Adding Secondary CIDR Range to EKS-Cluster

Jaswanth Kumar Jonnalagadda

October 2019

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Amazon Elastic Container Service for Kubernetes (EKS) now allows clusters to be created in a Amazon VPC addressed with additional IPv4 CIDR blocks in the 100.64.0.0/10 and 198.19.0.0/16 ranges. This allows customers additional flexibility in configuring the networking for their EKS clusters.

Previously, EKS customers could only create clusters in VPCs that were addressed with RFC 1918 private IP address ranges. This meant customers were often unable to allocate sufficient private IP address space to support the number of Kubernetes pods managed by EKS

Now, customers can create EKS clusters in Amazon VPCs addressed with CIDR blocks in the 100.64.0.0/10 and 198.19.0.0/16 ranges. This gives customers more available IP addresses for their pods managed by Amazon EKS and more flexibility for networking architectures. Additionally, by adding secondary CIDR blocks to a VPC from the 100.64.0.0/10 and 198.19.0.0/16 ranges, in conjunction with the CNI Custom Networking feature, it is possible for pods to no longer consume any RFC 1918 IP addresses in a VPC.

In this document, we will walk you through the configuration that is needed so that one can launch the Pod networking on top of secondary CIDRs

PreRequisite:

1. With the following commands you add 100.64.0.0/16 to your EKS cluster VPC

```
VPC_ID=$(aws ec2 describe-vpcs --filters Name=tag:Name,Values=<Name of EKS Cluster>* | jq -r '.Vpcs[].VpcId')

aws ec2 associate-vpc-cidr-block --vpc-id $VPC_ID --cidr-block 100.64.0.0/16
```

Sample Output:

```
{
  "CidrBlockAssociation": {
    "AssociationId": "vpc-cidr-assoc-0fc2518619e001a5d",
    "CidrBlock": "100.64.0.0/16",
    "CidrBlockState": {
      "State": "associating"
    }
  },
  "VpcId": "vpc-0674822c23b03659e"
}
```

2. Next step is to create subnets.

   a. We need to know how many subnets we are consuming, with the command

      aws ec2 describe-instances --filters "Name=tag: alpha.eksctl.io/cluster-name,Values=<Name of EKS Cluster>*" –query 'Reservations[*].Instances[*].[PrivateDnsName,Tags[?Key==`Name`].Value|[0],Placement.AvailabilityZone,PrivateIpAddress,PublicIpAddress]' --output table

      Sample Output:

```
                                            DescribeInstances
+--------------------------------------------+-----------------------------------------------------+------------+-------------+-------------+
| ip-10-3-3-229.us-west-2.compute.internal  |  EFX-CIDR-TST-eks-system-workload-Node          |  us-west-2b |  10.3.3.229  |  54.213.9.45 |
| ip-10-3-13-241.us-west-2.compute.internal |  EFX-CIDR-TST-eks-private-workloads-tenanttwo-Node  |  us-west-2b |  10.3.13.241 |  None     |
| ip-10-3-13-214.us-west-2.compute.internal |  EFX-CIDR-TST-eks-private-workloads-tenantone-Node  |  us-west-2b |  10.3.13.214 |  None     |
| ip-10-3-12-121.us-west-2.compute.internal |  EFX-CIDR-TST-eks-private-workloads-tenantone-Node  |  us-west-2a |  10.3.12.121 |  None     |
| ip-10-3-12-54.us-west-2.compute.internal  |  EFX-CIDR-TST-eks-private-workloads-tenanttwo-Node  |  us-west-2a |  10.3.12.54  |  None     |
+--------------------------------------------+-----------------------------------------------------+------------+-------------+-------------+
```

      Here I have 5 instances running on 2 subnets. For the purpose of demo, we will use the same AZ's and create 2 secondary CIDR subnets. One can customize according to the network requirements.

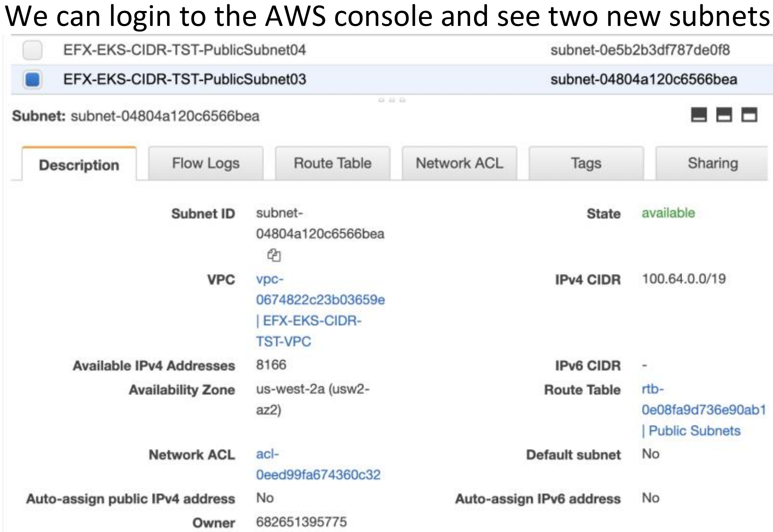
   b. Create two subnets with the following commands

      export AZ1=us-west-2a
      export AZ2=us-west-2b

      CGNAT_SNET1=$(aws ec2 create-subnet --cidr-block 100.64.0.0/19 --vpc-id $VPC_ID --availability-zone $AZ1 | jq -r .Subnet.SubnetId)

      CGNAT_SNET2=$(aws ec2 create-subnet --cidr-block 100.64.32.0/19 --vpc-id $VPC_ID --availability-zone $AZ2 | jq -r .Subnet.SubnetId)

      We can login to the AWS console and see two new subnets created.



3. Add necessary tags on created subnets.
    a. Retrieve the tags by querying current subnets

       aws ec2 describe-subnets --filters "Name=tag:aws:cloudformation:stack-name,Values=<cf-stack>" "Name=cidr-block,Values=<cidr-block>" --output text

       Sample Output:
       TAGS   aws:cloudformation:logical-id   PublicSubnet01
       TAGS   Name   EFX-EKS-CIDR-TST-PublicSubnet01
       TAGS   kubernetes.io/cluster/EFX-CIDR-TST   shared
       TAGS   kubernetes.io/role/elb 1
       TAGS   aws:cloudformation:stack-name   EFX-EKS-CIDR-TST
       TAGS   aws:cloudformation:stack-id arn:aws:cloudformation:us-west-2:682651395775:stack/EFX-EKS-CIDR-TST/03f06380-f862-11e9-a2e2-0a134f485a1c

    b. Add these tags through AWS Console or through AWS CLI.

       Using AWS CLI, with the commands
       aws ec2 create-tags --resources $CGNAT_SNET1 --tags Key= Name ,Value= EFX-EKS-CIDR-TST-PublicSubnet03
       aws ec2 create-tags --resources $CGNAT_SNET1 --tags Key=kubernetes.io/cluster/<Name of EKS Cluster>*,Value=shared
       aws ec2 create-tags --resources $CGNAT_SNET1 --tags Key=kubernetes.io/role/elb,Value=1

       Similarly add tags to other created subnets

4. Next step, we need to associate the subnets into the route table. For the demo purpose we will be adding the subnets to public route table that had connectivity to internet gateway
    a. Retrieving the subnet id from existing subnet with the command

       SNET1=$(aws ec2 describe-subnets --filters "Name=tag:aws:cloudformation:stack-name,Values=EFX-EKS-CIDR-TST" "Name=cidr-block,Values=10.3.2.0/24" | jq -r .Subnets[].SubnetId)

b. Retrieve route table id with the command

   RTASSOC_ID=$(aws ec2 describe-route-tables --filters Name=association.subnet-id,Values=$SNET1 | jq -r .RouteTables[].RouteTableId)

c. Associate the route table id to the newly created subnets.

   aws ec2 associate-route-table --route-table-id $RTASSOC_ID --subnet-id $CGNAT_SNET1

   aws ec2 associate-route-table --route-table-id $RTASSOC_ID --subnet-id $CGNAT_SNET2

   With this we had created entries for the subnets in public route tables

CONFIGURE CNI:

1. Make sure to use the latest CNI version
   a. To view the version, with the command

      kubectl describe daemonset aws-node --namespace kube-system | grep Image | cut -d "/" -f 2

      Sample Output:
      amazon-k8s-cni:v1.5.3

   b. If the version is less that 1.3 then update to the latest CNI version with the command

      kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/master/config/v1.5.3/aws-k8s-cni.yaml

   c. Wait for the pods are recycled. We can check the status of pods by using the command

      kubectl get pods -n kube-system -w

Configure Custom Networking:

1. Edit aws-node configmap and add AWS_VPC_K8S_CNI_CUSTOM_NETWORK_CFG environment variable to the node container spec and set it to true

With the command we can update the aws-node configmap

Add the bolded lines in the config and save the file.

```
spec:
   containers:
   - env:
     - name: AWS_VPC_K8S_CNI_CUSTOM_NETWORK_CFG
       value: "true"
     - name: AWS_VPC_K8S_CNI_LOGLEVEL
       value: DEBUG
     - name: MY_NODE_NAME
```

2. Terminate worker nodes so that Autoscaling launches newer nodes that come bootstrapped with custom network config

   NOTE: Following command will restart the worker nodes

   With the following command we will be restarting the worker nodes.

```
INSTANCE_IDS=(`aws ec2 describe-instances --query
'Reservations[*].Instances[*].InstanceId' --filters "Name=tag:alpha.eksctl.io/cluster-
name,Values==<Name of EKS Cluster>" --output text` )
for i in "${INSTANCE_IDS[@]}"
do
        echo "Terminating EC2 instance $i ..."
        aws ec2 terminate-instances --instance-ids $i
done
```

   Sample Output:

```
. . .
Terminating EC2 instance i-09570bf643ec67507 ...
{
  "TerminatingInstances": [
    {
      "InstanceId": "i-09570bf643ec67507",
      "CurrentState": {
        "Code": 32,
        "Name": "shutting-down"
      },
      "PreviousState": {
        "Code": 16,
        "Name": "running"
```

```
        }
      }
    ]
  }
  . . .
```

Restating might take around 20 minutes depending upon the number of instances and the autoscaling groups

CREATE CRDS:

In this phase we will add custom resources to ENIConfig custom resource definition (CRD). CRD's are extensions of Kubernetes API that stores collection of API objects of certain kind. In this case, we will store VPC Subnet and SecurityGroup configuration information in these CRD's so that Worker nodes can access them to configure VPC CNI plugin

EKS cluster when spun up will come up with a default ENIConfig CRD, we can check that with the command

```
kubectl get crd
```

Sample Output:

```
NAME                             CREATED AT
eniconfigs.crd.k8s.amazonaws.com   2019-10-27T03:54:21Z
```

If the ENIConfig is missing, we can install it with the command

```
kubectl apply -f https://raw.githubusercontent.com/aws/amazon-vpc-cni-k8s/master/config/v1.3/aws-k8s-cni.yaml
```

1. Create custom resources for each subnet by replacing the subnet id and security groups

   Sample config file

   ```
   apiVersion: crd.k8s.amazonaws.com/v1alpha1
   kind: ENIConfig
   metadata:
    name: group1-pod-netconfig
   spec:
    subnet: $SUBNETID1
    securityGroups:
    - $SECURITYGROUPID1
    - $SECURITYGROUPID2
   ```

For this demo purpose we will be creating two files for two new subnets we created.

Sample files with actual values

```yaml
apiVersion: crd.k8s.amazonaws.com/v1alpha1
kind: ENIConfig
metadata:
 name: group1-pod-netconfig
spec:
 subnet: subnet-04f960ffc8be6865c
 securityGroups:
 - sg-070d03008bda531ad
 - sg-06e5cab8e5d6f16ef
```

And save the files as group1-pod-netconfig.yaml

2. Apply the created CRD's with the kubectl command

   Kubectl apply -f group1-pod-netconfig.yaml
   Kubectl apply -f group2-pod-netconfig.yaml

3. We can view the configs created with the command

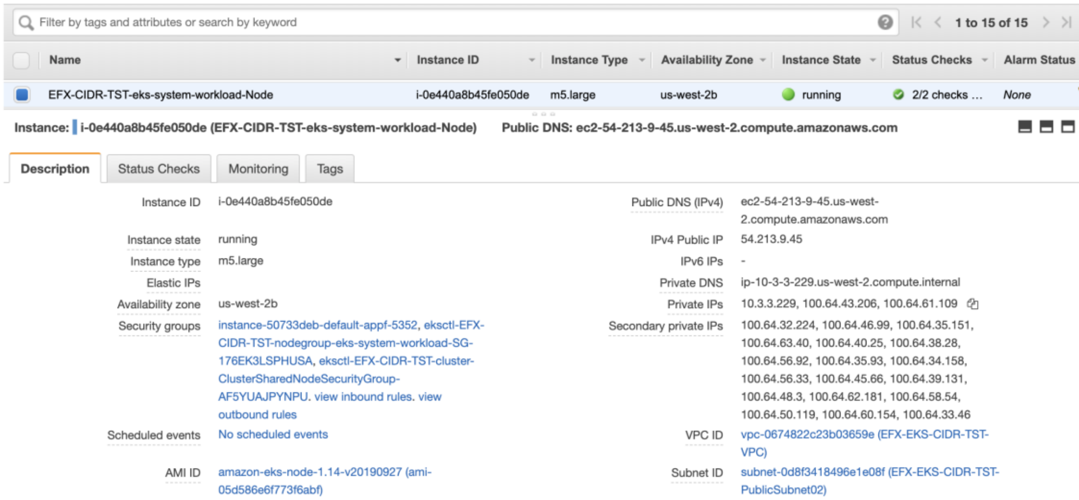
   kubectl get ENIConfig

   Sample Output:

NAME	AGE
group1-pod-netconfig	9h
group2-pod-netconfig	9h

4. As the last step will annotate the nodes to take advantage of secondary ips we added. We will be annotating the nodes with the command

   kubectl annotate node <private ip dns of ec2> k8s.amazonaws.com/eniConfig=group1-pod-netconfig
   Once annotated we can see secondary ip's for the annotated nodes as below.



With this we can observe the secondary ip range attached to the worker node.

Launching PODS in secondary CIDR Network:

Once everything is setup we can launch pods in the new ip range.

Let’s launch a nginx pod and see the ip’s the pod is attached with

kubectl run nginx --image=nginx
kubectl scale --replicas=2 deployments/nginx
kubectl expose deployment/nginx --type=NodePort --port 80

With this we deployed a nginx pod with 2 replicas.

View the ip’s attached to the pods with the command:

kubectl get pods -o wide

Sample Output:

NAME READY STATUS RESTARTS AGE IP NODE NOMINATED NODE
nginx-64f497f8fd-k962k 1/1 Running 0 40m **100.64.6.147** ip-192-168-52-113.us-east-2.compute.internal <none>
nginx-64f497f8fd-lkslh 1/1 Running 0 40m **100.64.53.10** ip-192-168-74-125.us-east-2.compute.internal <none>

Here we can observe that new pods are launched in the new CIDR range.
With this demo we can attach secondary IP range to and existing EKS Cluster.