

Kubernetes 1.31 Feature Guide

Overview

Kubernetes 1.31 delivers notable enhancements across networking, storage and security. AppArmor profiles are now stable, offering a native way to confine container capabilities ¹. Ingress connectivity is improved through kube-proxy changes that reduce downtime and traffic drops during topology changes ¹. Persistent volume claims can now report transition times, making storage lifecycle management observable ². Beta features introduce a new **NFTables backend** and support multiple service CIDRs, while alpha features expand dynamic resource allocation and device health reporting.

Key Enhancements and How to Use Them

1. AppArmor Support (GA)

AppArmor allows defining security profiles that limit system calls and capabilities for containers. To enable it:

```
apiVersion: v1
kind: Pod
metadata:
  name: secure-app
  annotations:
    container.apparmor.security.beta.kubernetes.io/secure-container:
localhost/docker-default
spec:
  containers:
  - name: secure-container
    image: myimage
```

- **Benefits:** Hardens workloads by restricting kernel operations. - **Pitfalls:** Profiles must be present on each node; mismatch leads to the runtime falling back to unconfined profile.

2. Improved Ingress Connectivity

Kube-proxy enhancements reduce downtime during upgrades and topology changes. No configuration change is required; ensure your nodes run Kubernetes 1.31 and verify that `Conntrack` timeouts and `iptables` timeouts are tuned appropriately.

3. Persistent Volume Transition Time

Kubernetes now records timestamps when a persistent volume claim (PVC) transitions between phases. Use `kubectl describe pvc` to view these events. This helps diagnose slow binding or provisioning issues.

4. Multiple Service CIDRs (Beta)

Define multiple `serviceCIDR` ranges in `kube-proxy` configuration to expand service IP space without downtime ³:

```
apiVersion: kubeproxy.config.k8s.io/v1beta1
kind: KubeProxyConfiguration
mode: "iptables"
serviceCIDR:
  - "10.96.0.0/16"
  - "10.97.0.0/16"
```

- **Benefits:** Allows dynamic scaling of service IPs and integration with Gateway API. - **Pitfalls:** Only available in beta; must enable the `ServiceIPStaticSubnets` feature gate.

5. NFTables Backend (Beta)

A new networking backend based on NFTables offers potentially faster rule processing and easier management. To enable: 1. Set `mode: nft` in the `KubeProxyConfiguration`. 2. Enable the feature gate: `KubeProxyIPTablesCleanup`. - **Caveats:** As a beta feature, it may not be suited for production clusters.

6. Deprecations

- **cgroup v1:** Now in maintenance mode; plan to migrate to cgroup v2.
- **CephFS volume plugin:** Removed. Use the CSI driver instead.

Migration Tips

- Review cluster configuration for deprecated features and enable feature gates for beta/alpha capabilities.
- Test AppArmor profiles in staging before applying to production.
- Monitor PVC transition times to identify storage bottlenecks.

Success Metrics

- Reduced downtime during upgrades.
- Improved security posture through AppArmor enforcement.
- Better capacity planning using multiple service CIDRs.

Sources

- Sysdig overview of Kubernetes 1.31 features ¹ ².
- Additional details on multiple service CIDR allocator ³.

¹ ² Kubernetes 1.31 Release: Key Features, Enhancements, and Deprecations
<https://cloudfleet.ai/blog/cloud-native-how-to/2024-08-kubernetes-1-31-release/>

3 Kubernetes 1.31 – What's new? | Sysdig

<https://www.sysdig.com/blog/whats-new-kubernetes-1-31>