KUBE-MONKEY

Introduction

Kube-monkey is an implementation of Netflix's Chaos Monkey for Kubernetes clusters. It randomly deletes Kubernetes (k8s) pods in the cluster encouraging and validating the development of failure-resilient services.

Kube-monkey runs at a pre-configured hour (run_hour, defaults to 8 a.m.) on weekdays and builds a schedule of deployments that faces a random pod death sometime during the same day. The time range during the day when the random pod death might occur is configurable and defaults from 10 a.m. to 4 p.m.

Kube-monkey is configured with a list of namespaces -

- to blacklist (any deployments within a blacklisted namespace is not disturbed)

To disable the blacklist, provide [""] in the blacklisted_namespaces config.param.

Implementation

Kube-monkey works on opt-in model and only schedules termination for Kubernetes (k8s) apps that have explicitly agreed to have their pods terminated by kube-monkey.

Opt-in is done by setting the following labels on a k8s app:

- **Kube-monkey/enabled:** Set to "enabled" to opt-in to kube-monkey
- **Kube-monkey/mtbf:** Mean time between failures (in days). For example, if set to "3", the k8s app can expect to have a pod killed around every third weekday.
- **Kube-monkey/identifier:** A unique identifier for the k8s apps. This identifies the pods that belong to a k8s app as pods inherit labels from their k8s app. When kube-monkey detects that app foo has enrolled to be a victim, it looks for all pods that have the label kube-monkey/identifier: foo to determine which pods are candidates for killing. Recommend to set this value to be the same as the app's name.
- **Kube-monkey/kill-mode:** Default behavior for kube-monkey is to kill only ONE pod of the app.

  Override this behavior by setting the value to:

  - **Kill-all:** Kube-monkey kills ALL the pods regardless of status (including not ready and not running pods). This does not require kill-value. Use this label carefully.
  - **Fixed:** Kube-monkey kills a specific number of running pods with kill-value. If over-specified, it kills all running pods and issues a warning.

- **Random-max-percent**: Specify a *maximum* % with kill-value that can be killed. At the scheduled time, a uniform *random specified* % of the running pods are terminated.
- **Fixed-percent:** Specify a *fixed* % with kill-value that can be killed. At the scheduled time, a specified *fixed* % of the running pods are terminated.

kube-monkey/kill-value: Specify the value for kill-mode

- **Fixed:** Provide an integer for pods to kill. The rule to kill pod is:

  Kill value = number of replica sets -1

  Example: In a deployment, if the replica set is 8, then the kill value should be between 1 and 8.
- **Random-max-percent:** Provide a number from 0-100 to specify the max % of pods to kill.
- **Fixed-percent:** Provide a number from 0-100 to specify the fixed % of pods to kill.

Example for Opted-in Deployment:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: dummy-deployment
  labels:
    app: nginx
    kube-monkey/enabled: enabled
    kube-monkey/identifier: dummy-deployment
    kube-monkey/mtbf: '2'
    kube-monkey/kill-mode: "fixed"
    kube-monkey/kill-value: '1'
spec:
  replicas: 3
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
```

```
    kube-monkey/enabled: enabled
    kube-monkey/identifier: dummy-deployment
spec:
 containers:
 - name: nginx
   image: nginx:1.14.2
   ports:
   - containerPort: 80
```

Working of Kube-monkey

Scheduling time

Scheduling occurs once a day on Weekdays. This is when a schedule for terminations for the current day is generated. During scheduling, kube-monkey will:

1. Generate a list of eligible k8s apps (k8s apps that have opted-in, are not blacklisted and are whitelisted, if specified).
2. For each eligible k8s app, flip a biased coin (bias is determined by kube-monkey/mtbf), to determine if a pod for that k8s app should be killed today or not.
3. For each victim, calculate the random time when a pod will be killed.

Termination time

This is the randomly generated time during the day when a victim k8s app will kill a pod. At termination time, kube-monkey will:

1. Check if the k8s app is still eligible (has not opted-out / been blacklisted / removed from the whitelist since scheduling).
2. Check if the k8s app has updated kill-mode and kill-value.
3. Depending on kill-mode and kill-value, execute the pods.

Steps to Configure Kube-monkey

To implement kube-monkey, install Helm chart. Steps for configuring kube-monkey:

1. Execute the command:

```
$ git clone https://github.com/asobti/kube-monkey
```

2. Change the directory to kube-monkey/helm:

```
$ cd kube-monkey/helm
```

3. Find the values.yaml file in Helm chart:

```
$ /chaos/kube-monkey/helm$ cd kubemonkey/
$ /chaos/kube-monkey/helm/kubemonkey$ ls
Chart.yaml  README.md  templates values.yaml
```

4. Disable dry-run mode by changing it in the config section to **false**. Add the default namespace to the whitelist so it kills the deployed pods. Keep the **blacklistedNamespaces** value or it cause severe damage to the system.

   Change this:

```
config:
        dryRun: true
        runHour: 8
        startHour: 10
        endHour: 16
        blacklistedNamespaces:
          - kube-system
        whitelistedNamespaces: []
To this:
        config:
        dryRun: false
        runHour: 8
        startHour: 10
        endHour: 16
        blacklistedNamespaces:
          - kube-system
```

```
whitelistedNamespaces:  ["default"]
```

5. In the debug section, set **enabled** and **schedule_immediate_kill** to **true.** This shows the pods being killed.

   Change this:

```
debug:
enabled: false
schedule_immediate_kill: false
```

   To this

```
debug:
enabled: true
schedule_immediate_kill: true
```

6. Run helm install command:

   $ /chaos/kube-monkey/helm$ helm install chaos kubemonkey

```
NAME: chaos
LAST DEPLOYED: Sat May 15 13:51:59 2021
NAMESPACE: default
STATUS: deployed
REVISION: 1
TEST SUITE: None
```

   NOTES:

   - Wait until the application is rolled out:

```
kubectl -n default rollout status deployment chaos-kube-monkey
```

- Check the logs:

```
kubectl logs -f deployment.apps/chaos-kube-monkey -n default
```

7. Check the logs:

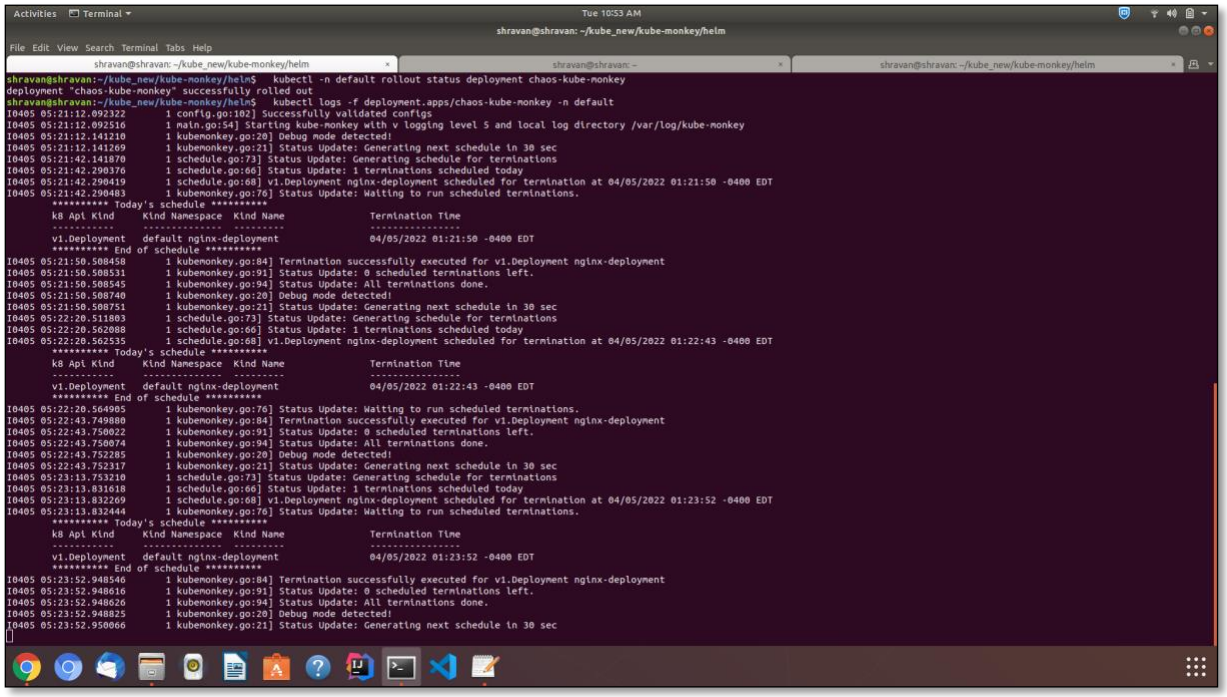

Figure 1: Kube-monkey Pods Logs

To see the pods getting killed, use the command:

```
kubectl get pods
```