

7 июня 2023 📍 Москва, МЦК ЗИЛ

# БЕКОН<sup>23</sup>

Первая в России конференция  
по БЕзопасности КОНтейнеров и контейнерных сред

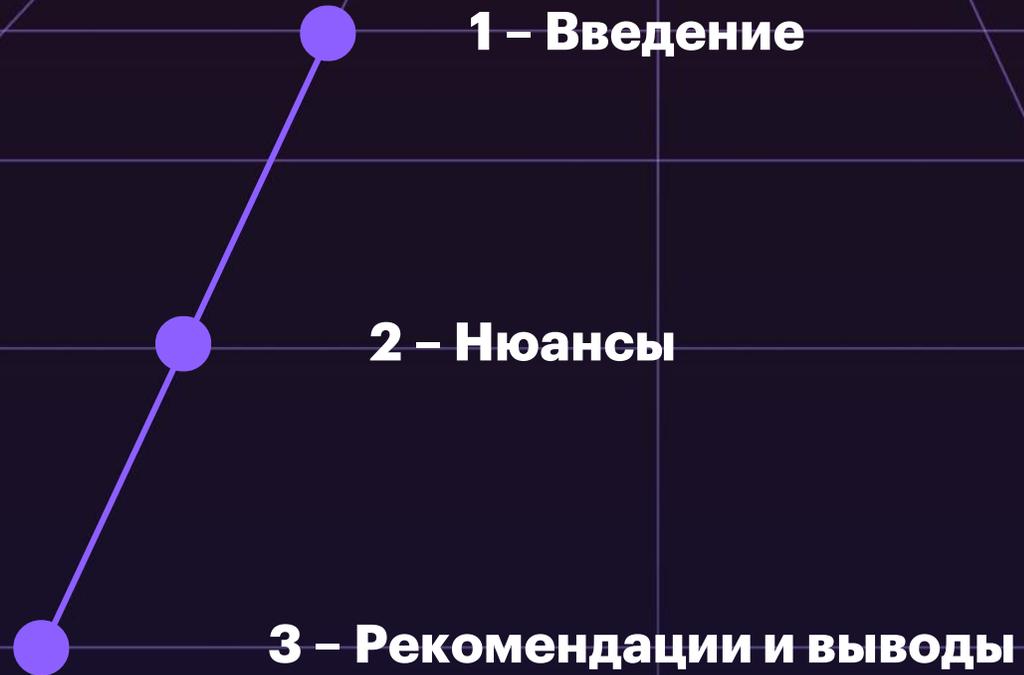
# Не такой очевидный RBAC Kubernetes

Дмитрий Евдокимов

Founder&CTO Luntry

- Основатель и технический директор [Luntry](#)
- Опыт в ИБ более 10 лет
- CFP DevOpsConf
- Бывший автор статей и редактор рубрик в журнале «ХАКЕР»
- Автор Telegram-канала [📩 «k8s \(in\)security»](#)
- Автор курса «Cloud Native безопасность в Kubernetes»
- Не верит, что систему можно сделать надежной и безопасной, не понимая ее
- Докладчик: BlackHat, HITB, ZeroNights, HackInParis, Confidence, SAS, OFFZONE, PHDays, Kazhackstan, DevOpsConf, KuberConf, VK Kubernetes Conference, HighLoad++ и др.





# Введение

## Role Based Access Control

# RBAC с высоты птичьего полета

## От аутентификации к авторизации



## Механизмы

### Механизмы авторизации

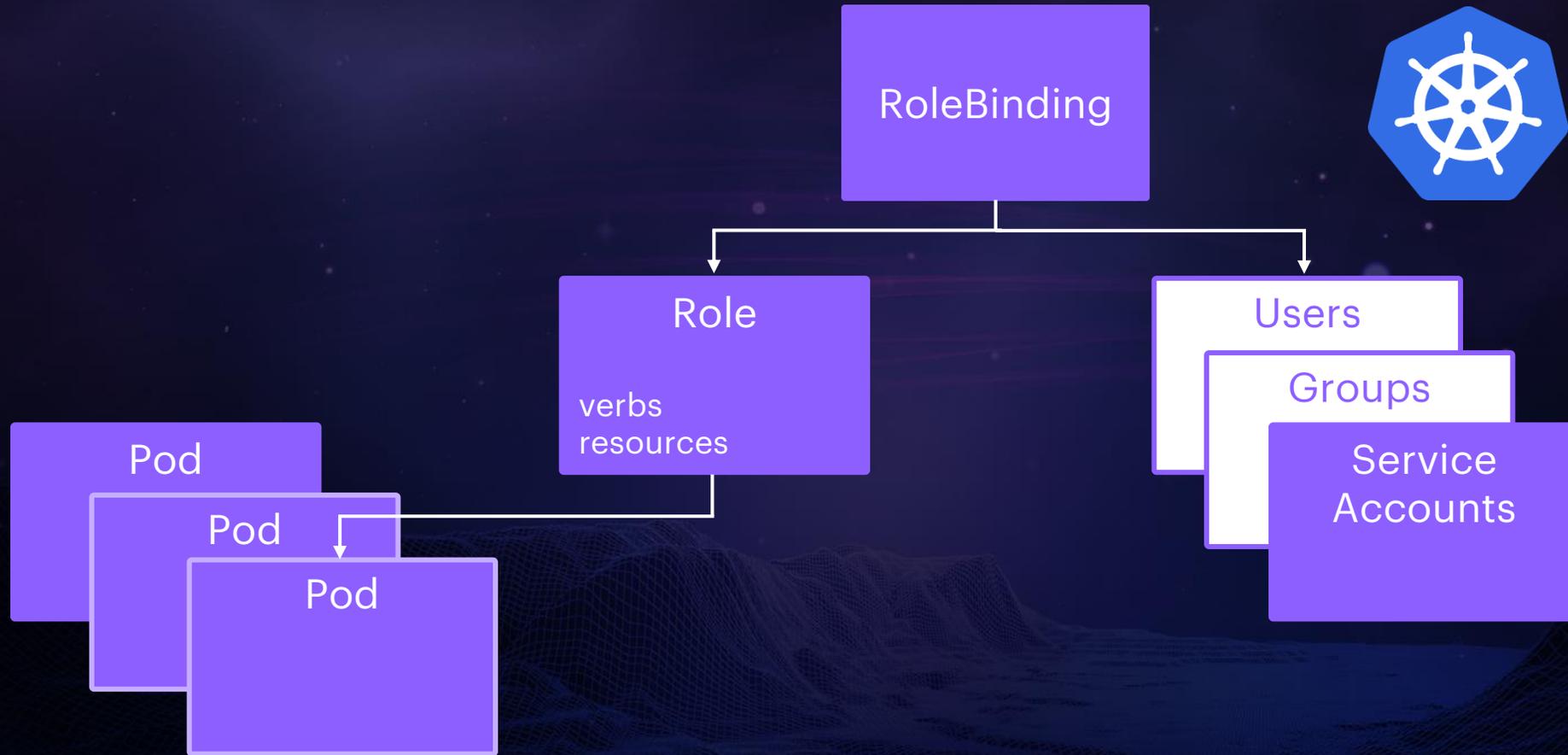
Механизм	Источник решения
Node	Встроено в API Server
ABAC	Статичный файл
RBAC	API ресурс
WebHook	Сторонний сервис
AlwaysDeny AlwaysAllow	Встроено в API Server

# RWAS с высоты птичьего полета

## Субъект, объект, операция



## Назначение прав



## Пример Role и RoleBinding

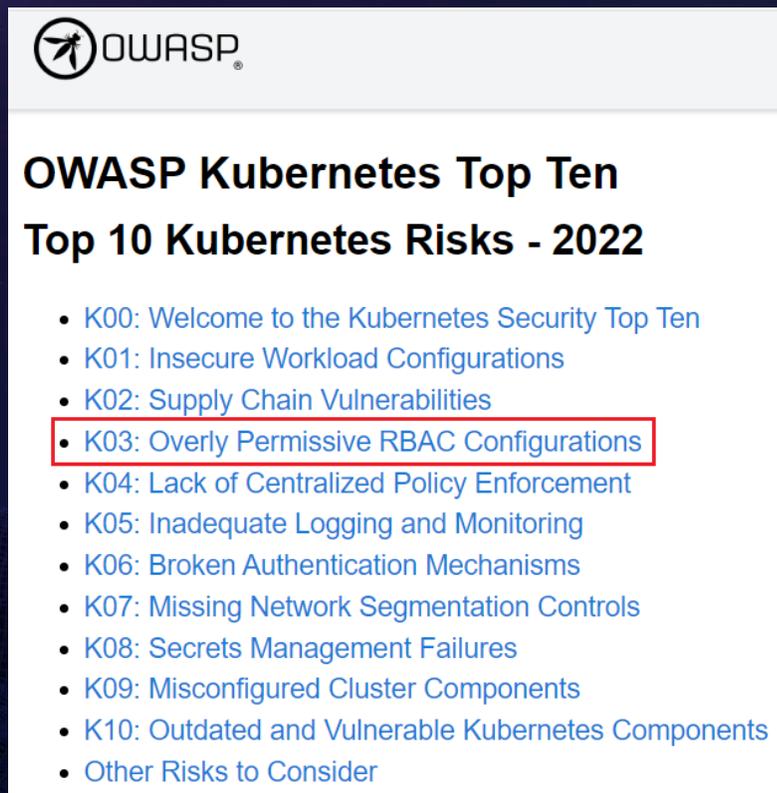
```
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  namespace: default
  name: pod-reader
rules:
- apiGroups: [""]
  resources: ["pods"]
  verbs: ["get", "watch", "list"]

apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: read-pods
  namespace: default
subjects:
- kind: User
  name: jane
  apiGroup: rbac.authorization.k8s.io
roleRef:
  kind: Role
  name: pod-reader
  apiGroup: rbac.authorization.k8s.io
```

# Проводите аудит RBAC?

Опасные права можно использовать для следующих атак:

- Манипулирование AuN/AuZ
- Получение токенов
- RCE
- Кража Pods
- Meddler-in-the-Middle

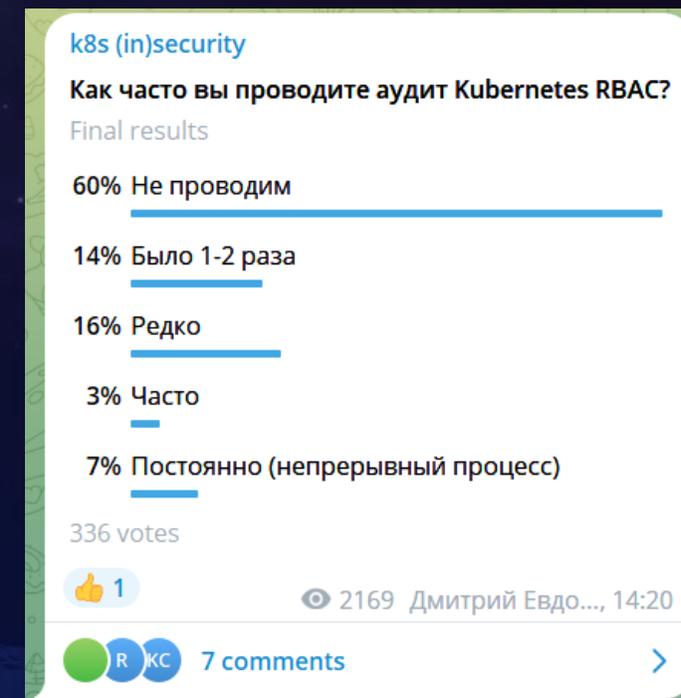


OWASP

## OWASP Kubernetes Top Ten

### Top 10 Kubernetes Risks - 2022

- K00: Welcome to the Kubernetes Security Top Ten
- K01: Insecure Workload Configurations
- K02: Supply Chain Vulnerabilities
- **K03: Overly Permissive RBAC Configurations**
- K04: Lack of Centralized Policy Enforcement
- K05: Inadequate Logging and Monitoring
- K06: Broken Authentication Mechanisms
- K07: Missing Network Segmentation Controls
- K08: Secrets Management Failures
- K09: Misconfigured Cluster Components
- K10: Outdated and Vulnerable Kubernetes Components
- Other Risks to Consider



Источник

# Пример: RBAC от ArgoCD и Flux

В системе могут появляться опасные Role/ClusterRole

В системе могут появляться RoleBinding/ClusterRoleBinding на стандартные Role/ClusterRole с опасными правами

```
apiVersion: rbac.authorization.k8s.io/v1beta1
kind: ClusterRole
metadata:
  labels:
    name: flux
  name: flux
rules:
- apiGroups: ['*']
  resources: ['*']
  verbs: ['*']
- nonResourceURLs: ['*']
  verbs: ['*']
```

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  labels:
    app.kubernetes.io/name: argocd-application-controller
    app.kubernetes.io/part-of: argocd
    app.kubernetes.io/component: application-controller
  name: argocd-application-controller
rules:
- apiGroups:
  - '*'
  resources:
  - '*'
  verbs:
  - '*'
- nonResourceURLs:
  - '*'
  verbs:
  - '*'
```

# Нюансы

## Role Based Access Control

# Нюанс 1: Встроенные сущности

- Встроенные сущности описаны в [коде](#): /plugin/pkg/auth/authorizer/rbac/bootstrappolicy/policy.go
- `kubectl get roles,rolebindings,clusterroles,clusterrolebindings -A -l kubernetes.io/bootstrapping=rbac-defaults`

	1.16.15	1.22.17	1.27.2
Role	7	7	7
RoleBinding	7	7	7
ClusterRole	53	62	62
ClusterRoleBinding	36	43	43

```
// ClusterRoles returns the cluster roles to bootstrap an API server with
func ClusterRoles() []rbacv1.ClusterRole {
    roles := []rbacv1.ClusterRole{
        {
            // a "root" role which can do absolutely anything
            ObjectMeta: metav1.ObjectMeta{Name: "cluster-admin"},
            Rules: []rbacv1.PolicyRule{
                rbacv1helpers.NewRule("").Groups("").Resources("").RuleOrDie(),
                rbacv1helpers.NewRule("").URLs("").RuleOrDie(),
            },
        },
    }
}
```

```
~/Documents kubectl get roles,rolebindings,clusterroles,clusterrolebindings -A -l kubernetes.io/bootstrapping=rbac-defaults
NAMESPACE NAME CREATED AT
kube-public role.rbac.authorization.k8s.io/system:controller:bootstrap-signer 2023-01-30T12:48:13Z
kube-system role.rbac.authorization.k8s.io/extension-apiserver-authentication-reader 2023-01-30T12:48:13Z
kube-system role.rbac.authorization.k8s.io/system:leader-locking-kube-controller-manager 2023-01-30T12:48:13Z
kube-system role.rbac.authorization.k8s.io/system:leader-locking-kube-scheduler 2023-01-30T12:48:13Z
kube-system role.rbac.authorization.k8s.io/system:controller:bootstrap-signer 2023-01-30T12:48:13Z
kube-system role.rbac.authorization.k8s.io/system:controller:cloud-provider 2023-01-30T12:48:13Z
kube-system role.rbac.authorization.k8s.io/system:controller:token-cleaner 2023-01-30T12:48:13Z

NAMESPACE AGE NAME ROLE
kube-public 4h20m rolebinding.rbac.authorization.k8s.io/system:controller:bootstrap-signer Role/system:controller:bootstrap-signer
kube-system 4h20m rolebinding.rbac.authorization.k8s.io/system:extension-apiserver-authentication-reader Role/extension-apiserver-authentication-read
er
kube-system 4h20m rolebinding.rbac.authorization.k8s.io/system:leader-locking-kube-controller-manager Role/system:leader-locking-kube-controller-
manager
kube-system 4h20m rolebinding.rbac.authorization.k8s.io/system:leader-locking-kube-scheduler Role/system:leader-locking-kube-scheduler
kube-system 4h20m rolebinding.rbac.authorization.k8s.io/system:controller:bootstrap-signer Role/system:controller:bootstrap-signer
kube-system 4h20m rolebinding.rbac.authorization.k8s.io/system:controller:cloud-provider Role/system:controller:cloud-provider
kube-system 4h20m rolebinding.rbac.authorization.k8s.io/system:controller:token-cleaner Role/system:controller:token-cleaner

NAMESPACE NAME CREATED AT
clusterrole.rbac.authorization.k8s.io/admin 2023-01-30T12:48:13Z
clusterrole.rbac.authorization.k8s.io/cluster-admin 2023-01-30T12:48:13Z
clusterrole.rbac.authorization.k8s.io/edit 2023-01-30T12:48:13Z
clusterrole.rbac.authorization.k8s.io/system:aggregate-to-admin 2023-01-30T12:48:13Z
```

# Нюанс 2: Аддитивная природа прав

- Права в системе можно только добавлять
- Забирать/ограничивать можно через PolicyEngine
- Реальные/полные права субъекта можно увидеть только в Runtime — в процессе выкатки YAML мы видим только конкретный YAML



# Нюанс 3: Бесконечные глаголы

- Нет фиксированного списка verbs
- Существуют virtual verbs
  - use
  - bind
  - sign
  - proxy
  - escalate
  - impersonate
  - userextras
- Если вы допустите опечатку, ничего не сломается!
- Можно создавать свои права доступа (verbs) ;)
- Пример: [“RBAC Virtual Verbs: Teaching Kubernetes to Educate Dolphins”](#)

HTTP verb	request verb
POST	create
GET, HEAD	get (for individual resources), list (for collections, including full object content), watch (for watching an individual resource or collection of resources)
PUT	update
PATCH	patch
DELETE	delete (for individual resources), deletecollection (for collections)

Kubernetes sometimes checks authorization for additional permissions using specialized verbs. For example:

- **PodSecurityPolicy**
  - use verb on podsecuritypolicies resources in the policy API group.
- **RBAC**
  - bind and escalate verbs on roles and clusterroles resources in the rbac.authorization.k8s.io API group.
- **Authentication**
  - impersonate verb on users, groups, and serviceaccounts in the core API group, and the userextras in the authentication.k8s.io API group.

[ИСТОЧНИК](#)

## Доступ без GET

```
~ kubectl get secret --token $TOKEN -o json | jq -r '.items[] | select(.metadata.name=="ultra-secret-string")'
{
  "apiVersion": "v1",
  "data": {
    "mysecret": "a3ViZXJuZXRlcyBMSVNUIHZlcmIgaXMgYSBsaWU="
  },
  "kind": "Secret",
  ...
}
```

["When LIST is a Lie in Kubernetes"](#)

### Listing secrets

It is generally clear that allowing `get` access on Secrets will allow a user to read their contents. It is also important to note that `list` and `watch` access also effectively allow for users to reveal the Secret contents. For example, when a List response is returned (for example, via `kubectl get secrets -A -o yaml`), the response includes the contents of all Secrets.

[Документация Kubernetes](#)

# Нюанс 5: Subresources, несуществующие ресурсы

```
ubuntu@ip-172-31-40-152:~$ kubectl api-resources
NAME                SHORTNAMES  APIVERSION          NAMESPACED  KIND
bindings            cs          v1                  true         Binding
componentstatuses   cs          v1                  false        ComponentStatus
configmaps           cm          v1                  true         ConfigMap
endpoints            ep          v1                  true         Endpoints
events              ev          v1                  true         Event
limitranges         limits      v1                  true         LimitRange
namespaces           ns          v1                  false        Namespace
nodes               no          v1                  false        Node
persistentvolumeclaims  pvc        v1                  true         PersistentVolumeClaim
persistentvolumes    pv          v1                  false        PersistentVolume
pods                po          v1                  true         Pod
podtemplates        pt          v1                  true         PodTemplate
replicationcontrollers  rc          v1                  true         ReplicationController
resourcequotas       rq          v1                  true         ResourceQuota
secrets             sec          v1                  true         Secret
serviceaccounts      sa          v1                  true         ServiceAccount
services            svc          v1                  true         Service
mutatingwebhookconfigurations  admissionregistration.k8s.io/v1  false        MutatingWebhookConfiguration
validatingwebhookconfigurations  admissionregistration.k8s.io/v1  false        ValidatingWebhookConfiguration
customresourcedefinitions  crd,crds  apiextensions.k8s.io/v1  false        CustomResourceDefinition
apiservices          api         apiregistration.k8s.io/v1  false        APIService
controllerrevisions  cr          apps/v1             true         ControllerRevision
daemonsets           ds          apps/v1             true         DaemonSet
deployments          deploy     apps/v1             true         Deployment
replicasets          rs          apps/v1             true         ReplicaSet
statefulsets         sts          apps/v1             true         StatefulSet
tokenreviews          tr          authentication.k8s.io/v1  false        TokenReview
```

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: edit
rules:
- apiGroups:
  - ""
  resources:
  - pods
  - pods/attach
  - pods/exec
  - pods/portforward
  - pods/proxy
  verbs:
  - create
  - delete
  - deletecollection
  - patch
  - update
```

# Получаем все subresources

- Простенький [скрипт](#)
- В 1.27.2 есть 41 subresources

```
#!/bin/bash

list=$(kubectl get --raw / |grep "^ \"/api"|sed 's/[",,]//g');
for _api in ${list[@]}; do
  _aruyo=$(kubectl get --raw $_api | jq .resources);
  if [ "x${_aruyo}" != "xnull" ]; then
    echo;
    echo "===${_api}===";
    kubectl get --raw $_api | jq -r ".resources[].name";
  fi;
done
```

```
namespaces/finalize
namespaces/status
nodes/proxy
nodes/status
persistentvolumeclaims/status
persistentvolumes/status
pods/attach
pods/binding
pods/ephemeralcontainers
pods/eviction
pods/exec
pods/log
pods/portforward
pods/proxy
pods/status
replicationcontrollers/scale
replicationcontrollers/status
resourcequotas/status
serviceaccounts/token
services/proxy
services/status
customresourcedefinitions/status
```

```
apiservices/status
daemonsets/status
deployments/scale
deployments/status
replicasets/scale
replicasets/status
statefulsets/scale
statefulsets/status
horizontalpodautoscalers/status
cronjobs/status
jobs/status
certificatesigningrequests/approval
certificatesigningrequests/status
flowschemas/status
prioritylevelconfigurations/status
ingresses/status
networkpolicies/status
poddisruptionbudgets/status
volumeattachments/status
```

```
C:\Users\d.evdokimov\Documents>kubectl.exe --kubeconfig=config127 get clusterroles system:certificates.k8s.io:legacy-unknown-approver -ojson
{
  "apiVersion": "rbac.authorization.k8s.io/v1",
  "kind": "ClusterRole",
  "metadata": {
    "annotations": {
      "rbac.authorization.kubernetes.io/autoupdate": "true"
    },
    "creationTimestamp": "2023-05-26T12:00:28Z",
    "labels": {
      "kubernetes.io/bootstrapping": "rbac-defaults"
    },
    "name": "system:certificates.k8s.io:legacy-unknown-approver",
    "resourceVersion": "147",
    "uid": "3c475c99-7f19-447a-8660-726e6c2a497f"
  },
  "rules": [
    {
      "apiGroups": [
        "certificates.k8s.io"
      ],
      "resourceNames": [
        "kubernetes.io/legacy-unknown"
      ],
      "resources": [
        "signers"
      ],
      "verbs": [
        "approve"
      ]
    }
  ]
}
```



# Нюанс 7: Aggregated ClusterRoles

Есть 3 встроенные роли (на момент 1.27.2):

- admin
- edit
- view

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: monitoring
aggregationRule:
  clusterRoleSelectors:
  - matchLabels:
      kubernetes.io/bootstrapping: "rbac-defaults"
rules: [] # The control plane automatically fills in the rules
```

```
C:\Users\d.evdokimov\Documents>kubectl.exe --kubeconfig=config_RBAC describe clusterrole monitoring
```

Name:	monitoring		
Labels:	<none>		
Annotations:	<none>		
PolicyRule:			
Resources	Non-Resource URLs	Resource Names	Verbs
*****	*****	*****	*****
*.*	[]	[]	[* delete get list patch update watch deletecollection]
	[*]	[]	[*]
nodes/log	[]	[]	[*]
nodes/metrics	[]	[]	[*]
nodes/proxy	[]	[]	[*]
nodes/stats	[]	[]	[*]
signers.certificates.k8s.io	[]	[kubernetes.io/kube-apiserver-client-kubelet]	[approve sign]
signers.certificates.k8s.io	[]	[kubernetes.io/kube-apiserver-client]	[approve sign]
signers.certificates.k8s.io	[]	[kubernetes.io/kubelet-serving]	[approve sign]
signers.certificates.k8s.io	[]	[kubernetes.io/legacy-unknown]	[approve sign]
leases.coordination.k8s.io	[]	[]	[create delete deletecollection get list patch update watch]
rolebindings.rbac.authorization.k8s.io	[]	[]	[create delete deletecollection get list patch update watch]
roles.rbac.authorization.k8s.io	[]	[]	[create delete deletecollection get list patch update watch]
configmaps	[]	[]	[create delete deletecollection patch update get list watch]
events	[]	[]	[create delete deletecollection patch update get list watch]
persistentvolumeclaims	[]	[]	[create delete deletecollection patch update get list watch]
Pods	[]	[]	[create delete deletecollection patch update get list watch]
replicationcontrollers/scale	[]	[]	[create delete deletecollection patch update get list watch]
replicationcontrollers	[]	[]	[create delete deletecollection patch update get list watch]

- Политики Kyverno для работы с сущностями RBAC <https://kyverno.io/policies/?policytypes=RBAC> (11 штук)
- Наша политика для контроля ролей с aggregationRule:

```
apiVersion: kyverno.io/v1
kind: ClusterPolicy
metadata:
  name: disallow-clusterrole-aggregationrule
spec:
  validationFailureAction: Enforce
  rules:
    - name: check-clusterrole-aggregationrule
      match:
        resources:
          kinds:
            - ClusterRole
      validate:
        message: "Creation of ClusterRoles with aggregationRule is not allowed."
        pattern:
          X(aggregationRule): "null"
```

# Нюанс 8: Свой RBAC поверх стандартного

["Least-Privilege Kubernetes Authorization with OPA"](#) - Charlie Cetin, Daniel Popescu, & Quentin Long

## Least-Privilege Kubernetes Authorization with OPA

Charlie Cetin  
Daniel Popescu  
Quentin Long

# Рекомендации и выводы

## Role Based Access Control

- Всегда изучайте то, что и с какими правами ставите в кластер
- Используйте Kubernetes Audit Log
- Используйте политики Policy Engine для ресурсов RBAC
- Используйте мощь и гибкость Kubernetes

- RBAC Kubernetes простой только с виду и имеет много неочевидных моментов
- Из-за проблем с RBAC нанести вред системе куда проще, чем через уязвимость сервиса
- Контролировать RBAC необходимо постоянно/непрерывно
- Благодаря декларативной природе Kubernetes и расширению через Kubernetes operators можно сделать более гибкую систему авторизации

- [“RBAC to the Future: Untangling Authorization in Kubernetes”](#) – Jimmy Mesta, KubeCon+CloudNativeCon 2023
- [“Cracking Kubernetes RBAC Authorization \(AuthZ\) Model \(2022\)”](#) – Arthur Chiao, Blog
- [“Assign permissions to an user in Kubernetes. An overview of RBAC-based AuthZ in k8s”](#) – Federico Carbonetti
- [“Kubernetes Privilege Escalation: Excessive Permissions in Popular Platforms”](#) – Yuval Avraham, Shaul Ben Hai
- [“Role Based Access Control Good Practices”](#) – Kubernetes documentation
- [“RBAC”](#) – unofficial Kubernetes documentation
- [“Kubernetes RBAC 101”](#) – Oleg Chunikhin
- [rbac.dev](#) – github rep

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# БЕИКОИЧ

The title 'БЕИКОИЧ' is rendered in a large, blue, outlined font. The letter 'О' is replaced by a blue octagonal frame containing the LUNTRY logo, which consists of a stylized 'L' and the word 'LUNTRY'.

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