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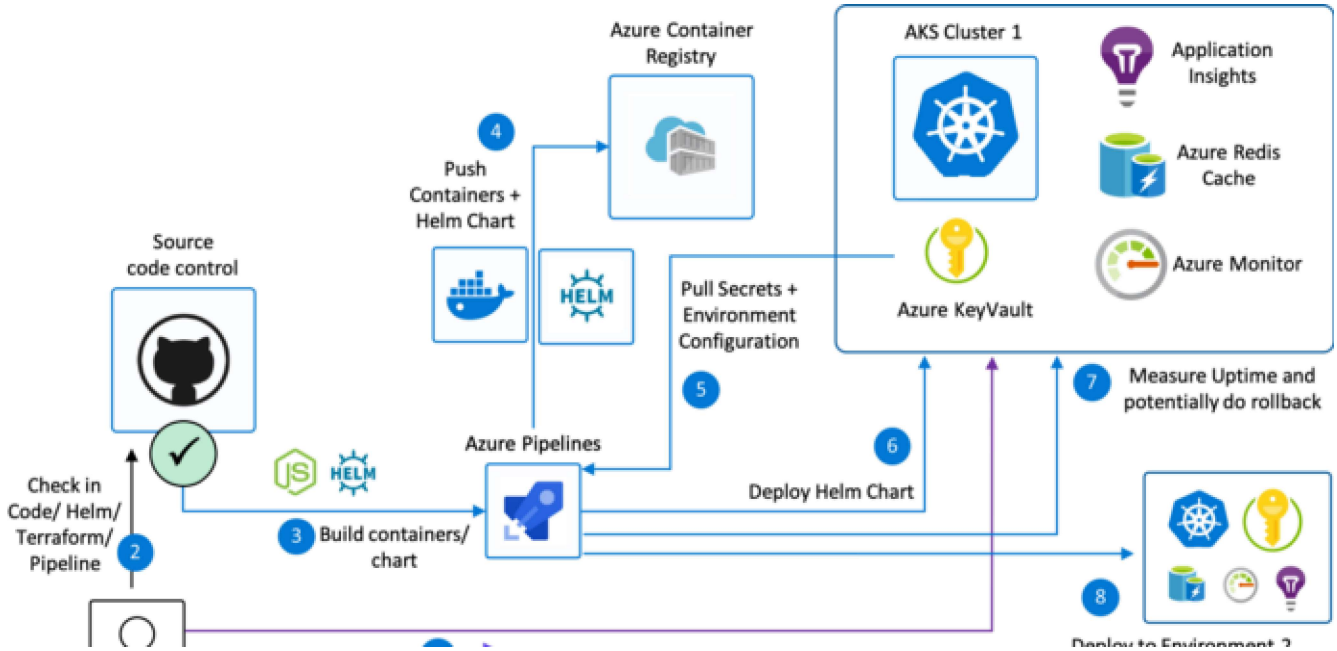
Continuous building, gating and releasing using AzureDevOps, Helm3, Application Insights and AKS with automated rollback — part 1

Dennis Zielke Mar 5, 2020 · 9 min read

This is the first part of a series of posts on deployment processes, where I wanted to document a couple of practices we have been implementing with our customers. I want to show this based on a simple demo application that we have been using for hands on workshops overs the last years and enable you to implement these practices on your own azure environment.

At the end of this post you will know how to implement the following scenario:



To make it more realistic for an enterprise setup here are a couple of design considerations that I consider worth pursuing:

1. Your process implementation and all assets should be versioned and stored with your source code — meaning you can re-use the process for another microservice, maybe run it from another repo and it will still work.
2. You should not bind your process to the particular implementation of your CI/CD toolchain — meaning we will be using scripts for implementing our build and release steps and not Azure DevOps tasks because they require manual configuration and are hard to test (without Azure DevOps).
3. All environment specific variables should be maintained in a secure store and injected into your pipelines — meaning all variables will be sourced from an azure KeyVault instance, which will be dedicated to an environment.

This will be a journey where we will be improving our process and adopting more advanced deployment practices in next posts and I encourage you to join along with your own apps, requirements and feedback.

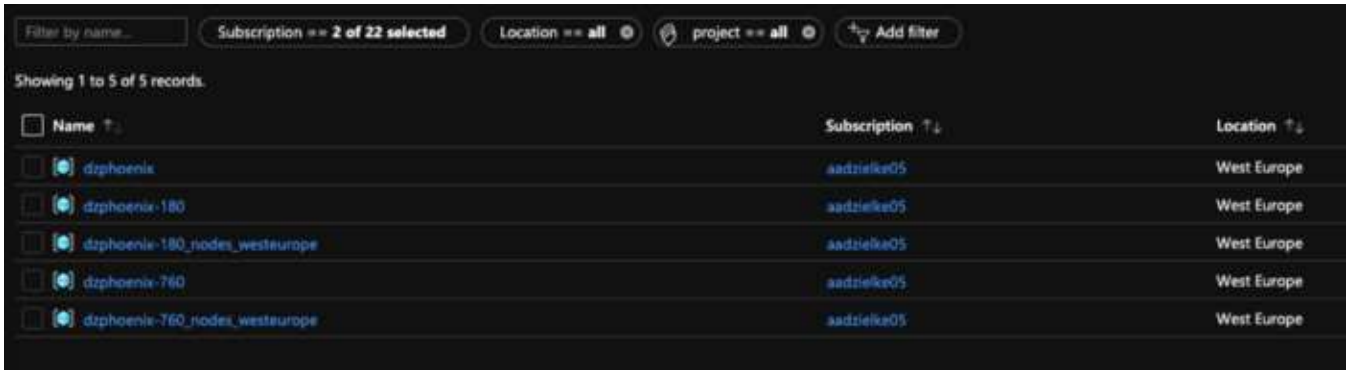
Lets get started.

First you should fork our phoenix repository which contains the terraform templates, app source code, docker files, helm charts, azure devops pipelines and scripts to build up your environment. The easiest way to deploy everything in your own azure subscription is to open up an azure shell , clone your repo there and follow these instructions to deploy at least one environment — ideally one extra environment so that the deployment process makes more sense for multi stage deployments. After running the deployment scripts please remember the output with the azure devops credentials, because we will need them later.

```
Your Kubernetes service_principal_id should be c421ef66-6243-4120-88f9-1f469b579395
Your Kubernetes service_principal_secret should be 625ecf32-6aee-4ad1-8b8a-ad80b5a32b2a
Your Azure DevOps service_principal_id should be a8764e97-ffb9-4e9f-9a21-7215bc026419
Your Azure DevOps service_principal_secret should be 2c2e3814-1ea1-469b-8d79-10a3f8a76cf7
```

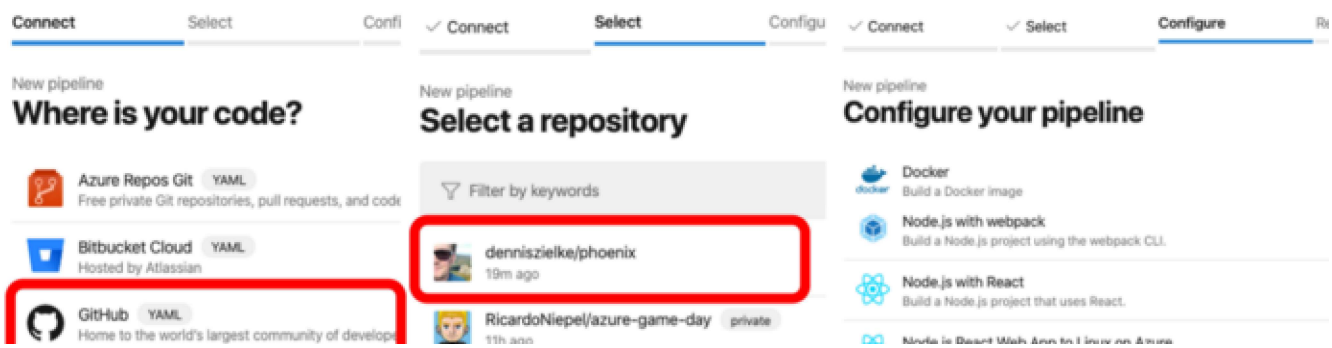
Remember the output your environment service principals for later

You should end up with a dedicated resource group for your azure container registry, one resource group for each environment which contains the Azure KeyVault (which should also already contain the configuration variables for that environment), Application Insights, Azure Redis Cache, VNETS, Azure Monitor and an AKS Cluster with an already deployed Nginx Ingress Controller inside plus one extra resource group for your Kubernetes worker nodes. Assuming you have the right permissions you will also have two service principals — one used by your AKS cluster and one is for your Azure Devops service connection to authenticate from your pipeline runners to your azure resources and especially your Azure Container Registry and Azure KeyVault.



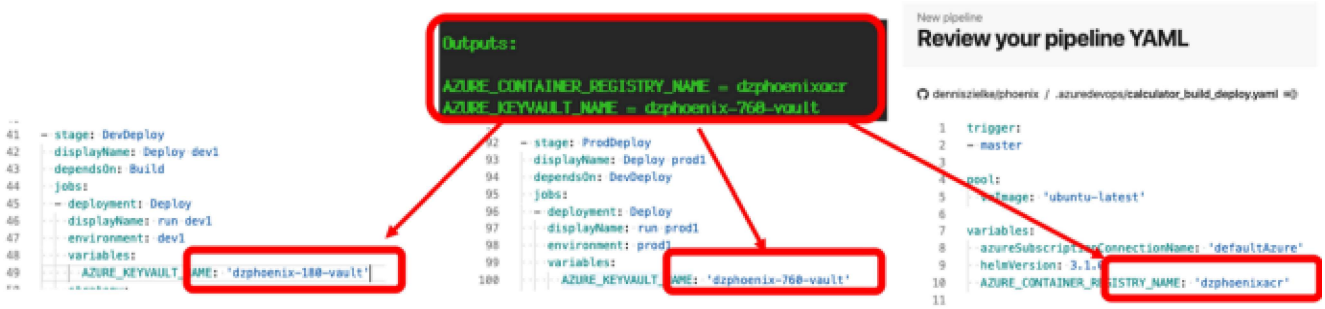
All deployments will be tagged with project=phoenix and should show up like this

Next you should create your Azure DevOps instance by going to dev.azure.com to create your project within your organisation. For the moment I would recommend you to not import the source code into your azure devops repo but rather leave the code on your github fork. Instead lets go directly to **Pipelines** and import the existing pipeline from your github repo located here: */.azuredevops/calculator_build_deploy.yaml* into azure devops.



1. Code from GitHub, 2. Select your repo and 3. Use Existing azure pipeline yaml file

To adjust the process to your environments you need to configure the name of your azure container registry (where all your containers and helm charts will be pushed to) and the names of the Azure KeyVault instances (which will contain all variables for the right environment) inside the variable section. Then press Save!



Your terraform output variables should have the right names your can find in the pipeline template.

You cannot run your pipeline yet because your Azure DevOps instance and also the pipeline runners do not have a way to authenticate and interact with your azure environment yet. For this to work you need to create a new service connection and hand it the credentials that have been generated before you created the environments via terraform.

Go via **Project settings -> Pipelines -> Service Connections** and create a new **Azure Resource Manager** connection with **Service Principal (manual)** and Enter all the values from the terraform deployment output. Also make sure that your **Service Connection Name** is either set to *defaultAzure* or matches the name in the pipeline template.

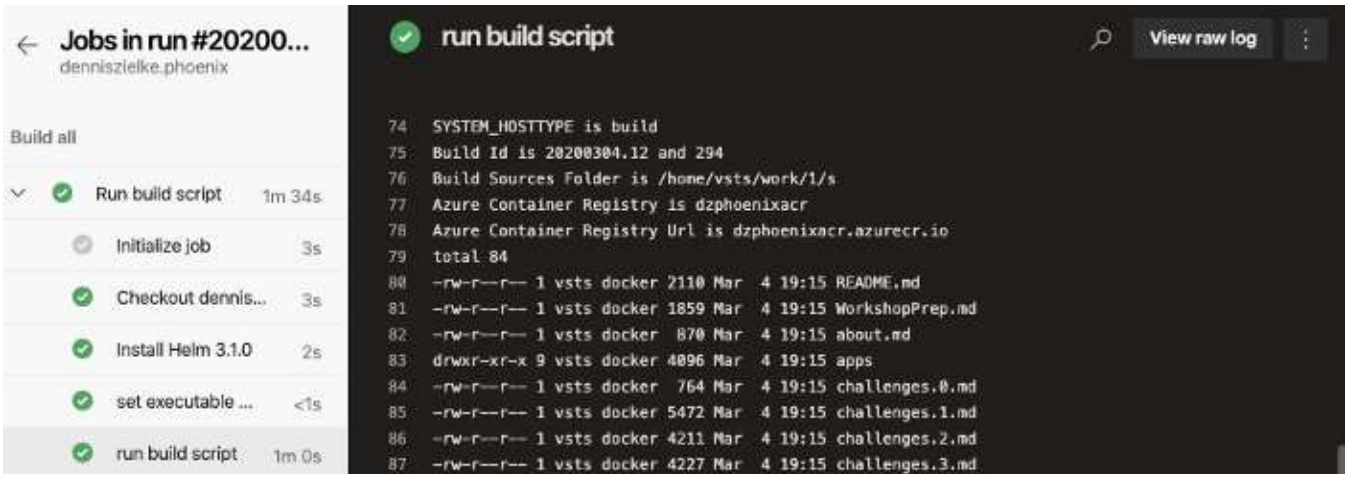
Now you can go back to your pipeline and run it for the first time.

What is happening behind the scenes, is that the azure pipeline runner will download the contents from the repo, download helm 3 (because for some reason the azure devops default ubuntu image still contains helm2 — dont ask me why 🤔), configure our bash script to be executable and run our build script which is stored under: *scripts/build_multicalculator.sh*

```yaml
jobs:
- job: Build
  displayName: Run build script
  steps:
  Settings
  - task: HelmInstaller@0
    displayName: 'Install Helm $(helmVersion)'
    inputs:
      helmVersion: $(helmVersion)
      checkLatestHelmVersion: false
  Settings
  - task: Bash@3
    displayName: set executable bit
    inputs:
      targetType: 'inline'
      script: chmod +x scripts/build_multicalculator.sh
  Settings
  - task: AzureCLI@1
    displayName: 'run build script'
    inputs:
      azureSubscription: $(azureSubscriptionConnectionName)
      scriptPath: scripts/build_multicalculator.sh
      workingDirectory: '$(Build.SourcesDirectory)'
```

We called our first stage Build which prepares our build environment and runs our bash script

The core idea is our entire build process will be customisation by bash script which will also run within the context of our azure devops service principal in an azure cli session (which also allows us to interact with our azure environment). In this case we are using it to authenticate to our azure container registry and push container images/helm charts to it. The required permissions have been granted during the terraform deployment. There are a couple of advantages to using scripts rather than the built in tasks — the results are reproduce-able, the process is easier to version, we can copy it over to another repo and as a bonus we can run the scripts offline.



Our bash script get executed within the context of our azure cli session.

Essentially we are not using much of the capabilities of the azure devops yaml pipeline schema and have defined our process as a set of stages. The first one is the build stage (also named **Build**) which should not produce any artefacts — since everything will be already versioned inside our azure container registry. The only exception are the build scripts which need to match the git changeset of our release process that we are currently in- which is why we are publishing the scripts folder as part of our build process to the staging directory of each release process instance.

```
Settings
35      - task: PublishBuildArtifacts@1
36        displayName: 'Publish Artifact: scripts'
37        inputs:
38          PathtoPublish: scripts
39          ArtifactName: scripts
```

We are publishing our build scripts to our release staging directory

As for the deployment stages we are defining a dependancy of the first deployment environment (here called **DevDeploy**) to the **Build** stage, give it a random name **dev1** (the exact name does not matter but needs to be the same if we have multiple microservices in different release pipelines deploying to the same environment) and introduce the Azure KeyVault instance name **dzphoenix-180-vault** as a stage variable. All the variables will be accessible under the same name in our bash scripts.

```
41  - stage: DevDeploy
42    displayName: Deploy dev1
43    dependsOn: Build
44    jobs:
45    - deployment: Deploy
46      displayName: run dev1
47      environment: dev1
48      variables:
49        AZURE_KEYVAULT_NAME: 'dzphoenix-180-vault'
```

A deployment stage is just a series of steps targeted towards an environment

deploy_multicalulator.sh will use the azure cli context to authenticate to the configured Azure KeyVault instance, collect the environment specific variables and perform a deployment to the corresponding AKS cluster.

```
50      strategy:
51        runOnce:
52          deploy:
53            steps:
                Settings
54            - task: HelmInstaller@0
55              displayName: 'Install Helm $(helmVersion)'
56              inputs:
57                helmVersion: $(helmVersion)
58                checkLatestHelmVersion: false
                Settings
59            - task: AzureCLI@1
60              displayName: 'run deploy script'
61              inputs:
62                azureSubscription: $(azureSubscriptionConnectionName)
63                scriptPath: '../scripts/deploy_multicalulator.sh'
64                workingDirectory: '$(Pipeline.Workspace)'
```

This time we will reference our deploy script from the pipeline artefacts folder

Since we also want to make sure that our deployment actually works we are triggering a traffic script that will in our case do nothing else but check if the ingress controller actually serves our application.

```
65          routeTraffic:
66            steps:
67            - download: current
68              artifact: scripts
                Settings
69            - task: AzureCLI@1
70              displayName: 'run traffic script'
71              inputs:
72                azureSubscription: $(azureSubscriptionConnectionName)
73                scriptPath: '../scripts/route_traffic_multicalculator.sh'
74                workingDirectory: '$(Pipeline.Workspace)'
```

The routetraffic step will be executed after a successful deployment and check our application.

You can probably come up with more advanced ways of validating that your application actually works on your own — or wait until we come the integration with azure monitor in a later post.

```
echo "curl http://$INGRESS_FQDN/ping"
curl http://$INGRESS_FQDN/ping
```

Not the most sophisticated way of an availability test — I am accepting pull requests.

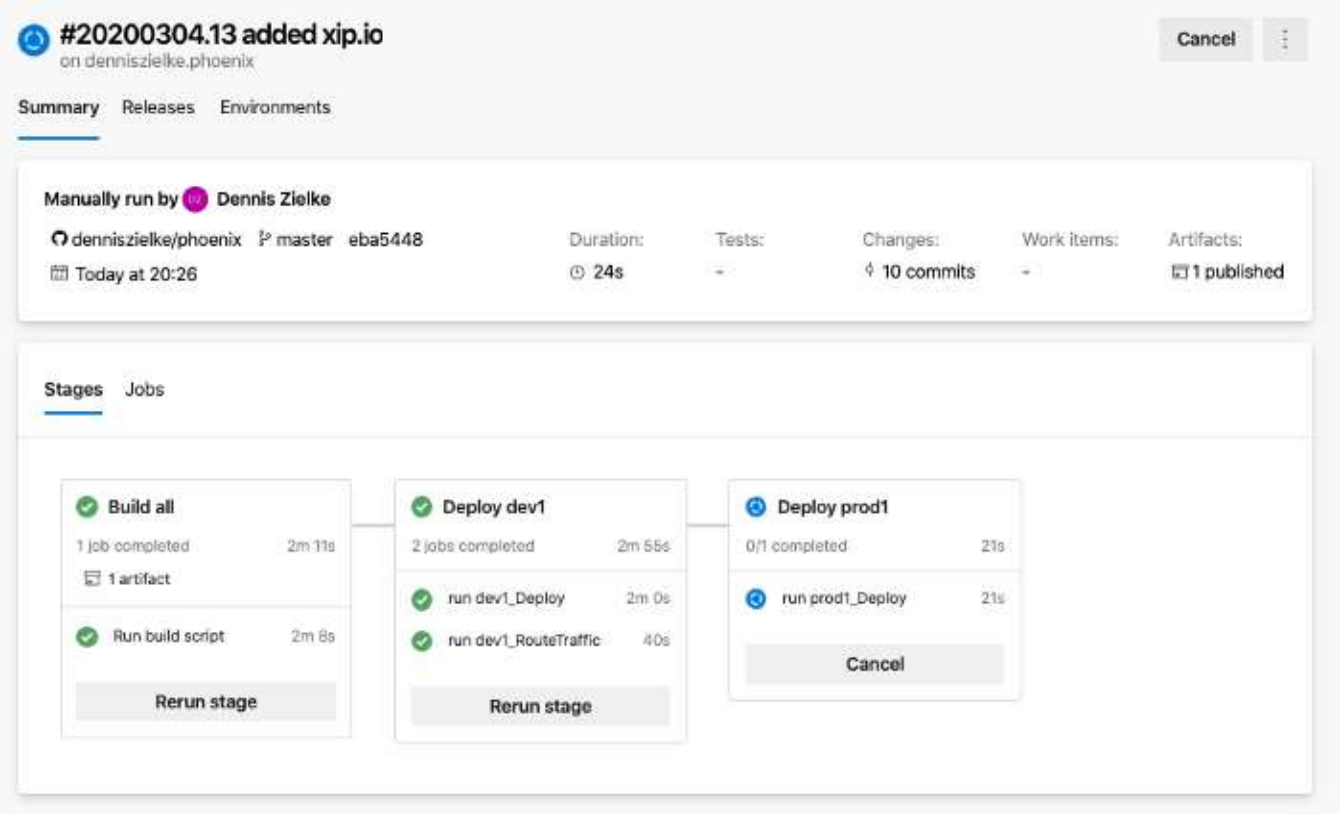
Just in case that something goes wrong we are triggering a rollback script that will perform a helm rollback to the latest working helm deployment.

```
      on:
        failure:
          steps:
          - download: current
            artifact: scripts
        Settings
          - task: HelmInstaller@0
            displayName: 'Install Helm $(helmVersion)'
            inputs:
              helmVersion: $(helmVersion)
              checkLatestHelmVersion: false
        Settings
          - task: AzureCLI@1
            displayName: 'run rollback script'
            inputs:
              azureSubscription: $(azureSubscriptionConnectionName)
              scriptPath: '../scripts/deploy_failure_multicalculator.sh'
              workingDirectory: '$(Pipeline.Workspace)'
```

An automatic rollback can be very useful to get back to a working application deployment

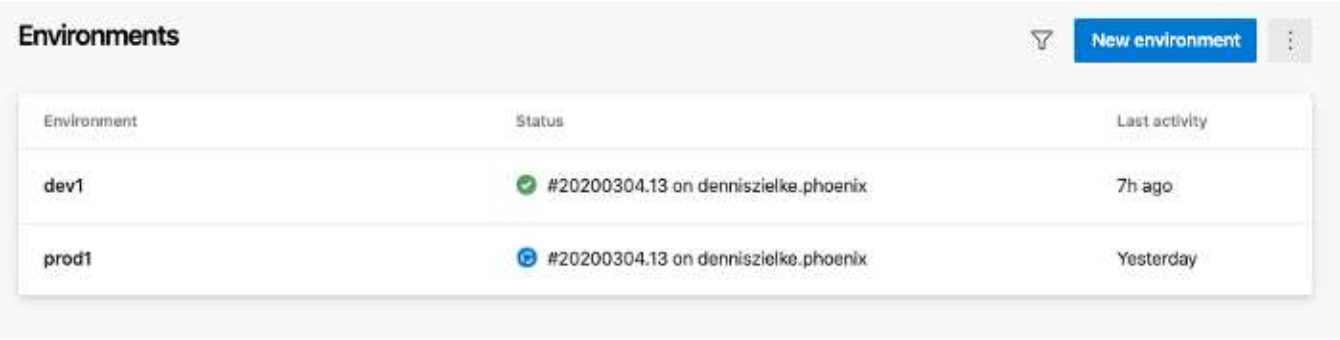
We are again depending on the azure cli session to retrieve the AKS context and perform the rollback via helm.

```
echo "Azure Container Registry is $AZURE_CONTAINER_REGISTRY_NAME"
AZURE_CONTAINER_REGISTRY_URL=$AZURE_CONTAINER_REGISTRY_NAME.azurecr.io
echo "Azure Container Registry Url is $AZURE_CONTAINER_REGISTRY_URL"
echo "Azure KeyVault is $AZURE_KEYVAULT_NAME"

KUBERNETES_NAMESPACE=$(az keyvault secret show --name "phoenix-namespace" --vault-name $AZURE_KEYVAULT_NAME --query value -o ts
AKS_NAME=$(az keyvault secret show --name "aks-name" --vault-name $AZURE_KEYVAULT_NAME --query value -o tsv)
AKS_GROUP=$(az keyvault secret show --name "aks-group" --vault-name $AZURE_KEYVAULT_NAME --query value -o tsv)

echo "Pulling kube-config for $AKS_NAME in $AKS_GROUP"
az aks get-credentials --resource-group=$AKS_GROUP --name=$AKS_NAME

echo "Ensuring kubernetes namespace $KUBERNETES_NAMESPACE"
kubectl get namespace
kubectl create namespace $KUBERNETES_NAMESPACE

echo "Rollback helm release to previous release"
helm rollback calculator --namespace $KUBERNETES_NAMESPACE 0
```



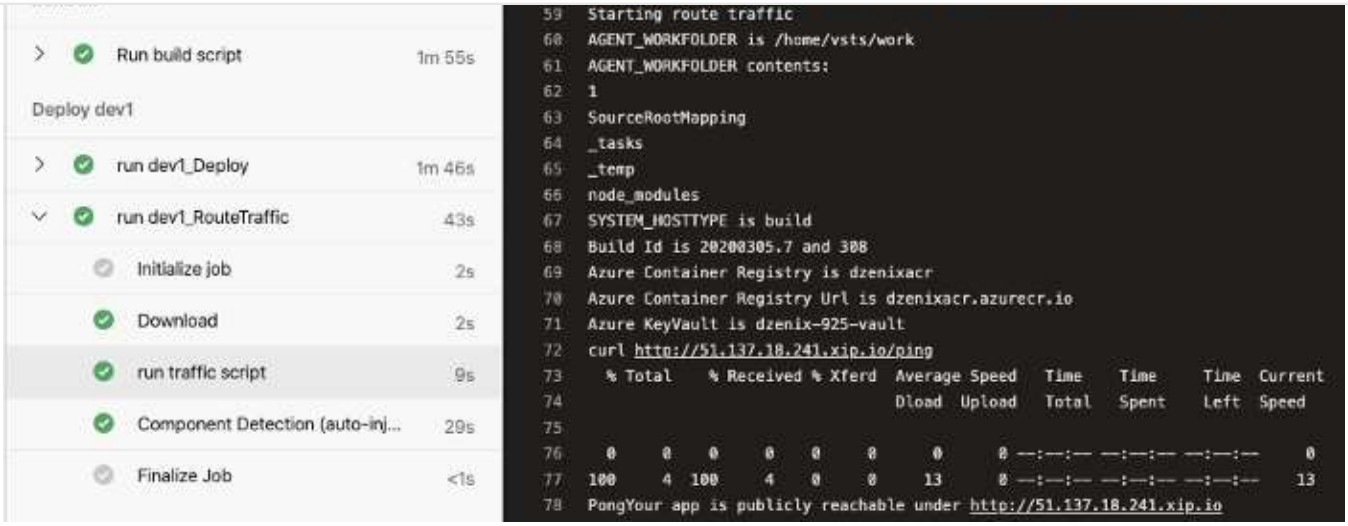
The deployment progresses automatically across all stages

If you check the '**Environments**' tab on the left you can see every release status across all deployments — which is very useful if you have not only one release pipeline, but a dedicated pipeline for each microservice.



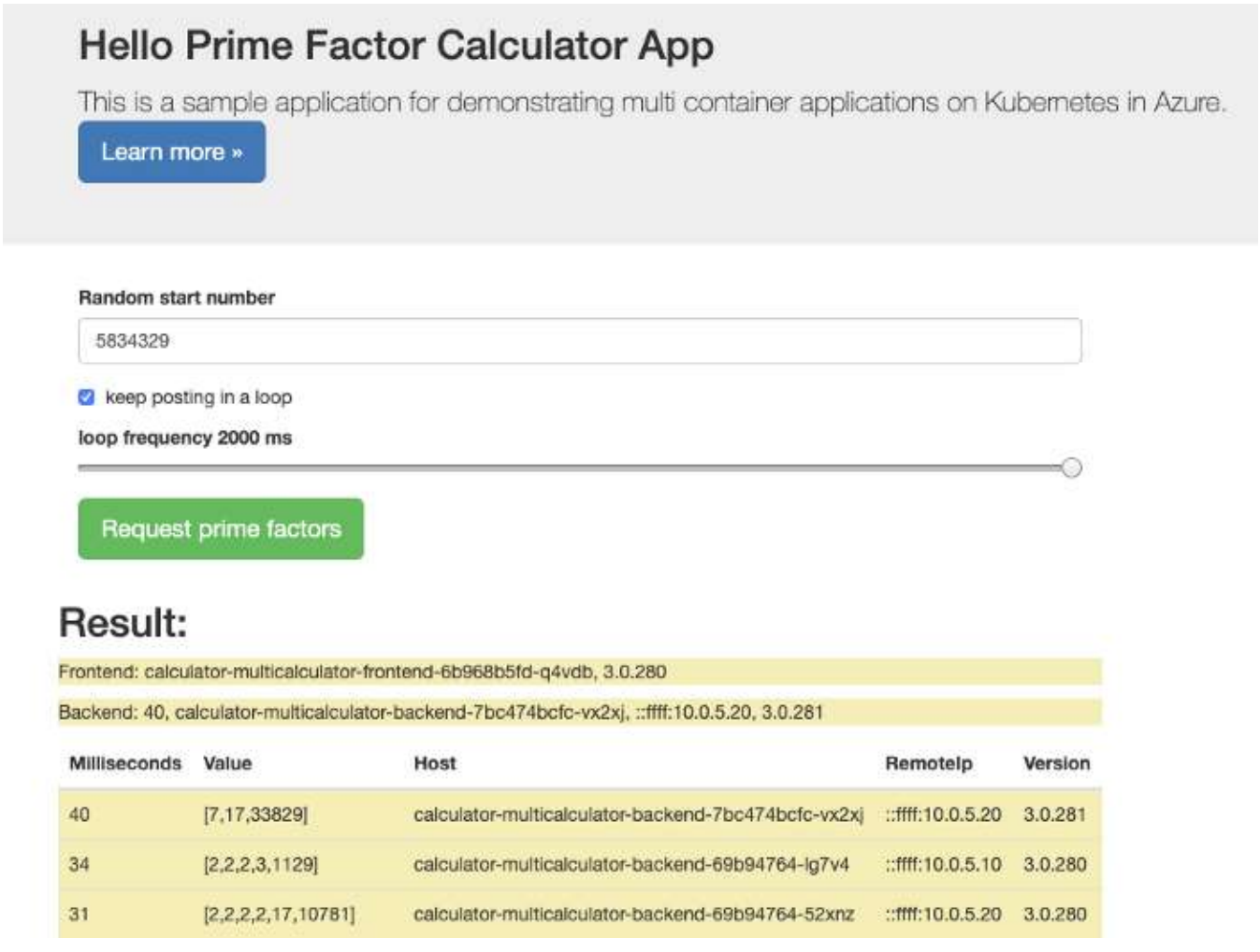
All releases status will be aggregated across all deployment pipelines

Our demo application is an unnecessary complicated prime factor calculator running in multiple microservices inside the cluster. You can retrieve the public dns (which is depending on the public ip of the ingress controller inside the cluster) by looking at the log output of the **routetraffic** task.



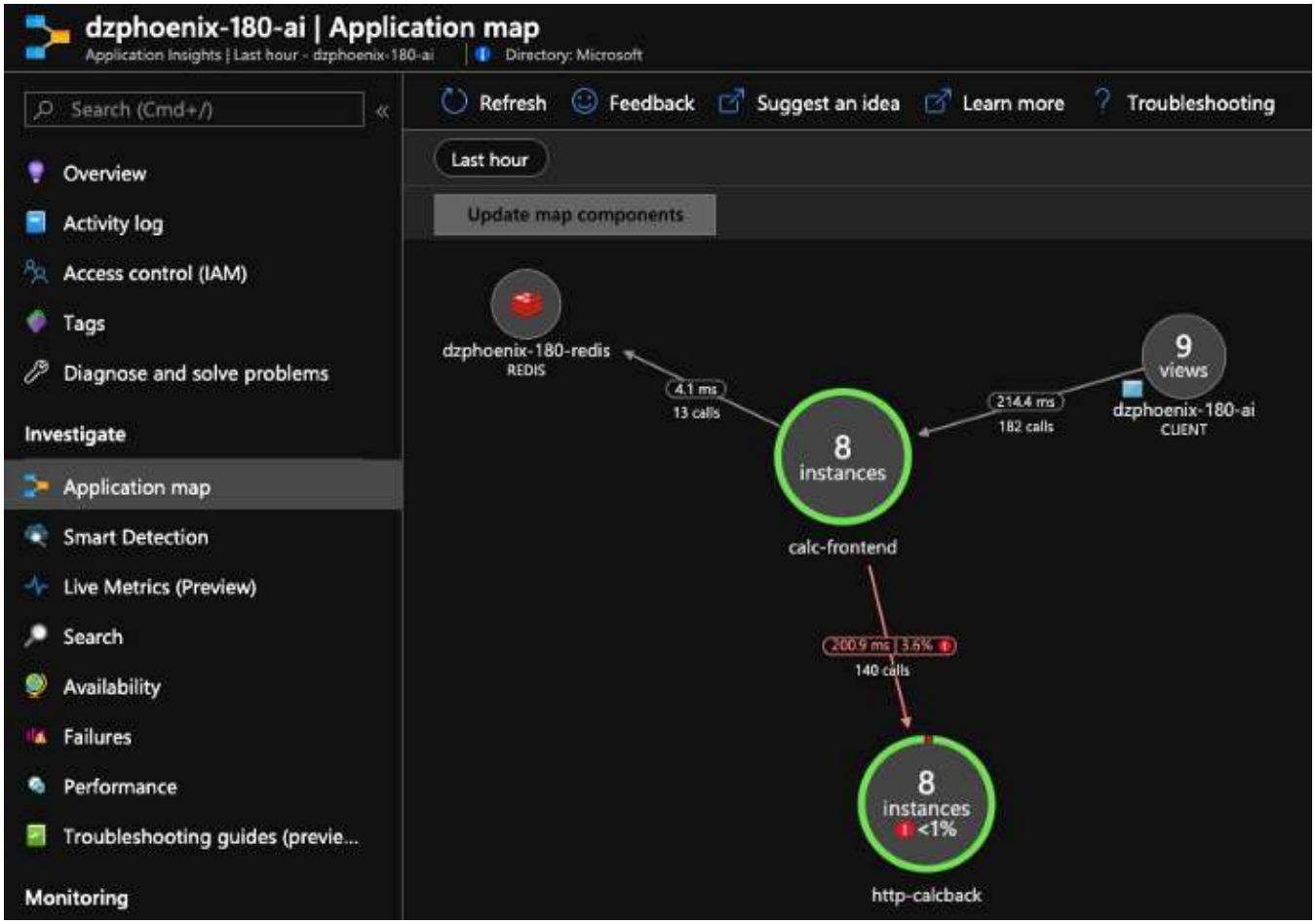
You can retrieve the dns from the bottom of the log output of the routetraffic step.

Assuming your deployment pipeline works you can now go ahead change sourcecode and see your changes flowing through all of your environments without interrupting your users.



Your application will not be interrupted while a version change is deployed in the backends

see the following in the section **Application map** of your Application Insight resource for each environment. It will be automatically generated based on the traffic between your microservices and your azure managed services and allows you to compare performance metrics, dependancies between components and trace the calls between them close to real time.



Performing distributed tracing of calls between microservices is a very valuable capability.

If you are interested in troubleshooting the failing calls and chase the source of the seemingly random delays in the backend responses (hint) I encourage you to play around with these values and use the application map and the performance diagnostics to hunt them down.

While this scenario works and hopefully completes our design requirements from above there are a couple possible issues that I want to outline here:

1. The deployment process performs a rollback in even of a deployment failure, but it does not prevent us from suffering application downtime while the broken

2. During the deployment process we are relying on our deployment user to have access to the cleartext values of our secrets which are pulled from Azure KeyVault. You can imagine that this could be the source of a potential credential leak. Look for part 3 of this series where we are locking down security and permissions in our environments and process.

3. The automation of infrastructure deployments is still depending on an external process to implement a process to trigger terraform and set up the pipeline. Look forward for part 4 of this series where we are trying to automate the process completely and include infrastructure changes in our deployment process.

I hope you learned something today and as usual am happy to accept feedback and pull requests in the repo.

Continue here for part 2 of our journey.

Stay tuned!

Kubernetes Azure Azure Devops Azure Kubernetes Service DevOps