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Europe 2023

SIG-Auth Deep Dive

David Eads (Red Hat), Jordan Liggitt (Google), Rita Zhang (Microsoft)

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SIG-Auth Deep Dive

David Eads, Red Hat
Jordan Liggitt, Google
Rita Zhang, Microsoft

SIG-Auth

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What do we do?

SIG-Auth is responsible for features in Kubernetes that control and **protect access** to the API and other core components. This includes **authentication** and **authorization**, but also encompasses features like **auditing** and some **security policy**.

https://github.com/kubernetes/community/blob/master/sig-auth/charter.md

SIG-Auth

Sub-Projects

- Audit Logging
- Authenticators
- Authorizers
- Certificates
- Encryption at rest
- Multi Tenancy
- Node Identity and Isolation
- Policy Management
- Service Accounts
- Secrets Store CSI Driver

Enhancements

Stable

- 2799 Reduce legacy service account token attack surface area
  - Stop auto-generating legacy tokens (beta v1.24, stable v1.26)

Implementable

- 2799 Reduce legacy service account token attack surface area
  - Track use of legacy tokens (beta v1.27, targeting stable v1.28)
  - Clean up unused legacy tokens (targeting alpha v1.28)
- 3325 API to get current user attributes, `kubectl whoami` (beta v1.27, targeting stable v1.28)
- 3299 KMS v2 encryption at rest (beta v1.27, targeting stable v1.29)
- 3257 Cluster Trust Bundles (API alpha in v1.27, targeting volume mount alpha in v1.28)

Provisional

- 3221 Structured Authorization Configuration (in design, targeting alpha v1.28)
- 3331 Structured OIDC Configuration (in design, targeting alpha v1.28)
- 3766 ReferenceGrant (in design)
- 2718 Client Exec Proxy (in design)

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Graduating Enhancements

Legacy Token Reduction

KEP-2799

Move away from long lived secret based SA tokens
Use ephemeral tokens via the token request API instead

- In v1.24+, secret based tokens default to not being auto-generated (**LegacyServiceAccountTokenNoAutoGeneration**
- In v1.26, feature is stable

Implementable Enhancements

Legacy Token Reduction

KEP-2799

Move away from long lived secret based SA tokens
Use ephemeral tokens via the token request API instead

- v1.26: **LegacyServiceAccountTokenTracking** alpha feature gate
  - Use of auto-generated secret based tokens emits warnings
  - Use of secret based tokens labels the secret with the last used date
- v1.27: **LegacyServiceAccountTokenTracking** feature is beta
- v1.28: Targeting alpha of cleanup of unused auto-generated token secrets

SelfSubjectReview

KEP-3325 - Beta in v1.27, targeting stable in v1.28

```
kubectl auth whoami -o json

{
    "kind": "SelfSubjectReview",
    "apiVersion": "authentication.k8s.io/v1beta1",
    "metadata": {
        "creationTimestamp": "2023-04-21T17:05:55Z"
    },
    "status": {
        "userInfo": {
            "username": "alice",
            "groups": [
                "system:authenticated"
            ]
        }
    }
}

--runtime-config=authentication.k8s.io/v1beta1=true
--feature-gates=APISelfSubjectReview=true
```

Encryption at Rest Improvements - v1 & v2

- Change algorithm for KMS data encryption to AES-GCM. No user action required.
  - v1.25: KMS v1 write using AES-GCM, read AES-GCM with fallback to AES-CBC
  - KMS v2 only allows AES-GCM
- Dynamic reload of *EncryptionConfiguration* file - v1.26
  - Does not require a kube-apiserver restart
- Custom resource encryption - v1.26
  - Add custom resources to *EncryptionConfiguration*
- Encrypt all resources - v1.27
  - `*.*` to encrypt all resources in all groups
    `*.<group>` to encrypt all resources in one group

```yaml
kind: EncryptionConfiguration
apiVersion: apiserver.config.k8s.io/v1
resources:
- resources:
  - secrets
  providers: …

- resources:
  - pandas.awesome.bears.com   🐼
  providers: …

- resources:
  - "*.*"
  providers: …
```

KMS v1 Gaps

- **Performance**
  - a new Data Encryption Key (DEK) is generated for each encryption
  - slow cluster startup times due to the large number of requests made to the remote vault
  - rate limits on external KMS
  - 160ms per request
- **Key Rotation**
  - manual and error-prone
  - hard to determine what keys are in-use
- **Health check & status**
  - kube-apiserver has to make encrypt and decrypt calls to determine KMS plugin health
- **Observability**
  - unable to correlate events across kube-apiserver, KMS plugin, and external KMS

What's new in KMS v2?

KEP-3299 - Alpha v1.25, v1.26, Beta v1.27, Stable targeted v1.29

- Benefits
  - Performance - DEK Re-use in API Server (80µs per request)
  - Health check & status - new status API health of the KMS plugin
  - Observability - new UID generated for each envelope operation.
  - New proto format for stored data in etcd
  - Key Rotation - key_id from status API is used to track current KMS key and KEK rotation allowing rotation without API server restart
- kubernetes.io/docs/tasks/administer-cluster/kms-provider
- Get involved #sig-auth-kms-dev on slack

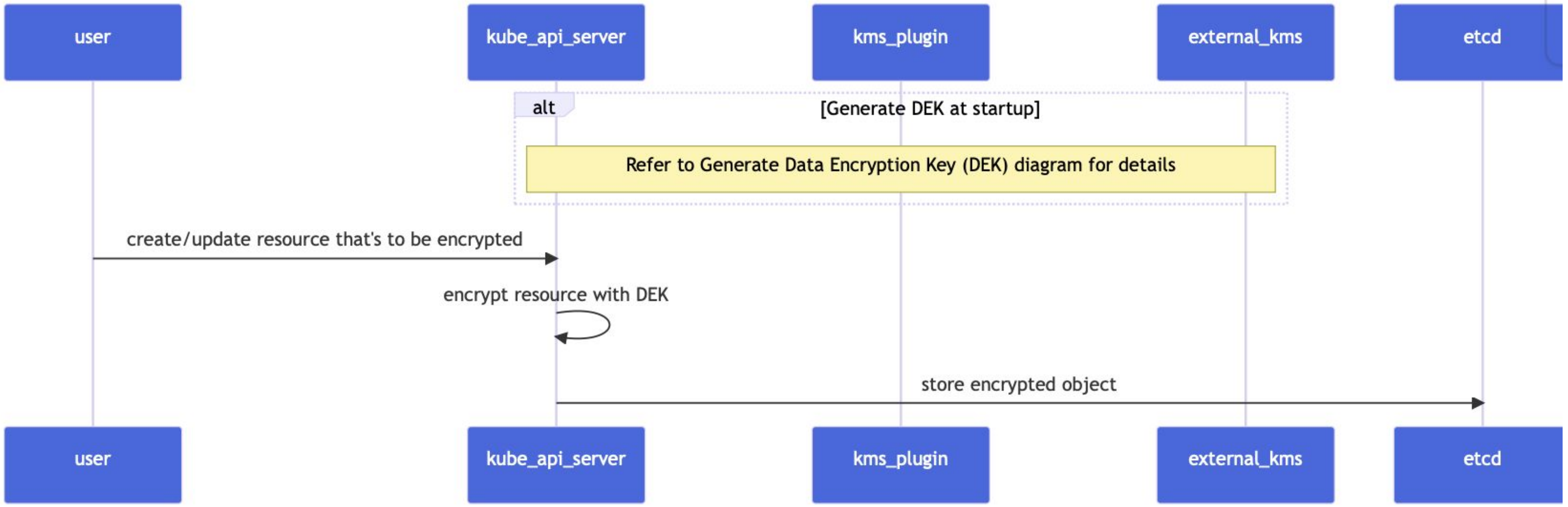
New proto format for stored data in etcd

For storage, a new structured protobuf format.

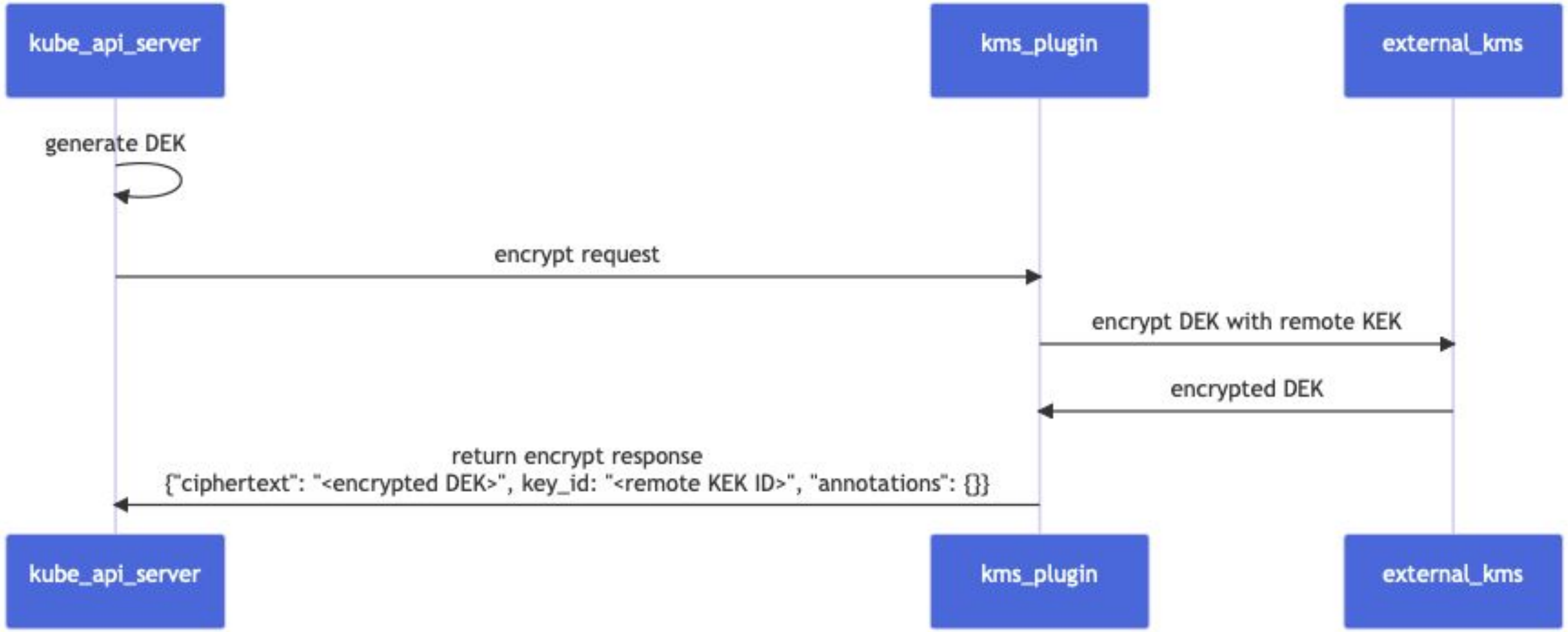
The prefix for the new format is `k8s:enc:kms:v2:<config name>:`.

```go
// EncryptedObject is the representation of data stored in etcd after envelope encryption.
type EncryptedObject struct {
   // EncryptedData is the encrypted data.
   EncryptedData []byte `protobuf:"bytes,1,opt,name=encryptedData,proto3"`

   // KeyID is the KMS key ID used for encryption operations.
   KeyID string `protobuf:"bytes,2,opt,name=keyID,proto3"`

   // EncryptedDEK is the encrypted DEK.
   EncryptedDEK  []byte `protobuf:"bytes,3,opt,name=encryptedDEK,proto3"`

   // Annotations is additional metadata that was provided by the KMS plugin.
   Annotations   map[string][]byte `protobuf:"name=annotations"`
}
```

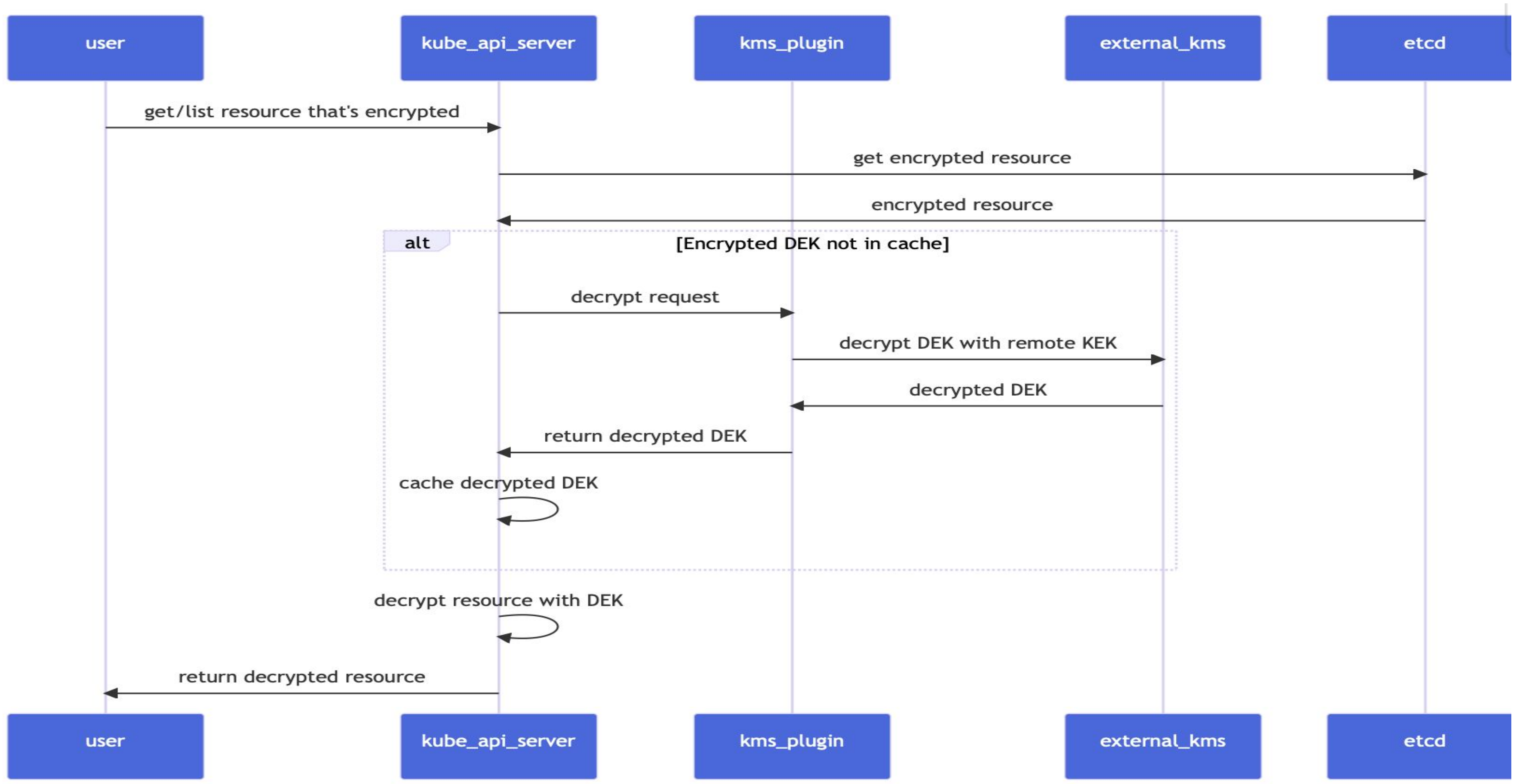
KMS v2 - Encrypt Request


user
kube_api_server
kms_plugin
external_kms
etcd
alt
[Generate DEK at startup]
Refer to Generate Data Encryption Key (DEK) diagram for details
create/update resource that's to be encrypted
encrypt resource with DEK
store encrypted object
user
kube_api_server
kms_plugin
external_kms
etcd

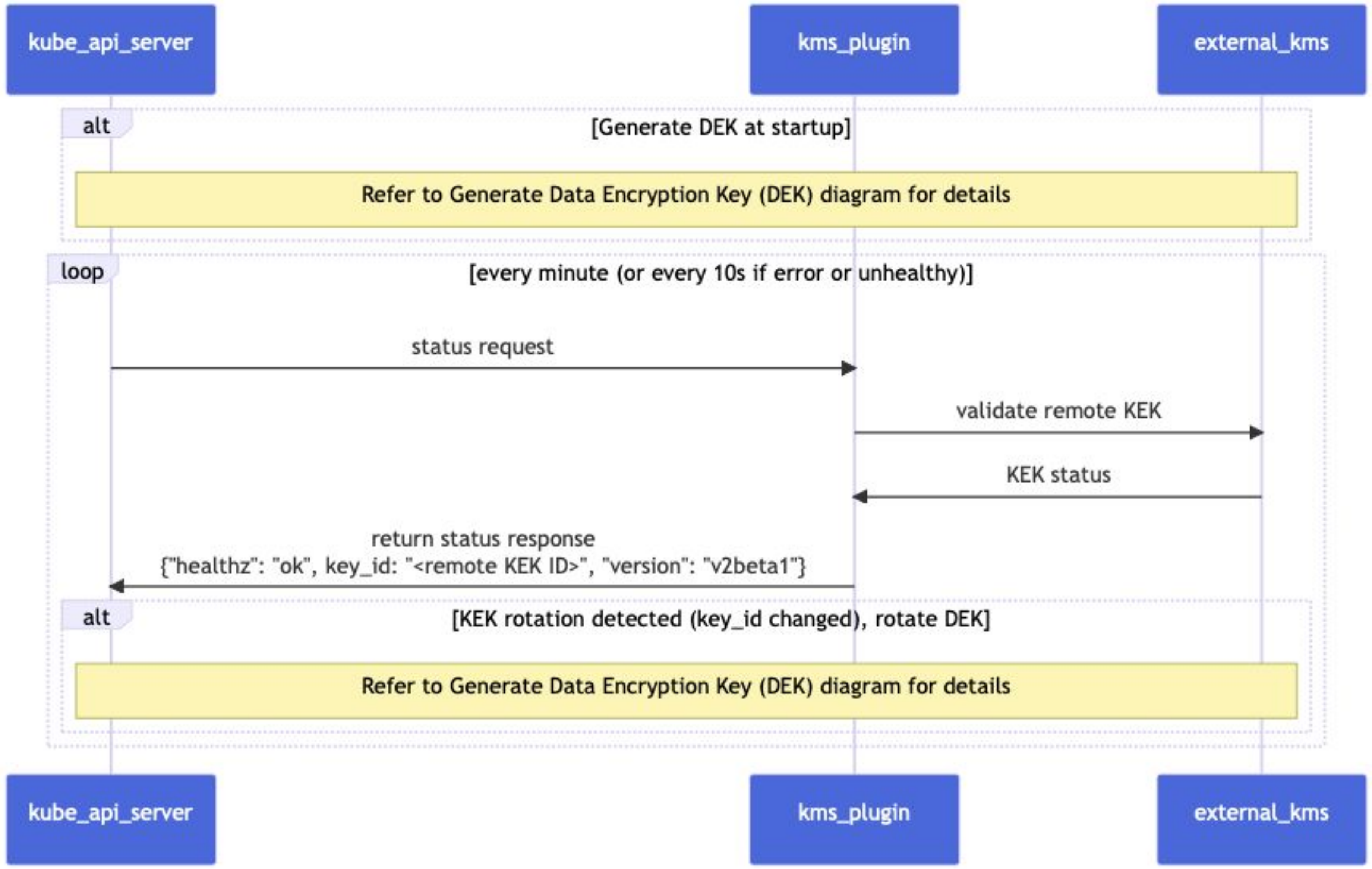
KMS v2 - Generate DEK



KMS v2 - Decrypt Request



KMS v2 - Status Request


kube_api_server
kms_plugin
external_kms
alt
[Generate DEK at startup]
Refer to Generate Data Encryption Key (DEK) diagram for details
loop
[every minute (or every 10s if error or unhealthy)]
status request
validate remote KEK
KEK status
return status response
{"healthz": "ok", key_id: "<remote KEK ID>", "version": "v2beta1"}
alt
[KEK rotation detected (key_id changed), rotate DEK]
Refer to Generate Data Encryption Key (DEK) diagram for details
kube_api_server
kms_plugin
external_kms

Cluster Trust Bundles

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KEP-3257

```go
type ClusterTrustBundleSpec struct {
 // The name of the associated signer.
 // +optional
 SignerName string `json:"signerName,omitempty"`

 // The individual trust anchors for this bundle.
 // A PEM bundle of PEM-wrapped,
 // DER-formatted X.509 certificate.
 // The order of certificates has no meaning.
 PEMTrustAnchors string `json:"pemTrustAnchors"`
}
```

DRAFT

```yaml
apiVersion: v1
kind: Pod
metadata:
 namespace: client
 name: client
spec:
 containers:
   name: main
   image: my-image
   volumeMounts:
    - mountPath: /var/run/example-com-server-tls-trust-anchors
      name: example-com-server-tls-trust-anchors
      readOnly: true
 volumes:
  - name: example-com-server-tls-trust-anchors
    projected:
      sources:
+       - pemTrustAnchors:
+           signerName: example.com/server
+           path: ca_certificates.pem
```

Cluster Trust Bundles

Trust the kube-apiserver, find your CA bundle

```
apiVersion: certificates.k8s.io/v1
kind: CertificateSigningRequest
spec:
 signerName: example.com/foo

apiVersion: certificates.k8s.io/v1alpha1
kind: ClusterTrustBundle
metadata:
 name: example.com:foo:v12
spec:
 signerName: example.com/foo
 trustBundle: [content here]
```

Current

```
kubectl get clustertrustbundle
--field-selector=spec.signerName=example.com/foo
```

Coming Soon

```
volumes:
+  - name: example-com-server-tls-trust-anchors
+    projected:
+      sources:
+      - pemTrustAnchors:
+          signerName: example.com/foo
+          path: ca_certificates.pem
```

Future

- Projected volume for workload client certificates? Pre-KEP proposal

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In-Design Enhancements

Structured Authorization Configuration

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KEP-3221

This proposal would allow:
- Dynamic config reload
- Multiple webhooks
- Configurable failure policy
- CEL-based filtering

```yaml
apiVersion: apiserver.config.k8s.io/v1alpha1
kind: AuthorizationConfiguration
authorizers:
  - type: Webhook
    webhook:
      unauthorizedTTL: 30s
      timeout: 3s
      subjectAccessReviewVersion: v1
      onError: Deny
      kubeConfigFile: /kube-system-authz-webhook.yaml
      matchConditions:
        - expression: |
            request.resourceAttributes.namespace == 'kube-system'
        - expression: |
            !('system:serviceaccounts:kube-system' in request.user.groups)
  - type: Node
  - type: RBAC
  - type: Webhook
    webhook:
      authorizedTTL: 5m
      unauthorizedTTL: 30s
      timeout: 3s
      subjectAccessReviewVersion: v1
      onError: NoOpinion
      kubeConfigFile: /authz-webhook.yaml
```

Structured OIDC Configuration

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KEP-3331

This proposal would allow:

- Dynamic config reload
- Multiple OIDC providers
- CEL-based authentication validation rules
- CEL-based claim extraction for user/group attributes
- Support for non-OIDC ID JWT credentials

```
claimValidationRules:
- rule: 'claims.aud == "charmander" || claims.aud == "bulbasaur"'
  message: clients other than charmander or bulbasaur are not allowed
- rule: 'claims.roles.split(",").exists(r, r == "kubernetes-user")'
  message: only kubernetes-user group members can access the cluster
- rule: '!claims.username.startsWith("system:")'
  message: system identities are not allowed

userValidationRules:
- rule: '!user.username.startsWith("myidp.")'
  message: system identities are not allowed
```

```
claimMappings:
  username: 'claims.username + ":external-user"'
  groups: 'claims.roles.split(",")'
  uid: 'claims.sub'
  extra:
  - key: '"client_name"'
    expression: 'claims.aud'
```

ReferenceGrant

KEP-3766

- Expansion of narrow API used by sig-network, sig-storage
- Goals
  - Users express intent to allow use of a resource
  - Controllers verify that intent was granted
  - Admins avoid broad permission grants to controllers
- Example uses
  - Gateway cross-namespace TLS secrets
  - PersistentVolumeClaim cross-namespace data sources

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Cross-SIG Work

Cross SIG Work

- CEL for Admission Control (api-machinery)
  - kubernetes/enhancements#3488
- Storage Version API (api-machinery)
  - kubernetes/enhancements#2339
- Kube API Server Identity (api-machinery)
  - kubernetes/enhancements#1965

Shout outs!

🙏 THANK YOU! 🙏

Anish @aramase KMSv2	Krzysztof @ibihim KMSv2 / kube-rbac-proxy	Nilekh @nilekhc KMSv2	Maksim @nabokihms whoami
Taahir @ahmedtd Cluster Trust Bundle	Standa @stlaz kube-rbac-proxy	Roma @r-erema OIDC tests	

SIG-Auth

Where can you find us?

Slack channel: #sig-auth

Home page: https://github.com/kubernetes/community/tree/master/sig-auth

Mailing list: https://groups.google.com/forum/#!forum/kubernetes-sig-auth

Bi-weekly meetings Wednesday at 11PT (agenda/recordings links on home page)