KubeCon CloudNativeCon North America 2026

#KubeCon #CloudNativeCon

Binary Version Is Not Behavior

Skip-Level Kubernetes Control Plane Upgrades With KEP-4330

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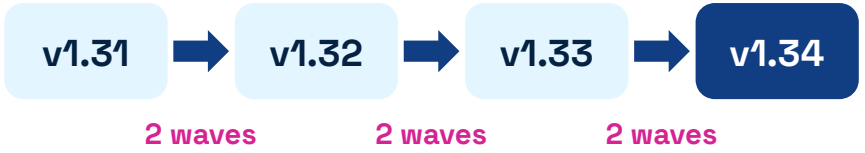
THE RESULT

v1.31 to v1.34 Across Production

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250+ CLUSTERS · ~500K NODES · ON-PREM

One minor at a time



6 fleet waves

40 business days

With emulated version



1 rollout + promotion

7 business days

Behavior Shipped With the Binary



Immediate GA Surface

New binary served promoted GA APIs immediately.



Asymmetric State Writes

Persisted state lacked downgrade guarantees.



Feature Gate Shifts

Default gate flips coincided with binary restart.

One restart. Three changes. No way to split them.

The Cost of One Minor at a Time

WAVE 1

apiservers, across the whole fleet



WAVE 2

controller-manager + scheduler

× 3 minors

= 6 waves

Why: the controller-manager and scheduler can't be newer than the apiserver they talk to.

```
upgrade time ≈ rollouts × ramps × (deploy + soak) ÷ daily window
```

Deploy Is Not Release

Applications

DEPLOY
Ship the new build dark

RELEASE
Turn behavior on with a flag

Control plane, before

DEPLOY
Restart on the new binary

RELEASE
Same restart, all at once.

Control plane, with KEP-4330

DEPLOY
New binary, with `--emulated-version` pinned

RELEASE
Raise `--emulated-version`

Multi-Release Control Plane Emulation via KEP-4330

New code, old behavior: gates and APIs follow the emulated version, not the binary.

Three-minor window: on v1.34, emulate as far back as v1.31.

No stepping rule: nothing requires stopping at v1.32 or v1.33.

Reversible soak: storage stays readable by the v1.31 binary.

```
kube-apiserver \
  --emulated-version=1.31

# Binary Version: v1.34.0
# Emulated API & Gates: v1.31
# Storage Versions: readable by v1.31
```

Operational Traps & Verification

Traps

New code still runs: canary it.

Deleted gates: prune them first, on the old binary.

Kubelets wait: until promotion.

No newer gates: statusz included.

Verification

`kubernetes_build_info` shows the binary only.

`version_info` shows the emulated version.

`kubernetes_feature_enabled` shows which gates are on.

Six Waves to One: Rollout & Rollback

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6 fleet waves → **2 fleet waves** → **1 rollout + promotion**

3 minors × 2 waves | one binary jump | no fleet-wide wait

40 → 7 business days

Phase	Binary	Emulated	Rollback
0. Gate sanitization	v1.31	v1.31	Manifest revert
1. Binary rollout & soak	**v1.34**	v1.31 (pinned)	**Binary downgrade**
2. Promotion	**v1.34**	**v1.34**	**Flag step-back, same binary**

What to Take Home

Separate binary from behavior

Pin it, roll it out, promote later.

Prune gates first

Before the binary swap.

Verify, don't assume

Emulated version, not build version.

EASY TO MISS AT PROMOTION

Removed APIs break at promotion

Zero the deprecated API metric first.

Alpha features aren't emulated

They behave as v1.34.

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Thank You & Questions



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