cnSGW-C Rolling Software Update

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Feature Summary and Revision History

Summary Data

Table 1: Summary Data

Applicable Product(s) or Functional Area	cnSGW-C
Applicable Platform(s)	SMI
Feature Default Setting	Not Applicable
Related Documentation	Not Applicable

Revision History

Table 2: Revision History

Revision Details	Release
First introduced.	2021.02.0

Introduction

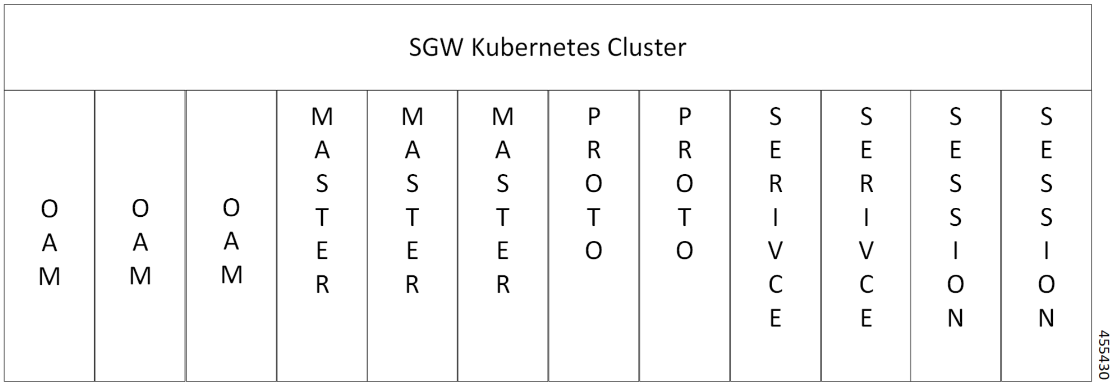
The cnSGW-C has a three-tier architecture consisting of Protocol, Service, and Session. Each tier includes a set of microservices (pods) for a specific functionality. Within these tiers, there exists a Kubernetes Cluster comprising of Kubernetes (K8s) master, and worker nodes (including Operation and Management (OAM) nodes).

For high availability and fault tolerance, a minimum of two K8s worker nodes are configured for each tier. You can have multiple replicas for each worker node. Kubernetes orchestrates the pods using the StatefulSets controller. The pods require a minimum of two replicas for fault tolerance.

The following figure depicts cnSGW-C K8s cluster with 12 nodes.

- Three master nodes
- Three OAM worker nodes
- Two Protocol worker nodes
- Two Service worker nodes
- Two Session (data store) worker nodes

Figure 1: cnSGW-C Kubernetes Cluster



The cnSGW-C Kubernetes cluster comprises of the following nodes:

- The OAM worker nodes host the Ops Center pods for configuration management and metrics pods for statistics and Key Performance Indicators (KPIs).
- The Protocol worker nodes host the cnSGW-C protocol-related pods for service-based interfaces (N11, N7, N10, N40) and UDP-based protocol interfaces (N4, S5/S8).
- The Service worker nodes host the cnSGW-C application-related pods that perform session management processing.
- The Session worker nodes host the database-related pods that store subscriber session data.

Updating cnSGW-C

The rolling software update is a process of updating or migrating the build from an older to a newer version or updating the patch for the prescribed deployment set of application pods.

Rolling update takes place with zero downtime by incrementally updating the pod instances with the new ones.

Note The applications must be available when new versions are expected to be deployed with the new build versions or patches.

Update Scope

The rolling update feature is supported from an older to the newer versions within the same major release.

- **Assumptions:** When updating, it is assumed that the following has not been changed between the versions:
  - Features supported in the old and the new versions.
  - Configuration addition, deletion, or modification of the existing CLI behavior.
  - Interface change within the peer or across the pods.
- **Recommendations:**
  - Configuration changes are not recommended during the update process.
  - All configuration changes should be done after the update process is complete.
- **Failure Handling:** The system should be downgraded manually to an older healthy build following the downgrade process for:
  - Failure during the process such as crash, and pods deployment failures.
  - Failure after the successful update such as new events or procedures.

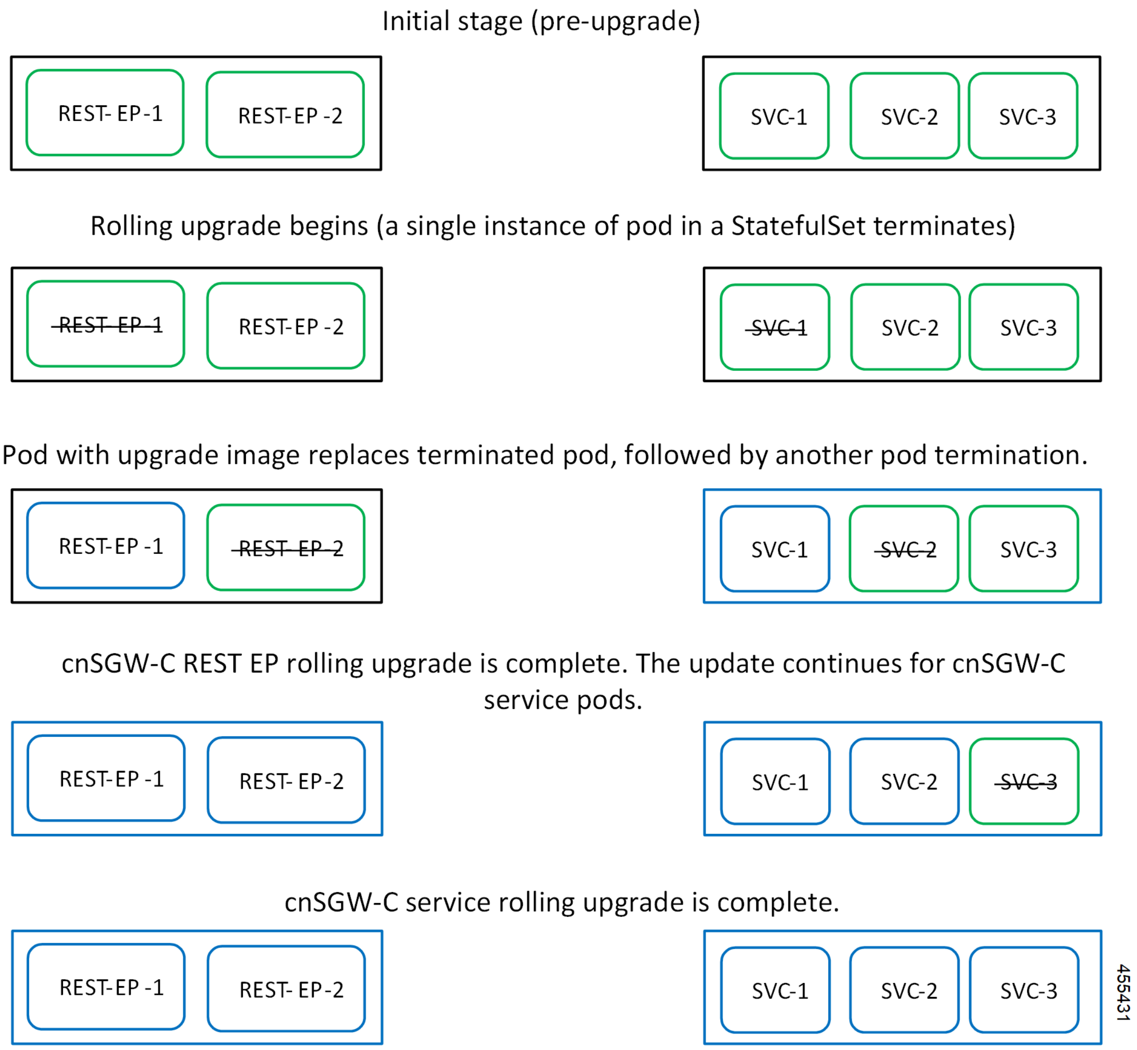
Rolling Software Update Using the SMI Cluster Manager

The cnSGW-C software update or in-service update procedure utilizes the K8s rolling strategy to update the pod images. In this strategy, the pods of a StatefulSet are updated sequentially to ensure that the ongoing process remains unaffected. Initially, a rolling update on a StatefulSet causes a single pod instance to terminate. A pod with an updated image replaces the terminated pod. This process continues until all the replicas of the StatefulSet are updated. The terminating pods exit gracefully after competing all the ongoing processes. Other in-service pods continue to receive and process the traffic to provide a seamless software update. You can control the software update process through the Ops Center CLI.

Note Each pod needs a minimum of two pods for high availability. In a worst-case scenario, the processing capacity of the pod may briefly reduce to 50% while the software update is in-progress.

The following figure illustrates a cnSGW-C rolling update for cnSGW-C REST endpoint pods (two replicas) on Protocol worker nodes along with cnSGW-C Service pods (three replicas) on Service worker nodes.

Figure 2: cnSGW-C Rolling Update


Initial stage (pre-upgrade)
REST- EP -1
REST-EP -2
SVC-1
SVC-2
SVC-3
Rolling upgrade begins (a single instance of pod in a StatefulSet terminates)
~~REST- EP -1~~
REST-EP -2
~~SVC-1~~
SVC-2
SVC-3
Pod with upgrade image replaces terminated pod, followed by another pod termination.
REST-EP -1
~~REST- EP -2~~
SVC-1
~~SVC-2~~
SVC-3
cnSGW-C REST EP rolling upgrade is complete. The update continues for cnSGW-C service pods.
REST-EP -1
REST- EP -2
SVC-1
SVC-2
~~SVC-3~~
cnSGW-C service rolling upgrade is complete.
REST-EP -1
REST- EP -2
SVC-1
SVC-2
SVC-3
455431

Prerequisites

The prerequisites for upgrading cnSGW-C are:

- All the nodes that include all the pods in the node that are up and running.
- A patch version of the cnSGW-C software.

Note Major versions do not support rolling update.

Important Trigger rolling update only when the CPU usage of the nodes is less than 50%.

- Intra-site HA support.

cnSGW-C Health Check

Perform a health check to ensure that all the services are running and the nodes are in the ready state.

To perform health check, use the following configuration:

- Log in to the master node and use the following configuration:

```
kubectl get pods -n smi
kubectl get nodes
kubectl get pod --all-namespaces -o wide
kubectl get pods -n cnsgw-wsp -o wide
kubectl get pods -n cee-wsp -o wide
kubectl get pods -n smi-vips -o wide
helm list
kubectl get pods -A | wc -l
```

Important Make sure that all the services are running and nodes are in the ready state before you proceed.

Backing Up the Deployment File

To create a backup configuration, logs, and deployment files, use the following configuration:

1. Log in to the SMI Cluster Manager Node as an Ubuntu user.
2. Create a new directory for deployment.

   Example:

   ```
   test@smicnsgw-cm01:~$ mkdir -p "temp_$(date +'%m%d%Y_T%H%M')" && cd "$_"
   ```
3. Back up the working files into the newly created deployment directory.
4. Untar the `cnsgw` deployment file.

   Example:

   ```
   test@smi1cnsgw01-cm01:~/temp_08072019_T1651$ tar -xzvf cnsgw.2020.01.0-1.SPA.tgz
   ./
   ./cnsgw_REL_KEY-CCO_RELEASE.cer
   ./cisco_x509_verify_release.py
   ./cnsgw.2020.01.0-1.tar
   ./cnsgw.2020.01.0-1.tar.signature.SPA
   ./cnsgw.2020.01.0-1.tar.SPA.README
   ```
5. Verify the downloaded image.

   Example:

   ```
   test@smi1cnsgw01-cm01:~/temp_08072019_T1651$ cat cnsgw.2020.01.0-1.tar.SPA.README
   ```

Important Follow the procedure mentioned in the *SPA.README* file to verify the build before proceeding to the next step.

Backing Up the Ops Center Configuration

To back up the Ops Center configurations, use the following configuration:

1. Log in to the SMI Cluster Manager node as an Ubuntu user.
2. Back up the SMI Ops Center configuration to the **/home/ubuntu/smiops.backup** file, using the following configuration:

   ```
   ssh -p <port_number> admin@$(kubectl get svc -n smi | grep
   '.*netconf.*<port_number>' | awk '{ print $4 }') "show run | nomore"
   > smiops.backup_$(date +'%m%d%Y_T%H%M')
   ```

3. Back up the CEE Ops Center configuration to the **/home/ubuntu/ceeops.backup** file, using the following configuration:

   ```
   ssh admin@<cee-vip> "show run | nomore" > ceeops.backup_$(date
   +'%m%d%Y_T%H%M')
   ```

4. Back up the cnSGW-C Ops Center configuration to the **/home/ubuntu/cnSGWops.backup** file, using the following configuration:

   ```
   ssh admin@<cnSGW-vip> "show run | nomore" > cnSGWops.backup_$(date
   +'%m%d%Y_T%H%M')
   ```

Back Up CEE and cnSGW-C Ops Center Configuration

To back up the CEE and Ops Center configuration from the master node, use the following configuration:

1. Log in to the master node as an Ubuntu user.
2. Create a directory to backup the configuration files, using the following configuration:

   ```
   mkdir backups_$(date +'%m%d%Y_T%H%M') && cd "$_"
   ```

3. Back up the cnSGW-C Ops Center configuration and verify the line count of the backup files, using the following configuration:

   ```
   ssh -p <port_number> admin@$(kubectl get svc -n $(kubectl get namespaces
    | grep -oP 'cnSGW-(\d+|\w+)') | grep <port_number> | awk '{ print $3
    }') "show run | nomore" > cnSGWops.backup_$(date +'%m%d%Y_T%H%M') &&
    wc -l cnSGWops.backup_$(date +'%m%d%Y_T%H%M')
   ```

   Example:

   ```
   ubuntu@pocnSGW-mas01:~/backups_09182019_T2141$ ssh -p 2024 admin@$(kubectl get svc -n
   $(kubectl get namespaces | grep -oP 'cnSGW-(\d+|\w+)') | grep <port_number> | awk '{
   print $3 }') "show run | nomore" > cnSGWops.backup_$(date +'%m%d%Y_T%H%M') && wc -l
   cnSGWops.backup_$(date +'%m%d%Y_T%H%M')
   admin@<ipv4address>'s password: cnSGW-OPS-PASSWORD
   334 cnSGWops.backup
   ```

4. Back up the CEE Ops Center configuration and verify the line count of the backup files, using the following configuration:

   ```
   ssh -p <port_number> admin@$(kubectl get svc -n $(kubectl get namespaces
    | grep -oP 'cee-(\d+|\w+)') | grep <port_number> | awk '{ print $3
   }') "show run | nomore" > ceeops.backup_$(date +'%m%d%Y_T%H%M') && wc
    -l ceeops.backup_$(date +'%m%d%Y_T%H%M')
   ```

   Example:

```
ubuntu@pocnSGW-mas01:~/backups_09182019_T2141$ ssh -p <port_number> admin@$(kubectl get
 svc -n $(kubectl get namespaces | grep -oP 'cee-(\d+|\w+)') | grep <port_number> | awk
 '{ print $3 }') "show run | nomore" > ceeops.backup_$(date +'%m%d%Y_T%H%M') && wc -l
ceeops.backup_$(date +'%m%d%Y_T%H%M')
admin@<ipv4address>'s password: CEE-OPS-PASSWORD
233 ceeops.backup
```

5. Move the SMI Ops Center backup file (from the SMI Cluster Manager) to the backup directory, using the following configuration:

   ```
   scp $(grep cm01 /etc/hosts | awk '{ print $1
   }'):/home/ubuntu/smiops.backup_$(date +'%m%d%Y_T%H%M') .
   ```

   Example:

   ```
   ubuntu@pocnSGW-mas01:~/backups_09182019_T2141$ scp $(grep cm01 /etc/hosts | awk '{ print
    $1 }'):/home/ubuntu/smiops.backup_$(date +'%m%d%Y_T%H%M') .
   ubuntu@<ipv4address>'s password: SMI-CM-PASSWORD
   smiops.backup                                                     100% 9346    22.3MB/s
      00:00
   ```

6. Verify the line count of the backup files.

   Example:

   ```
   ubuntu@pocnSGW-mas01:~/backups_09182019_T2141$ wc -l *
     233 ceeops.backup
     334 cnSGWops.backup
     361 smiops.backup
     928 total
   ```

Staging a New cnSGW-C Image

To stage a new cnSGW-C image before initiating the update, use the following configuration:

1. Download and verify the new cnSGW-C image.

2. Log in to the SMI Cluster Manager node as an Ubuntu user.

3. Copy the image to the **uploads** directory.

   ```
   sudo mv <cnSGW_new_image.tar> /data/software/uploads
   ```

   Note The SMI uses the new image present in the **uploads** directory to update.

4. Verify whether the image is picked up by the SMI for processing from the **uploads** directory.

   ```
   sleep 30; ls /data/software/uploads
   ```

   Example:

   ```
   ubuntu@pocnSGW-cm01:~/temp_08072019_T1651$ sleep 30; ls /data/software/uploads
   ubuntu@pocnSGW-cm01:~/temp_08072019_T1651$
   ```

5. Verify whether the images were successfully picked up and processed.

   Example:

   ```
   auser@unknown:$ sudo du -sh /data/software/packages/*
   1.6G /data/software/packages/cee.2019.07
   5.3G /data/software/packages/cnSGW.2019.08-04
   16K /data/software/packages/sample
   ```

Note: The SMI must unpack the images into the **packages** directory successfully to complete the staging.

Triggering the Rolling Software Upgrade

cnSGW-C utilizes the SMI Cluster Manager to perform a rolling software update.

To update cnSGW-C using SMI Cluster Manager, use the following configurations:

Important: Before you begin, ensure that cnSGW-C is up and running with the current version of the software.

1. Log in to the SMI Cluster Manager Ops Center.
2. Download the latest tarall from the URL.

   ```
   software-packages download url
   ```

   NOTES:

   - **software-packages download** *url*—Specifies the software packages to be downloaded through HTTP/HTTPS.

   Example:

   ```
   SMI Cluster Manager# software-packages download <url>
   ```

3. Verify whether the tarall is loaded.

   ```
   software-packages list
   ```

   NOTES:

   - **software-packages list** —Specifies the list of available software packages.

   Example:

   ```
   SMI Cluster Manager# software-packages list
   [ cnSGW-2019-08-21 ]
   [ sample ]
   ```

4. Update the product repository URL with the latest version of the product chart.

   Note: If the repository URL contains multiple versions, the Ops Center automatically selects the latest version.

   ```
   configure
     cluster cluster_name
      ops-centers app_name cnSGW_instance_name
           repository url
            exit
          exit
   ```

   Example:

```
SMI Cluster Manager# config
SMI Cluster Manager(config)# clusters test2
SMI Cluster Manager(config-clusters-test2)# ops-centers cnSGW data
SMI Cluster Manager(config-ops-centers-cnSGW/data)# repository <url>
SMI Cluster Manager(config-ops-centers-cnSGW/data)# exit
SMI Cluster Manager(config-clusters-test2)# exit
```

5. To update to the latest version of the product chart, run the **cluster sync** command using the following command:

   ```
   clusters cluster_name actions sync run
   ```

   Example:

   ```
   SMI Cluster Manager# clusters test2 actions sync run
   ```

NOTES:

- **cluster** —Specifies the K8s cluster.
- *cluster_name* —Specifies the name of the cluster.
- **ops-centers** *app_name instance_name* —Specifies the product Ops Center and instance. *app_name* is the application name. *instance_name* is the name of the instance.
- **repository** *url*—Specifies the local registry URL for downloading the charts.
- **actions** —Specifies the actions performed on the cluster.
- **sync run** —Triggers the cluster synchronization.

Important

- The cluster synchronization updates the cnSGW-C Ops Center, which in turn updates the application pods (through **helm sync** command) one at a time automatically.
- When you trigger rolling upgrade on a specific pod, the cnSGW-C avoids routing new calls to that pod.
- The cnSGW-C honors in-progress call by waiting for 30 seconds before restarting the pod where rolling upgrade is initiated. Also, the cnSGW-C establishes all the in-progress calls completely within 30 seconds during the upgrade period (maximum call-setup time is 10 seconds).

Monitoring the Update Procedure

To monitor the status update through SMI Cluster Manager Ops Center, use the following configurations:

```
config
   clusters cluster_name actions sync run debug true
   clusters cluster_name actions sync logs
   monitor sync-logs cluster_name
   clusters cluster_name actions sync status
   exit
```

Example:

```
SMI Cluster Manager# clusters test1 actions sync run
SMI Cluster Manager# clusters test1 actions sync run debug true
SMI Cluster Manager# clusters test1 actions sync logs
```

```
SMI Cluster Manager# monitor sync-logs test1
SMI Cluster Manager# clusters test1 actions sync status
```

NOTES:

- **clusters** *cluster_name*—Specifies the information about the nodes to be deployed. *cluster_name* is the name of the cluster.
- **actions**—Specifies the actions performed on the cluster.
- **sync run**—Triggers the cluster synchronization.
- **sync logs**—Shows the current cluster synchronization logs.
- **sync status** —Shows the current status of the cluster synchronization.
- **debug true**—Enters the debug mode.
- **monitor sync logs**—Monitors the cluster synchronization process.

Important You can view the pod details after the upgrade through the CEE Ops Center. For more information on pod details, see Viewing the Pod Details, on page 10 section.

Viewing the Pod Details

To view the details of the current pods through CEE Ops Center, use the following command in the CEE Ops Center CLI:

`cluster pods` *`instance_name pod_name`* **`detail`**

NOTES:

- **cluster pods**—Specifies the current pods in the cluster.
- *instance_name*—Specifies the name of the instance.
- *pod_name*—Specifies the name of the pod.
- **detail**—Displays the details of the specified pod.

The following example displays the details of the pod named *alertmanager-0* in the *cnSGW-data* instance.

Example:

```
cee# cluster pods cnSGW-data alertmanager-0 detail
details apiVersion: "v1"
kind: "Pod"
metadata:
  annotations:
    alermanager.io/scrape: "true"
    cni.projectcalico.org/podIP: "<ipv4address/subnet>"
    config-hash: "5532425ef5fd02add051cb759730047390b1bce51da862d13597dbb38dfbde86"
  creationTimestamp: "2020-02-26T06:09:13Z"
  generateName: "alertmanager-"
  labels:
    component: "alertmanager"
    controller-revision-hash: "alertmanager-67cdb95f8b"
    statefulset.kubernetes.io/pod-name: "alertmanager-0"
  name: "alertmanager-0"
  namespace: "cnSGW"
  ownerReferences:
  - apiVersion: "apps/v1"
    kind: "StatefulSet"
    blockOwnerDeletion: true
    controller: true
    name: "alertmanager"
    uid: "82a11da4-585e-11ea-bc06-0050569ca70e"
  resourceVersion: "1654031"
  selfLink: "/api/v1/namespaces/cnSGW/pods/alertmanager-0"
  uid: "82aee5d0-585e-11ea-bc06-0050569ca70e"
spec:
  containers:
  - args:
    - "/alertmanager/alertmanager"
    - "--config.file=/etc/alertmanager/alertmanager.yml"
    - "--storage.path=/alertmanager/data"
    - "--cluster.advertise-address=$(POD_IP):6783"
    env:
    - name: "POD_IP"
      valueFrom:
        fieldRef:
          apiVersion: "v1"
          fieldPath: "status.podIP"
    image: "<path_to_docker_image>"
    imagePullPolicy: "IfNotPresent"
    name: "alertmanager"
    ports:
    - containerPort: 9093
      name: "web"
      protocol: "TCP"
    resources: {}
    terminationMessagePath: "/dev/termination-log"
    terminationMessagePolicy: "File"
    volumeMounts:
    - mountPath: "/etc/alertmanager/"
      name: "alertmanager-config"
    - mountPath: "/alertmanager/data/"
      name: "alertmanager-store"
    - mountPath: "/var/run/secrets/kubernetes.io/serviceaccount"
      name: "default-token-kbjnx"
      readOnly: true
  dnsPolicy: "ClusterFirst"
  enableServiceLinks: true
  hostname: "alertmanager-0"
  nodeName: "for-smi-cdl-1b-worker94d84de255"
  priority: 0
  restartPolicy: "Always"
  schedulerName: "default-scheduler"
  securityContext:
    fsGroup: 0
    runAsUser: 0
  serviceAccount: "default"
  serviceAccountName: "default"
  subdomain: "alertmanager-service"
  terminationGracePeriodSeconds: 30
  tolerations:
  - effect: "NoExecute"
    key: "node-role.kubernetes.io/oam"
    operator: "Equal"
    value: "true"
  - effect: "NoExecute"
    key: "node.kubernetes.io/not-ready"
    operator: "Exists"
```

```
      tolerationSeconds: 300
    - effect: "NoExecute"
      key: "node.kubernetes.io/unreachable"
      operator: "Exists"
      tolerationSeconds: 300
    volumes:
    - configMap:
        defaultMode: 420
        name: "alertmanager"
      name: "alertmanager-config"
    - emptyDir: {}
      name: "alertmanager-store"
    - name: "default-token-kbjnx"
      secret:
        defaultMode: 420
        secretName: "default-token-kbjnx"
  status:
    conditions:
    - lastTransitionTime: "2020-02-26T06:09:02Z"
      status: "True"
      type: "Initialized"
    - lastTransitionTime: "2020-02-26T06:09:06Z"
      status: "True"
      type: "Ready"
    - lastTransitionTime: "2020-02-26T06:09:06Z"
      status: "True"
      type: "ContainersReady"
    - lastTransitionTime: "2020-02-26T06:09:13Z"
      status: "True"
      type: "PodScheduled"
    containerStatuses:
    - containerID: "docker://821ed1a272d37e3b4c4c9c1ec69b671a3c3fe6eb4b42108edf44709b9c698ccd"

      image: "<path_to_docker_image>"
      imageID: "docker-pullable://<path_to_docker_image>"
      lastState: {}
      name: "alertmanager"
      ready: true
      restartCount: 0
      state:
        running:
          startedAt: "2020-02-26T06:09:05Z"
    hostIP: "<host_ipv4address>"
    phase: "Running"
    podIP: "<pod_ipv4address>"
    qosClass: "BestEffort"
    startTime: "2020-02-26T06:09:02Z"
  cee#
```

Rolling Software Update on Non-SMI Cluster

To configure the helm repository, use the following configuration:

- Log in to cnSGW-C Ops Center and use the following configuration:

```
config
 helm default-repository cn
 helm repository cn
 access-token
smf-deployer.gen:AKCp5ekcX7DcBhuAmMZYfGLaHvH3E4Syr9TQDp1gjzcSjYrqsrGbXSYs5X2XYij3d9n9VfWQe

 url <old-build/new-build>
exit
```

Validating the Update

The health check, current helm charts, and subscriber/peer/session information help in understanding whether the rolling update process is successful.

To validate the update, use the following steps:

1. All pods that are deployed should be in the running state before and after an update.

   ```
   kubectl get pods -n cn
   ```

2. Helm charts should reflect charts from the appropriate build.

   To check the helm charts currently deployed, use the following command in the cnSGW-C Ops Center.

   ```
   show helm charts
   show running-config helm repository
   ```

3. Check subscriber, session, or peer information for retention validation, using the following configuration:

   ```
   show subscriber namespace sgw count all
   show peers all
   ```

Rolling Upgrade Optimization

Table 3: Feature History

Feature Name	Release Information	Description
Rolling Upgrade Optimization for Protocol PFCP Pods	2024.04.0	For the protocol (PFCP) pods, Converged Core Gateway introduces a session-level response messages cache at the service pod for handling the retransmitted requests. This optimization helps in reduced session and Call Events Per Second (CEPS) loss during the upgrade procedure.

Feature Name	Release Information	Description
Rolling Upgrade Optimization for Endpoint Pods	2024.03.0	Converged Core Gateway provides the rolling upgrade optimization support for the following pods: • Radius endpoint pod • Diameter endpoint pod • UDP proxy pod • GTPP endpoint pod This optimization is an enhancement to the existing optimization. This feature uses the existing CLI command **supported-features [app-rx-retx-cache | app-tx-retx | rolling-upgrade-all | rolling-upgrade-enhancement-infra]** in the converged core profile.
Rolling Upgrade Optimization	2024.02.0	Converged Core Gateway provides the following support: • Retry mechanism at service and protocol pods during upgrades • Configuration-based rolling upgrade enhancements This optimization helps in reduced session and Call Events Per Second (CEPS) loss during the upgrade procedure. The configurable rolling upgrade enhancements enable smooth rollout of the changes. This feature introduces the new CLI command **supported-features [app-rx-retx-cache | app-tx-retx | rolling-upgrade-all | rolling-upgrade-enhancement-infra]** in the converged core profile. **Default Setting:** Disabled – Configuration Required

Converged Core Gateway (CCG) software version 2024.02.0 and higher support rolling upgrade with additional optimizations. Rolling upgrade lets you perform graceful upgrade of all pods with minimal impact on sessions and CEPS. The additional optimizations provide an operational flexibility by allowing you an option to enable or disable rolling upgrade features through the CLI command for the upgrade process, as required.

This feature supports the following application-level enhancements:

- Retry mechanisms at protocol pods during service pods upgrade.
- Handling of transient sessions or transactions at service pods and protocol pods during their upgrades.
- Handling of topology and IPC mechanism changes to detect pods that are restarting or inactive. For inactive pods, the retry option is attempted toward other instances of pods.

You can configure the rolling upgrade enhancements through the **supported-features [app-rx-retx-cache | app-tx-retx | rolling-upgrade-all | rolling-upgrade-enhancement-infra]** CLI command.

Important

- It is recommended that you do not enable or disable the rolling upgrade features at run time to prevent an impact on the existing sessions.
- It is highly recommended that you use only the **rolling-upgrade-all** option as all the other command options are available only for debugging purpose.

Feature Description

Converged Core Gateway (CCG) software version 2024.02.0 and higher supports rolling upgrade with additional optimizations. Rolling upgrade lets you perform graceful upgrade of all pods with minimal impact on sessions and CEPS.

This feature supports the following application-level enhancements:

- Retry mechanisms at protocol pods during service pods upgrade.
- Handling of transient sessions or transactions at service pods and protocol pods during their upgrades.
- Handling of topology and IPC mechanism changes to detect pods that are restarting or inactive. For inactive pods, the retry option is attempted toward other instances of pods.

You can configure the rolling upgrade enhancements through the **supported-features [app-rx-retx-cache | app-tx-retx | rolling-upgrade-all | rolling-upgrade-enhancement-infra]** CLI command.

Important

- It is recommended that you do not enable or disable the rolling upgrade features at run time to prevent an impact on the existing sessions.
- It is highly recommended that you use only the **rolling-upgrade-all** option as all the other command options are available only for debugging purpose.

How Rolling Upgrade Optimization Works

This section describes upgrades of various pods and the rolling upgrade procedure.

Pod Upgrades

Service Pod

Peer pods are made aware of the upgrade or restart of a particular pod so that the transactions from/to that pod are handled gracefully.

The following section describes the handling of incoming and outgoing messages on a service pod:

Incoming Messages

- During an upgrade, the state of a service pod is communicated to other pods through the topology update. If no affinity exists for the session, the pod is not selected for forwarding new messages.
- For a session, if a service pod doesn't have a context, which is the first message for a user after a cache timeout, an Application Stop message is communicated to the protocol pod. This pod redirects messages to other service pod instances.
- If a service pod has a context for the session with no pending procedures or transactions for the session or user, an Application Stop message is communicated to the protocol pod. This pod redirects messages to other service pod instances. However, before communication to the protocol pod, the forceful Sync of Session State is done toward CDL. In addition, the affinity entry is removed for the session or user.

Outgoing Messages

- After completion of a call flow or a procedure for a session or user, if a service pod receives an upgrade or restart indication, then synchronization of the session or PDU state with CDL is performed. In addition, the affinity entry is removed for the service or user to disallow the triggering of further messages toward the service pod instance.
- For the existing call flows, which are in progress, the transactions are handled on the best-effort basis for call completion.

Protocol Pod

This section describes the handling of messages on the REST endpoint, GTPC endpoint, and protocol (PFCP) endpoint pods.

REST Endpoint Pod

The following section describes the handling of incoming and outgoing messages on the REST endpoint pod.

Incoming Messages

- For new TCP connections the ingress K8 service doesn't select a specific REST endpoint pod during an upgrade or restart. These requests are forwarded to other instances.
- After receiving an upgrade or restart indication, a GOAWAY frame is sent on the existing connections. By sending this frame, the new messages are sent on a new connection from the peer node.

Outgoing Messages

- After receiving the outgoing request messages from service pods, the Application Stop indication is communicated back to the service pod. With this communication, a service pod can select another REST endpoint instance to trigger the messages.

- For outgoing responses for the existing transient messages, the best effort is made to complete the transactions.

GTPC Endpoint Pod

Incoming Messages

Session level response messages cache is added at service pod to support handling of incoming request messages during GTPC endpoint pod restart. Service pods store response messages buffers based on the sequence number, source IP address, source port, and request message type.

- If there is a response message loss on wire due to GTPC endpoint pod restart, then peer retries the request message. This message is responded using a session level response message cache.
- Even if a response message isn’t generated at a service pod, the message is detected as retransmission at the service and handled accordingly.

Outgoing Messages

The outgoing request messages during GTPC endpoint pod restart are handled in the following way:

- The service pod sets the request timeout interval and the number of retransmissions while doing BGIPC. The timeout interval and the number of transmissions are based on the N3 T3 defined for S5, S11, and S5E interfaces.
- Instead of the GTPC endpoint pod, the service pod sets the source port and sequence number.
- This mechanism helps in retransmission of the outgoing message when a response message is lost during pod restart. The service pod generates the sequence number and port. In this case, there's no ambiguity of messages on the wire for the peer also to detect the message as retransmission.

Node Manager Pod

One instance of a node manager pod is available to serve the calls during upgrades. The readiness probe and the timer are also configured for the upgrade scenario. In case a pod is inactive, the service pods retry the other node manager pod instances.

CDL Pod

CDL pods have multiple replicas for the service continuity during the upgrade process. Multiple connection streams are available towards CDL endpoints to minimize failures during upgrade and restart processes. In case of errors for these processes, the retry mechanism is also implemented towards another CDL endpoint connection.

Upgrading Software to Version with Rolling Upgrade Optimization Support

This section describes how to perform the rolling upgrade and to enable the rolling upgrade enhancements.

Important Review these important guidelines associated with the rolling upgrade procedure.

- The rolling upgrade optimization feature should only be used when you are upgrading from Release 2024.02.0 or later.

  If you are upgrading to Release 2024.02.0 or later from a version that is prior to Release 2024.02.0, perform the shut-start upgrade first.

- After the upgrade, make sure you enable the rolling upgrade enhancements using CLI command. Then, the subsequent rolling upgrades to future releases will include the available optimizations.

Rolling Upgrade Considerations

Both the racks (Rack 1 and Rack 2) of are in a sunny day scenario and are on a version that is prior to Release 2024.02.0.

To perform the rolling strategy, follow these steps:

1. Move Rack 1 to a rainy day scenario and keep Rack 2 active for both the GR instances.
2. Move the GR instances on Rack 1 to Standby_ERROR.
3. Shutdown Rack 1.
4. Perform cluster sync, through sync-phase ops-center, for Rack 1 to move to Release 2024.02.
5. Apply the recommended configurations to enable the rolling upgrade enhancements.

   The recommended configuration for rolling upgrade is as follows:

   ```
   config
     profile converged-core converged_core_profile_name
     supported-features [ rolling-upgrade-all ]
     end
   ```

6. Start Rack 1.
7. Wait for 30 minutes for completion of CDL reconciliation.
8. Switch the GR instances to Primary to make Rack 1 active.
9. Shutdown Rack 2.
10. Continue with Steps 4–6 for Rack 2.
11. Make the Rack 1 and Rack 2 configurations for a sunny day scenario.

Limitations

This feature has the following limitations:

- During a rolling upgrade, service pods restart one at a time. This upgrade leads to a skewed redistribution of sessions. The service pod that restarts first has the higher number of sessions. Similarly, the service pod that restarted last has the least number of sessions. Such redistribution of sessions can lead to a temporary spike in the memory requirement for some service pods. The system works as expected after the sessions are removed from the local cache of a service pod.

- Ongoing procedures in service pods continue during the rolling upgrade. However, the best effort mechanism is implemented for their successful completion.

Configuring the Supported Features for Rolling Upgrade

To enable the supported features for a rolling upgrade, use the following sample configuration:

```
config
  profile converged-core cc_profile_name
    supported-features [ app-rx-retx-cache | app-tx-retx |
rolling-upgrade-all | rolling-upgrade-enhancement-infra ]
    end
```

NOTES:

- **profile converged-core** *cc_profile_name*: Specify the name of the converged core profile. This keyword allows you to enter the converged core profile configuration mode.
- **supported-features [app-rx-retx-cache | app-tx-retx | rolling-upgrade-all | rolling-upgrade-enhancement-infra]**: Specify one of the following options to enable the supported features for the rolling upgrade.
    - **app-rx-retx-cache**: Enable retransmission cache for inbound messages at application.
    - **app-tx-retx**: Enable retransmission for outbound messages at application.
    - **rolling-upgrade-all**: Enable all the rolling upgrade features that are available through **rolling-upgrade-enhancement-infra**, **app-rx-retx-cache**, and **app-tx-retxrolling** keyword options. By default, the rolling upgrade features are disabled.

      rolling-upgrade-all is the only recommended option.
    - **rolling-upgrade-enhancement-infra**: Enable infra-level features.

Important

- It is recommended that you do not enable or disable the rolling upgrade features at run time to prevent an impact on the existing sessions.
- It is highly recommended that you use only the **rolling-upgrade-all** option as all the other command options are available only for debugging purpose.

Verifying Rolling Upgrade Optimization

Use the **show running-config profile amf-services** command to verify the supported features for a rolling upgrade.

The following is an example output of the **show running-config amf-services** command.

```
show running-config profile amf-services
amf-services am1
   supported-features [ rolling-upgrade-all ]
exit
```

OAM Support

Bulk Statistics

The following statistics are supported for the rolling upgrade optimization feature.

IPC retry statistics:

The "ipc_request_total" statistics is updated with an additional label "retry_cause" for the cause of a retry attempt.

CDL statistics:

The following statistics are added for the CDL operations:

- cdl_request_total
- cdl_response_total
- cdl_request_seconds_total
- cdl_request_duration_histogram_total

These CDL statistics are updated with the following filters:

- **retry**: Used to view the retry messages
- **method_name**: Used to view the CDL force sync update

Note In the previous releases, CDL statistics were visible through RPC statistics with the filter **rpc_name** as STREAM_SESSION_DB. From Release 2024.02 onwards, CDL statistics are available only using the preceding CDL statistics.

Application stop counter:

The "application_stop_action" statistics is added to view actions on App-infra. Some examples of these actions are session cache removal and affinity removal.