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Open Policy Agent (OPA) Intro, Deep Dive & 1.0 Update

Charlie Egan (@charlieegan3) – Styra
Rita Zhang (@ritazh) – Microsoft

What is Policy?

Policy defines allowed operations and controls system behaviors

- Authorize users & workloads based on organizational requirements
- Grant Kubernetes access to teams
- Implement API access controls
- Define dataset & filtering permissions
- Control actions taken by CI/CD jobs

What is Policy?

“Only currently on-call members of the support team can trigger deployments to production without review on the weekend.”

What is Policy as Code?

What is Policy?

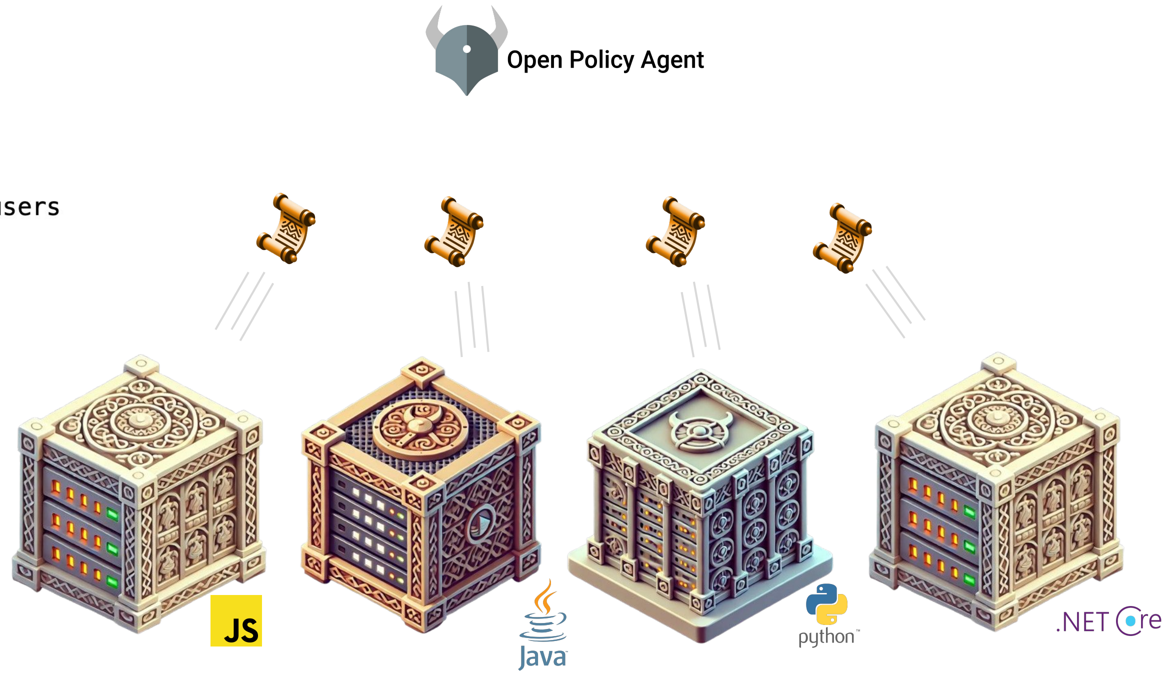
“Only c ntly on-call me bers of the supp t team can trigger dep oyments to prod ction witho review on he weeke d.”

What is Policy as Code?

```
package deployments.production

import rego.v1

default allow := false

allow if {
    is_weekend

    "support" in input.user.roles

    input.user.id in data.oncall_users
}

# ...
```

What is Policy as Code?

```
package deployments.production

import rego.v1

default allow := false

allow if {
    is_weekend

    "support" in input.user.roles

    input.user.id in data.oncall_users
}

# ...
```



Why does **Policy as Code** work?

Developers can focus on delivering business value

- Decouple policy decision logic from applications

Version controlled configurations aid rollbacks and audits

- Use code review to control changes and create versioned policy artefacts

Security settings can be shared and managed centrally

- Easily share and supplement organizational policies with team-specific rules

Code can be collaborated on, tested and statically analyzed

- Policy logic benefits from all the modern coding tools we have

What is Open Policy Agent ?

It's the building blocks of your Policy as Code Platform

What is OPA?

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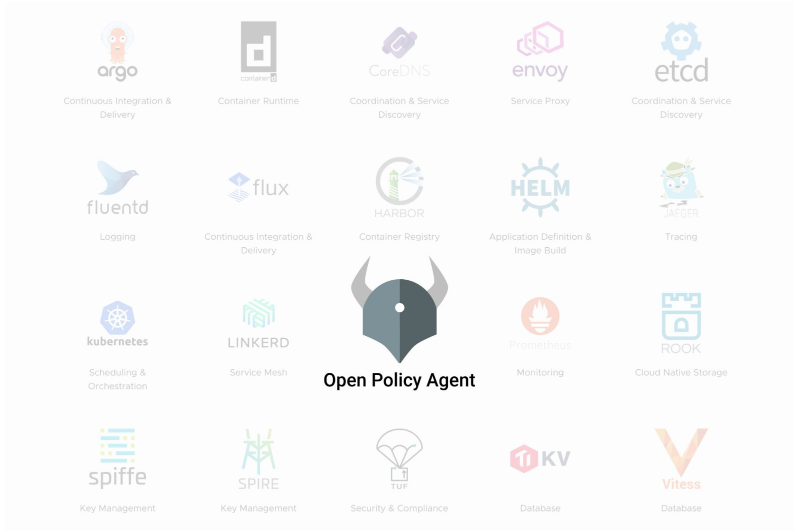
- Open source, general purpose policy engine
- Graduated CNCF project since January 2021
- Unified toolset and framework for working with policy across the stack
- Decouples policy from application logic
- Separates policy decision from enforcement
- Policies written in declarative language Rego



What is OPA?

Domain Specific Language for Policy

```
package example

import rego.v1

default allow := false

allow if user.role == "admin"
```

Rego

+

Policy Server

=

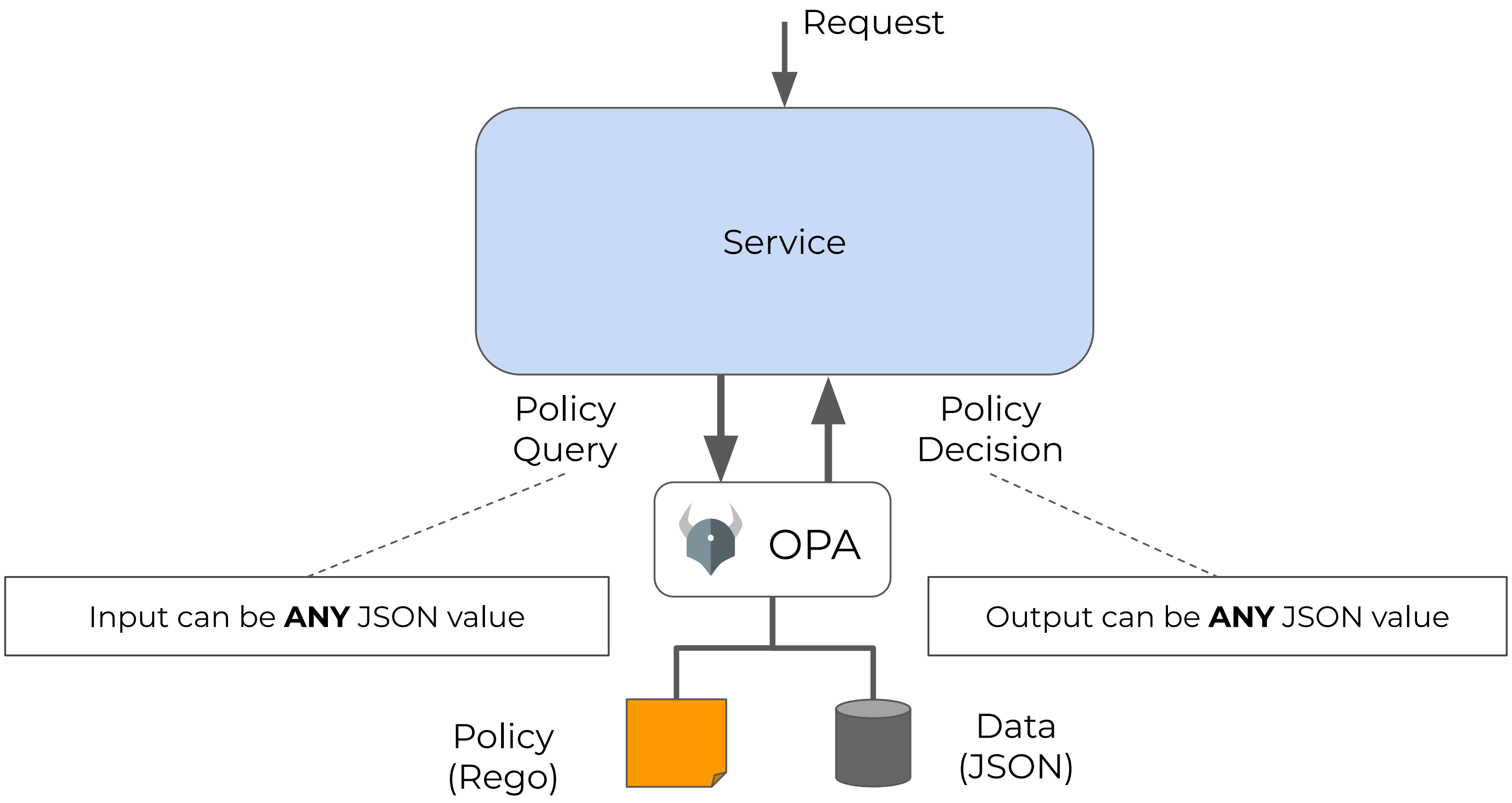
OPA!

APIs

- Policy Evaluation
- Policy Reloading
- Decision Logging

...

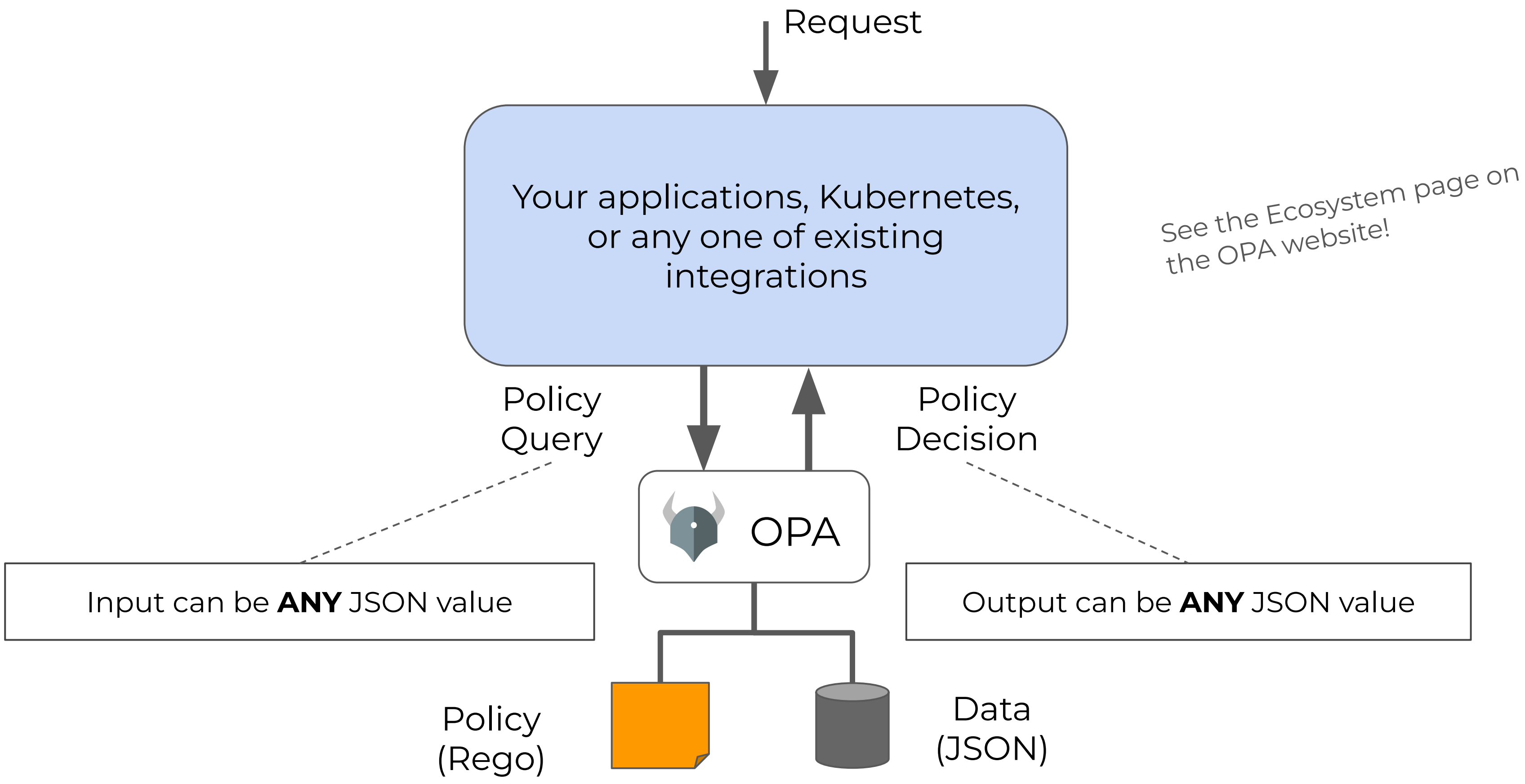
OPA's Decision Model



Input can be **ANY** JSON value

Output can be **ANY** JSON value

OPA's Decision Model


Request
Your applications, Kubernetes, or any one of existing integrations
Policy Query
Policy Decision
OPA
Input can be **ANY** JSON value
Output can be **ANY** JSON value
Policy (Rego)
Data (JSON)
See the Ecosystem page on the OPA website!

OPA’s Decision Model

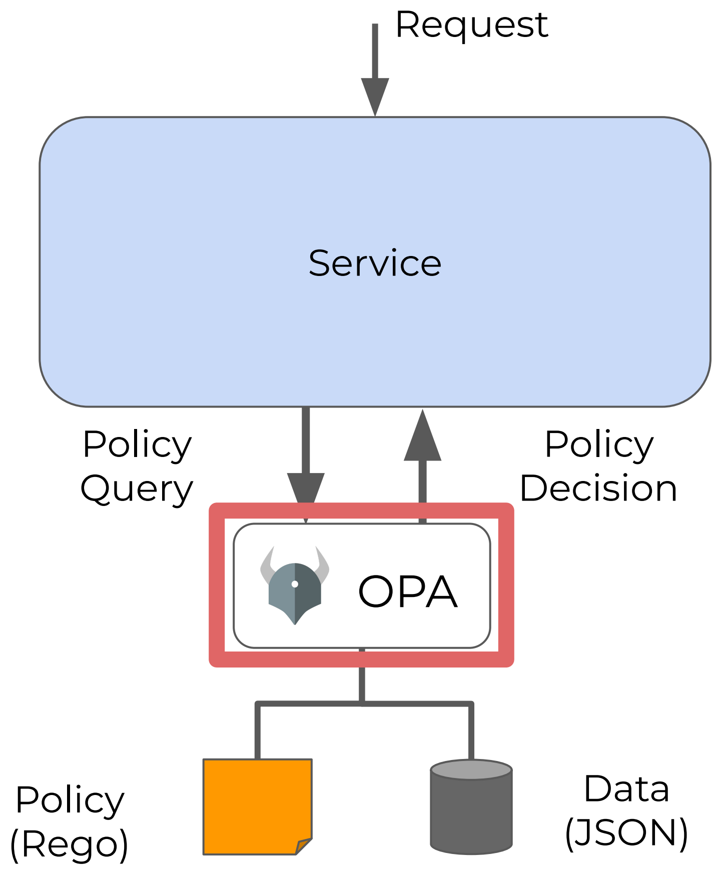
$$\begin{tikzcd} \text{Input} \arrow[r] & \text{Policy} \arrow[r] & \text{Decision} \end{tikzcd}$$

```
{
    "request": {
        "method": "PUT",
        "path": ["users", "anders"]
    },
    "user": {
        "name": "peter",
        "roles": [
            "developer"
        ]
    }
}
```

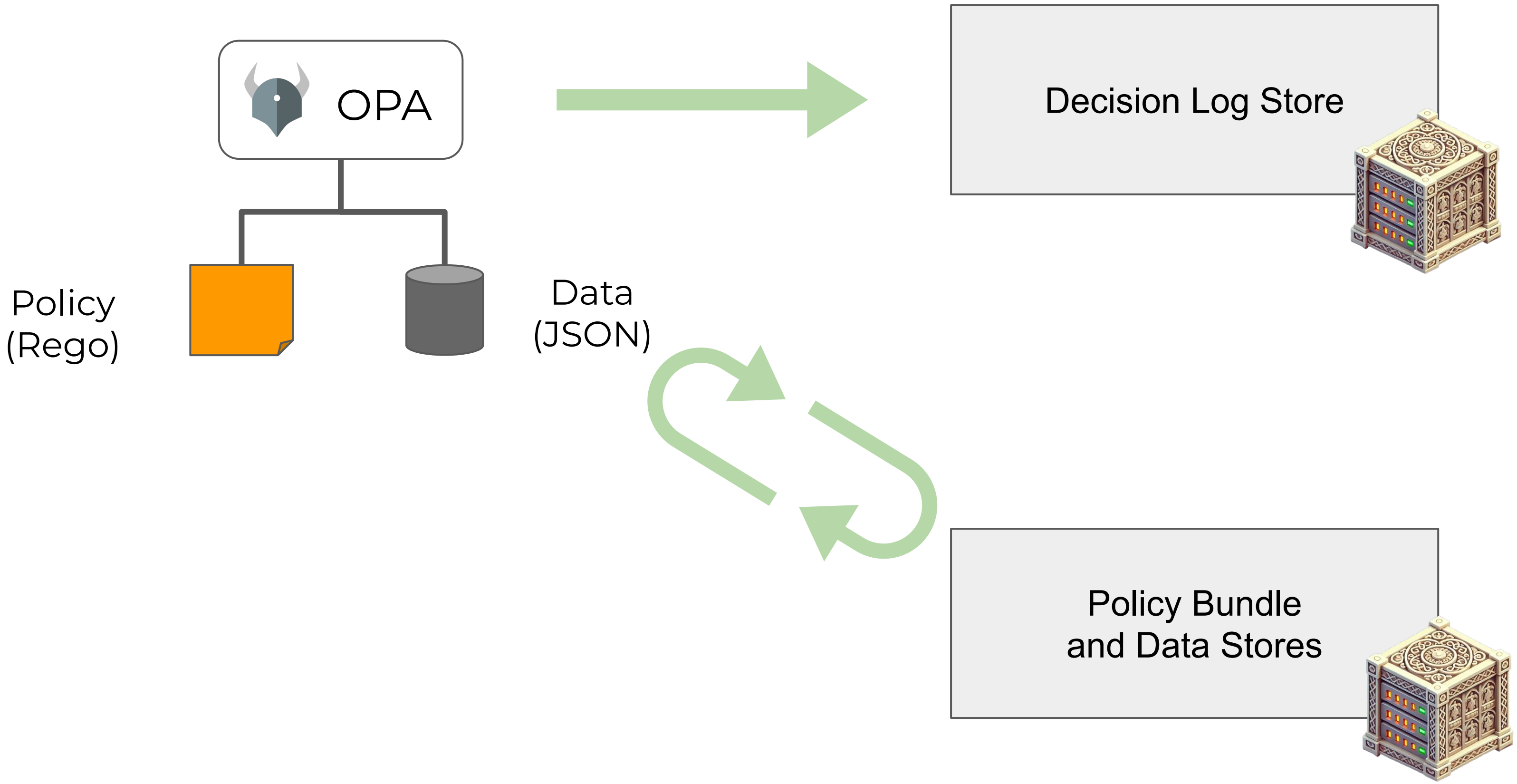
```
package policy

default allow := false

allow if "admin" in input.user.roles

allow if {
    input.request.method == "GET"
    input.request.path[0] == "users"
}

allow if {
    input.request.method == "PUT"
    input.request.path == ["users", input.user.name]
}
```

```
{
    "allow": false
}
```

OPA's Decision Model

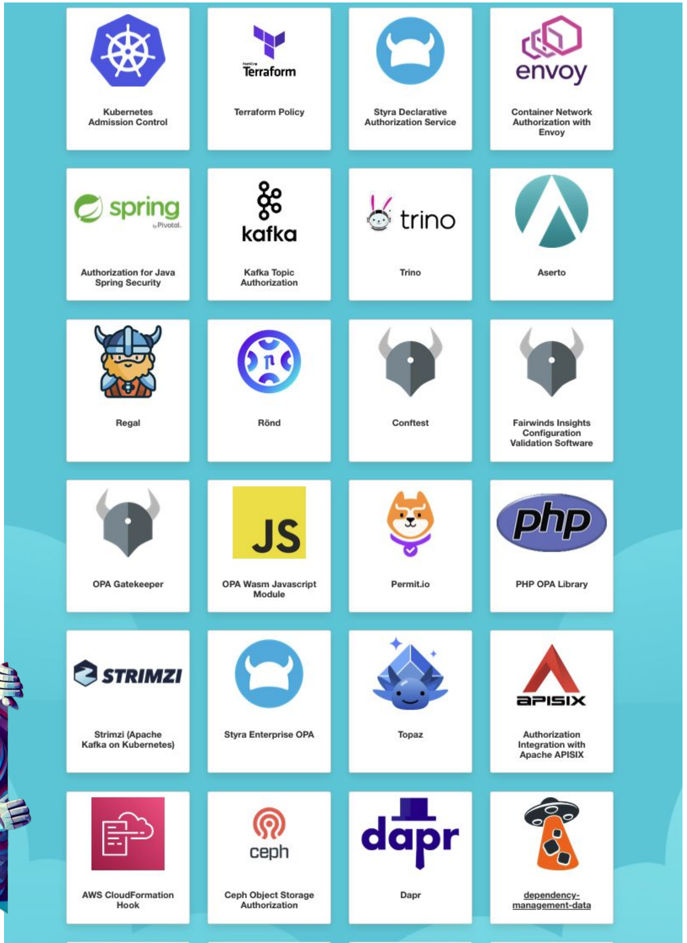


OPA's Responsibilities



OPA Community

- **Vibrant community** of users and contributors
- **100+** Integrations
- **9K+** GitHub Stars
- **8K+** Slack Users
- **Hundreds of millions** of downloads
- **OPA Gatekeeper, Conftest**
- **Editor integrations**


Terraform
Kubernetes Admission Control
Terraform Policy
Styra Declarative Authorization Service
Container Network Authorization with Envoy
spring
kafka
trino
Authorization for Java Spring Security
Kafka Topic Authorization
Trino
Aserto
Regal
Rönd
Conftest
Fairwinds Insights Configuration Validation Software
JS
php
OPA Gatekeeper
OPA Wasm Javascript Module
Permit.io
PHP OPA Library
STRIMZI
APISIX
Strimzi (Apache Kafka on Kubernetes)
Styra Enterprise OPA
Topaz
Authorization Integration with Apache APISIX
ceph
dapr
AWS CloudFormation Hook
Ceph Object Storage Authorization
Dapr
dependency-management-data

OPA Works!

“OPA provides us a generic way to apply policy consistently across all our services and systems”

Yao Weng, Bloomberg

(2024)

https://www.youtube.com/watch?v=zPRoybQm_d4

OPA 1.0

- **The target release date for OPA 1.0 is December 2nd!**
- Milestone release that consolidates OPA functionality for years to come.
- OPA 1.0 will still have a backwards compatible mode.

0.65.0 0.66.0 0.67.0 0.68.0 0.69.0 0.70.0 **1.0.0!**

OPA 1.0

Users will have two upgrade options:

- Update their Rego to be v1 compatible
  - Recommended for most users
  - We have CLI tools to make the process largely automatic

This presentation will show you how!

- Use the `--v0-compatible` functionality after upgrading
  - Recommended only for those running 3rd party Rego policies
  - Users are still encouraged to upgrade policies where possible
  - Come to the KubeCon Kiosk to discuss in detail

OPA 1.0

- The `if` and `contains` keywords will be mandatory
  - Resolve some ambiguities in the Rego language
- "Future" keywords become the new Rego v1 syntax
- Deprecated built-in functions will no longer work
- Many strict mode violations will be defaults
  - Duplicate imports are prohibited
  - `input` and `data` keywords are reserved
  - Use of deprecated functions is an error

https://www.openpolicyagent.org/docs/latest/opa-1/

OPA 1.0

Current OPA

```
package example

import future.keywords.every
import future.keyword.in

l := [1, 2, 3]

default allow := false

allow {
  count(violations) == 0
}

violations[msg] {
  every x in l {
    x > 0
  }
  msg := "no negative entries"
}

```

OPA 1.0

```
package example

l := [1, 2, 3]

default allow := false

allow if count(violations) == 0

violations contains "no negative entries" if every x in l {
    x > 0
}

```

Get ready today with

`import rego.v1`

https://www.openpolicyagent.org/docs/latest/opa-1/

OPA 1.0 - Get Your Rego Ready

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Step 1 `opa check`

- This will:
  - Find parse errors
  - Raise compilation errors

Checkout this OPA errors index for help if you get stuck!

OPA 1.0 - Get Your Rego Ready

Step 2 `opa check --strict`

- This will help you find:
  - Duplicate imports & Unused imports
  - Unused local assignments
  - Use of deprecated functions
  - Overriding reserved keywords input and data
- `check --strict` will exit early, run this until there are no more errors.
- Once you've done this you're nearly there!

OPA 1.0 - Get Your Rego Ready

Step 3 `opa fmt --write --rego-v1`

- This will re-write your Rego to use the v1 syntax

```
package app.authz

allow = count(deny) == 0

deny[message] {
    input.role != "admin"
    message := "You are not an admin"
}
```

```
package app.authz

import rego.v1

allow if count(deny) == 0

deny contains message if {
    input.role != "admin"
    message := "You are not an admin"
}
```

(You running `opa fmt`!)

OPA 1.0 - Get Your Rego Ready

Step 4 `regal lint`

- This will help you:
  - Identify bugs and mistakes
  - Find performance improvements
  - Write more consistent and idiomatic Rego

(You running `regal lint`!)

Regal docs CLI and other editors

https://marketplace.visualstudio.com/items?itemName=tsandall.opa

Regal comes with the OPA VS Code Extension!

Need Help?

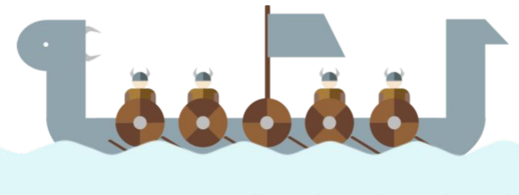
- The **#help** channel in the OPA slack is the best starting point for OPA help.
    - Use **#opa-gatekeeper** for GK queries
- You can also open discussions at github.com/orgs/open-policy-agent/discussions
- If you find a bug or have a feature request, open an issue! github.com/open-policy-agent/opa/issues/new

Read the “Renovating Rego” Blog

OPA Slack can be joined instantly at:
slack.openpolicyagent.org

OPA Use-Case: Kubernetes Admission Webhook

https:gatekeeper.sh



What's new in v3.17?

- K8sNativeValidation (CEL) engine is graduated to beta and enabled by default.
  - Use enable-k8s-native-validation feature flag to disable.
- Kubernetes Validating Admission Policy (VAP) generation is alpha!
  - Use `default-create-vap-for-templates` and `default-create-vap-binding-for-constraints` flags to enable generation.
- Turn on and off specific action for Gatekeeper: webhook, audit, gator, or VAP in the same constraint
  - scopedEnforcementActions
- Validation of CONNECT operations.

What's new in v3.17?

VAP included as `enforcementPoint`

```yaml
apiVersion:
constraints.gatekeeper.sh/v1beta1
kind: K8sRequiredLabels
metadata:
  name: ns-must-have-gk
Spec:
  enforcementAction: deny
```

```yaml
apiVersion: constraints.gatekeeper.sh/v1beta1
kind: K8sRequiredLabels
metadata:
  name: ns-must-have-gk
Spec:
  enforcementAction: scoped
  scopedEnforcementActions:
    - action: deny
      enforcementPoints:
      - name: vap.k8s.io
      - name: gator.gatekeeper.sh
      - name: audit.gatekeeper.sh
```

What's new in v3.17?

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Generating VAP has transitioned from an annotation to a field under `K8sNativeValidation` engine.

```yaml
targets:
    - target: admission.k8s.gatekeeper.sh
      code:
        - engine: K8sNativeValidation
          source:
            generateVAP: true
            validations:
            - expression: '[object, oldObject].exists(obj, obj != null &&
has(obj.metadata) && variables.params.labels.all(entry, has(obj.metadata.labels) &&
entry.key in obj.metadata.labels))'
              messageExpression: '"missing required label, requires all of: " +
variables.params.labels.map(entry, entry.key).join(", ")'
```

Demo

Checkout demo with VAP enforcement point

https://qr-codes.io/Qu5Gap

What’s coming in v3.18?

- K8sNativeValidation (CEL) engine is GA.
    - Use enable-k8s-native-validation feature flag to disable.
- Added wait for VAPB generation
- gator sync test
- gator verify now supports ExpansionTemplates
- operation=generate is added to isolate and run generation processes for CRDs and VAPs as a singleton pod
    - Set --operation=generate on a singleton pod, e.g. as part of the audit pod.
- Gatekeeper Config resource reports error through status

What's coming in v3.18?

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Support for `ExpansionTemplate` in gator verify

```yaml
apiVersion: test.gatekeeper.sh/v1alpha1
kind: Suite
tests:
- name: foo-is-bar-expansion
  template: template.yaml
  constraint: constraint.yaml
  expansion: expansion.yaml
  ...
```

```yaml
apiVersion: expansion.gatekeeper.sh/v1alpha1
kind: ExpansionTemplate
metadata:
  name: expand-foo
spec:
  applyTo:
  - groups: [ "apps" ]
    kinds: [ "Deployment" ]
    versions: [ "v1" ]
  templateSource: "spec.template"
  generatedGVK:
    kind: "Pod"
    group: ""
    version: "v1"
```

CEL Library

Check out gatekeeper policy library with CEL rules

https://qr-codes.io/8KGclv

Questions & Feedback

Please ask questions!

You can also come to the OPA Kiosk **(11A)** in the **Project Pavillion**

(tomorrow until 14:00)

View these slides

Please leave feedback about this session so we can improve for the next OPA talk at **KubeCon London**!