Disable this feature to persist your own computer name setting.

Set Wallpaper
☑ Overlay instance information on the current wallpaper.

Extend Boot Volume
☑ Extend OS partition to consume free space for boot volume.

Add DNS Suffix List
☑ Add DNS suffix list to allow DNS resolution of servers running in EC2 without providing the fully qualified domain name.

Handle User Data
☑ Execute user data provided at instance launch. Note: This will be re-enabled when running shutdown with sysprep below.

Administrator Password
● Random (Retrieve from console)
○ Specify (Temporarily store in config file)
○ Do Nothing (Customize Unattend.xml for sysprep)

These changes will take effect on next boot if Ec2Launch script is scheduled. By default, it is scheduled by shutdown options below.

Sysprep
Sysprep is a Microsoft tool that prepares an image for multiple launches.
Ec2Launch Script Location: Found
C:\ProgramData\Amazon\EC2-Windows\Launch\Scripts\InitializeInsta
☐ Run EC2Launch on every boot (instead of just the next boot).

Shutdown with Sysprep then create new AMI from stopped instance.

8.2 Powershell script to compile Bankdemo on EDz

Bankdemo-build.ps1

```
### Documentation: https://www.microfocus.com/documentation/enterprise-developer/ed50pu2/ED-Eclipse/HRCMRHCOML0L.html

### Variables
$env:SOURCE_COBOL_FOLDER = "C:\Users\Administrator\TestBuild\Bankdemo\Sources\cbl"
$env:COBOL_EXE_PATH_FILE = "C:\Program Files (x86)\Micro Focus\Enterprise Developer\bin64\cobol.exe"
$env:CBLLINK_EXE_PATH_FILE = "C:\Program Files (x86)\Micro Focus\Enterprise Developer\bin64\cbllink.exe"
$env:COBOL_COMPILER_DIRECTIVES = "preprocess(EXCI),CICSECM()"
$env:COBDIR="C:\Program Files (x86)\Micro Focus\Enterprise Developer\;$env:COBDIR" # where to find the message file
$env:COBCPY = "C:\Program Files (x86)\Micro Focus\Enterprise Developer\cpylib;$env:COBCPY" # where to find copybooks such as DFHAID




echo "==============================================================================="
echo "Environment Variables:"
echo "SOURCE_COBOL_FOLDER: $env:SOURCE_COBOL_FOLDER"
echo "COBOL_COMPILER_DIRECTIVES: $env:COBOL_COMPILER_DIRECTIVES"
echo "COBOL_EXE_PATH_FILE: $env:COBOL_EXE_PATH_FILE"
echo "CBLLINK_EXE_PATH_FILE: $env:CBLLINK_EXE_PATH_FILE"
echo "COBDIR: $env:COBDIR"
echo "COBCPY: $env:COBCPY"
echo ""

echo "==============================================================================="
echo "Compiling begins"
foreach ($f in Get-ChildItem $env:SOURCE_COBOL_FOLDER -Filter "*.cbl") {
   $CBL_FILE =  $f.FullName
   echo "-------------------------------------------------------------------------------"
   echo "Compiling $CBL_FILE..."
   & $env:COBOL_EXE_PATH_FILE "$CBL_FILE,,,$env:COBOL_COMPILER_DIRECTIVES;"

    }
echo "-------------------------------------------------------------------------------"
echo "Compilling ends"
echo ""

echo "==============================================================================="
echo "Linking begins"

foreach ($f in Get-ChildItem "." -Filter "*.obj") {
   $OBJ_FILE =  $f.FullName
   echo "-------------------------------------------------------------------------------"
   echo "Linking $OBJ_FILE..."
   & $env:CBLLINK_EXE_PATH_FILE -d $OBJ_FILE

    }
 echo "-------------------------------------------------------------------------------"
 echo "Linking ends"
```