

Ingress

FEATURE STATE: [Kubernetes v1.19](#) [stable]

An API object that manages external access to the services in a cluster, typically HTTP.

Ingress may provide load balancing, SSL termination and name-based virtual hosting.

Terminology

For clarity, this guide defines the following terms:

- Node: A worker machine in Kubernetes, part of a cluster.
- Cluster: A set of Nodes that run containerized applications managed by Kubernetes. For this example, and in most common Kubernetes deployments, nodes in the cluster are not part of the public internet.
- Edge router: A router that enforces the firewall policy for your cluster. This could be a gateway managed by a cloud provider or a physical piece of hardware.
- Cluster network: A set of links, logical or physical, that facilitate communication within a cluster according to the Kubernetes [networking model](#).
- Service: A Kubernetes [Service](#) that identifies a set of Pods using [label](#) selectors. Unless mentioned otherwise, Services are assumed to have virtual IPs only routable within the cluster network.

What is Ingress?

[Ingress](#) exposes HTTP and HTTPS routes from outside the cluster to [services](#) within the cluster. Traffic routing is controlled by rules defined on the Ingress resource.

Here is a simple example where an Ingress sends all its traffic to one Service:

Figure. Ingress

An `Ingress` may be configured to give `Services` externally-reachable URLs, load balance traffic, terminate SSL / TLS, and offer name-based virtual hosting. An [Ingress controller](#) is responsible for fulfilling the `Ingress`, usually with a load balancer, though it may also configure your edge router or additional frontends to help handle the traffic.

An `Ingress` does not expose arbitrary ports or protocols. Exposing services other than HTTP and HTTPS to the internet typically uses a service of type [Service.Type=NodePort](#) or [Service.Type=LoadBalancer](#).

Prerequisites

You must have an [Ingress controller](#) to satisfy an `Ingress`. Only creating an `Ingress` resource has no effect.

You may need to deploy an `Ingress` controller such as [ingress-nginx](#). You can choose from a number of [Ingress controllers](#).

Ideally, all `Ingress` controllers should fit the reference specification. In reality, the various `Ingress` controllers operate slightly differently.

Note: Make sure you review your `Ingress` controller's documentation to understand the caveats of choosing it.

The `Ingress` resource

A minimal `Ingress` resource example:

```
service/networking/minimal-ingress.yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: minimal-ingress
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /
spec:
  ingressClassName: nginx-example
  rules:
  - http:
      paths:
      - path: /testpath
        pathType: Prefix
```

```
backend:
  service:
    name: test
    port:
      number: 80
```

An `Ingress` needs `apiVersion`, `kind`, `metadata` and `spec` fields. The name of an `Ingress` object must be a valid [DNS subdomain name](#). For general information about working with config files, see [deploying applications](#), [configuring containers](#), [managing resources](#). `Ingress` frequently uses annotations to configure some options depending on the `Ingress` controller, an example of which is the [rewrite-target annotation](#). Different [Ingress controllers](#) support different annotations. Review the documentation for your choice of `Ingress` controller to learn which annotations are supported.

The [Ingress spec](#) has all the information needed to configure a load balancer or proxy server. Most importantly, it contains a list of rules matched against all incoming requests. `Ingress` resource only supports rules for directing HTTP(S) traffic.

If the `ingressClassName` is omitted, a [default Ingress class](#) should be defined.

There are some `ingress` controllers, that work without the definition of a default `IngressClass`. For example, the `Ingress-NGINX` controller can be configured with a [flag](#) `--watch-ingress-without-class`. It is [recommended](#) though, to specify the default `IngressClass` as shown [below](#).

Ingress rules

Each HTTP rule contains the following information:

- An optional host. In this example, no host is specified, so the rule applies to all inbound HTTP traffic through the IP address specified. If a host is provided (for example, `foo.bar.com`), the rules apply to that host.
- A list of paths (for example, `/testpath`), each of which has an associated backend defined with a `service.name` and a `service.port.name` or `service.port.number`. Both the host and path must match the content of an incoming request before the load balancer directs traffic to the referenced Service.
- A backend is a combination of Service and port names as described in the [Service doc](#) or a [custom resource backend](#) by way of a [CRD](#). HTTP (and

HTTPS) requests to the Ingress that match the host and path of the rule are sent to the listed backend.

A defaultBackend is often configured in an Ingress controller to service any requests that do not match a path in the spec.

DefaultBackend

An Ingress with no rules sends all traffic to a single default backend and .spec.defaultBackend is the backend that should handle requests in that case. The defaultBackend is conventionally a configuration option of the [Ingress controller](#) and is not specified in your Ingress resources. If no .spec.rules are specified, .spec.defaultBackend must be specified. If defaultBackend is not set, the handling of requests that do not match any of the rules will be up to the ingress controller (consult the documentation for your ingress controller to find out how it handles this case).

If none of the hosts or paths match the HTTP request in the Ingress objects, the traffic is routed to your default backend.

Resource backends

A Resource backend is an ObjectRef to another Kubernetes resource within the same namespace as the Ingress object. A Resource is a mutually exclusive setting with Service, and will fail validation if both are specified. A common usage for a Resource backend is to ingress data to an object storage backend with static assets.

[service/networking/ingress-resource-backend.yaml](#)

```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: ingress-resource-backend
spec:
  defaultBackend:
    resource:
      apiGroup: k8s.example.com
      kind: StorageBucket
      name: static-assets
  rules:
  - http:
      paths:
      - path: /icons
```

```
pathType: ImplementationSpecific
backend:
  resource:
    apiGroup: k8s.example.com
    kind: StorageBucket
    name: icon-assets
```

After creating the Ingress above, you can view it with the following command:

```
kubectl describe ingress ingress-resource-backend
Name:          ingress-resource-backend
Namespace:     default
Address:
Default backend: APIGroup: k8s.example.com, Kind: StorageBucket, Name:
static-assets
Rules:
  Host      Path      Backends
  ----      -
  *         /icons    APIGroup: k8s.example.com, Kind: StorageBucket,
Name: icon-assets
Annotations: <none>
Events:      <none>
```

Path types

Each path in an Ingress is required to have a corresponding path type. Paths that do not include an explicit pathType will fail validation. There are three supported path types:

- ❑ **ImplementationSpecific:** With this path type, matching is up to the IngressClass. Implementations can treat this as a separate pathType or treat it identically to Prefix or Exact path types.
- ❑ **Exact:** Matches the URL path exactly and with case sensitivity.
- ❑ **Prefix:** Matches based on a URL path prefix split by /. Matching is case sensitive and done on a path element by element basis. A path element refers to the list of labels in the path split by the / separator. A request is a match for path p if every p is an element-wise prefix of p of the request path.

Note: If the last element of the path is a substring of the last element in request path, it is not a match (for example: `/foo/bar` matches `/foo/bar/baz`, but does not match `/foo/barbaz`).

Examples

Kind	Path(s)	Request path(s)	Matches?
Prefix	/	(all paths)	Yes
Exact	/foo	/foo	Yes
Exact	/foo	/bar	No
Exact	/foo	/foo/	No
Exact	/foo/	/foo	No
Prefix	/foo	/foo, /foo/	Yes
Prefix	/foo/	/foo, /foo/	Yes
Prefix	/aaa/bb	/aaa/bbb	No
Prefix	/aaa/bbb	/aaa/bbb	Yes
Prefix	/aaa/bbb/	/aaa/bbb	Yes, ignores trailing slash
Prefix	/aaa/bbb	/aaa/bbb/	Yes, matches trailing slash
Prefix	/aaa/bbb	/aaa/bbb/ccc	Yes, matches subpath
Prefix	/aaa/bbb	/aaa/bbbxyz	No, does not match string prefix
Prefix	/, /aaa	/aaa/ccc	Yes, matches /aaa prefix
Prefix	/, /aaa, /aaa/bbb	/aaa/bbb	Yes, matches /aaa/bbb prefix
Prefix	/, /aaa, /aaa/bbb	/ccc	Yes, matches / prefix
Prefix	/aaa	/ccc	No, uses default backend
Mixed	/foo (Prefix), /foo (Exact)	/foo	Yes, prefers Exact

Multiple matches

In some cases, multiple paths within an Ingress will match a request. In those cases precedence will be given first to the longest matching path. If two paths are still equally matched, precedence will be given to paths with an exact path type over prefix path type.

Hostname wildcards

Hosts can be precise matches (for example "foo.bar.com") or a wildcard (for example "*.foo.com"). Precise matches require that the HTTP host header matches the host field. Wildcard matches require the HTTP host header is equal to the suffix of the wildcard rule.

Host	Host header	Match?
*.foo.com	bar.foo.com	Matches based on shared suffix

Host	Host header	Match?
*.foo.com	baz.bar.foo.com	No match, wildcard only covers a single DNS label
*.foo.com	foo.com	No match, wildcard only covers a single DNS label

[service/networking/ingress-wildcard-host.yaml](#)

```

apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: ingress-wildcard-host
spec:
  rules:
  - host: "foo.bar.com"
    http:
      paths:
      - pathType: Prefix
        path: "/bar"
        backend:
          service:
            name: service1
            port:
              number: 80
  - host: "*.foo.com"
    http:
      paths:
      - pathType: Prefix
        path: "/foo"
        backend:
          service:
            name: service2
            port:
              number: 80

```

Ingress class

Ingresses can be implemented by different controllers, often with different configuration. Each Ingress should specify a class, a reference to an IngressClass resource that contains additional configuration including the name of the controller that should implement the class.

[service/networking/external-lb.yaml](#)

```

apiVersion: networking.k8s.io/v1
kind: IngressClass
metadata:
  name: external-lb
spec:
  controller: example.com/ingress-controller
  parameters:

```

```
apiGroup: k8s.example.com
kind: IngressParameters
name: external-lb
```

The `.spec.parameters` field of an `IngressClass` lets you reference another resource that provides configuration related to that `IngressClass`.

The specific type of parameters to use depends on the ingress controller that you specify in the `.spec.controller` field of the `IngressClass`.

`IngressClass` scope

Depending on your ingress controller, you may be able to use parameters that you set cluster-wide, or just for one namespace.

- [Cluster](#)
- [Namespaced](#)

The default scope for `IngressClass` parameters is cluster-wide.

If you set the `.spec.parameters` field and don't set `.spec.parameters.scope`, or if you set `.spec.parameters.scope` to `Cluster`, then the `IngressClass` refers to a cluster-scoped resource. The kind (in combination the `apiGroup`) of the parameters refers to a cluster-scoped API (possibly a custom resource), and the name of the parameters identifies a specific cluster scoped resource for that API.

For example:

```
---
apiVersion: networking.k8s.io/v1
kind: IngressClass
metadata:
  name: external-lb-1
spec:
  controller: example.com/ingress-controller
  parameters:
    # The parameters for this IngressClass are specified in a
    # ClusterIngressParameter (API group k8s.example.net) named
    # "external-config-1". This definition tells Kubernetes to
    # look for a cluster-scoped parameter resource.
    scope: Cluster
    apiGroup: k8s.example.net
    kind: ClusterIngressParameter
    name: external-config-1
```

Deprecated annotation

Before the `IngressClass` resource and `ingressClassName` field were added in Kubernetes 1.18, `Ingress` classes were specified with a `kubernetes.io/ingress.class` annotation on the `Ingress`. This annotation was never formally defined, but was widely supported by `Ingress` controllers.

The newer `ingressClassName` field on `Ingresses` is a replacement for that annotation, but is not a direct equivalent. While the annotation was generally used to reference the name of the `Ingress` controller that should implement the `Ingress`, the field is a reference to an `IngressClass` resource that contains additional `Ingress` configuration, including the name of the `Ingress` controller.

Default `IngressClass`

You can mark a particular `IngressClass` as default for your cluster. Setting the `ingressclass.kubernetes.io/is-default-class` annotation to `true` on an `IngressClass` resource will ensure that new `Ingresses` without an `ingressClassName` field specified will be assigned this default `IngressClass`.

Caution: If you have more than one `IngressClass` marked as the default for your cluster, the admission controller prevents creating new `Ingress` objects that don't have an `ingressClassName` specified. You can resolve this by ensuring that at most 1 `IngressClass` is marked as default in your cluster.

There are some `ingress` controllers, that work without the definition of a default `IngressClass`. For example, the `Ingress-NGINX` controller can be configured with a [flag](#) `--watch-ingress-without-class`. It is [recommended](#) though, to specify the default `IngressClass`:

```
service/networking/default-ingressclass.yaml
apiVersion: networking.k8s.io/v1
kind: IngressClass
metadata:
  labels:
    app.kubernetes.io/component: controller
    name: nginx-example
  annotations:
    ingressclass.kubernetes.io/is-default-class: "true"
spec:
  controller: k8s.io/ingress-nginx
```

Types of `Ingress`

Ingress backed by a single Service

There are existing Kubernetes concepts that allow you to expose a single Service (see [alternatives](#)). You can also do this with an Ingress by specifying a *default backend* with no rules.

[service/networking/test-ingress.yaml](#)

```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: test-ingress
spec:
  defaultBackend:
    service:
      name: test
      port:
        number: 80
```

If you create it using `kubectl apply -f` you should be able to view the state of the Ingress you added:

```
kubectl get ingress test-ingress
```

NAME	CLASS	HOSTS	ADDRESS	PORTS	AGE
test-ingress	external-lb	*	203.0.113.123	80	59s

Where 203.0.113.123 is the IP allocated by the Ingress controller to satisfy this Ingress.

Note: Ingress controllers and load balancers may take a minute or two to allocate an IP address. Until that time, you often see the address listed as `<pending>`.

Simple fanout

A fanout configuration routes traffic from a single IP address to more than one Service, based on the HTTP URL being requested. An Ingress allows you to keep the number of load balancers down to a minimum. For example, a setup like:

Figure. Ingress Fan Out

It would require an Ingress such as:

[service/networking/simple-fanout-example.yaml](#)

```
apiVersion: networking.k8s.io/v1
```

```

kind: Ingress
metadata:
  name: simple-fanout-example
spec:
  rules:
  - host: foo.bar.com
    http:
      paths:
      - path: /foo
        pathType: Prefix
        backend:
          service:
            name: service1
            port:
              number: 4200
      - path: /bar
        pathType: Prefix
        backend:
          service:
            name: service2
            port:
              number: 8080

```

When you create the Ingress with `kubectl apply -f:`

```

kubectl describe ingress simple-fanout-example
Name:          simple-fanout-example
Namespace:     default
Address:       178.91.123.132
Default backend: default-http-backend:80 (10.8.2.3:8080)
Rules:
  Host          Path  Backends
  ----          -
  foo.bar.com   /foo  service1:4200 (10.8.0.90:4200)
                /bar  service2:8080 (10.8.0.91:8080)
Events:
  Type        Reason      Age          From                      Message
  ----        -
  Normal      ADD         22s          loadbalancer-controller   default/test

```

The Ingress controller provisions an implementation-specific load balancer that satisfies the Ingress, as long as the Services (`service1`, `service2`) exist. When it has done so, you can see the address of the load balancer at the Address field.

Note: Depending on the [Ingress controller](#) you are using, you may need to create a `default-http-backend` [Service](#).

Name based virtual hosting

Name-based virtual hosts support routing HTTP traffic to multiple host names at the same IP address.

Figure. Ingress Name Based Virtual hosting

The following Ingress tells the backing load balancer to route requests based on the [Host header](#).

```
service/networking/name-virtual-host-ingress.yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: name-virtual-host-ingress
spec:
  rules:
  - host: foo.bar.com
    http:
      paths:
      - pathType: Prefix
        path: "/"
        backend:
          service:
            name: service1
            port:
              number: 80
  - host: bar.foo.com
    http:
      paths:
      - pathType: Prefix
        path: "/"
        backend:
          service:
            name: service2
            port:
              number: 80
```

If you create an Ingress resource without any hosts defined in the rules, then any web traffic to the IP address of your Ingress controller can be matched without a name based virtual host being required.

For example, the following Ingress routes traffic requested for first.bar.com to service1, second.bar.com to service2, and any traffic whose request host header doesn't match first.bar.com and second.bar.com to service3.

```
service/networking/name-virtual-host-ingress-no-third-host.yaml
```

```

apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: name-virtual-host-ingress-no-third-host
spec:
  rules:
  - host: first.bar.com
    http:
      paths:
      - pathType: Prefix
        path: "/"
        backend:
          service:
            name: service1
            port:
              number: 80
  - host: second.bar.com
    http:
      paths:
      - pathType: Prefix
        path: "/"
        backend:
          service:
            name: service2
            port:
              number: 80
  - http:
      paths:
      - pathType: Prefix
        path: "/"
        backend:
          service:
            name: service3
            port:
              number: 80

```

TLS

You can secure an Ingress by specifying a [Secret](#) that contains a TLS private key and certificate. The Ingress resource only supports a single TLS port, 443, and assumes TLS termination at the ingress point (traffic to the Service and its Pods is in plaintext). If the TLS configuration section in an Ingress specifies different hosts, they are multiplexed on the same port according to the hostname specified through the SNI-TLS extension (provided the Ingress controller supports SNI). The TLS secret must contain keys named `tls.crt` and `tls.key` that contain the certificate and private key to use for TLS. For example:

```

apiVersion: v1
kind: Secret

```

```

metadata:
  name: testsecret-tls
  namespace: default
data:
  tls.crt: base64 encoded cert
  tls.key: base64 encoded key
type: kubernetes.io/tls

```

Referencing this secret in an Ingress tells the Ingress controller to secure the channel from the client to the load balancer using TLS. You need to make sure the TLS secret you created came from a certificate that contains a Common Name (CN), also known as a Fully Qualified Domain Name (FQDN) for `https-example.foo.com`.

Note: Keep in mind that TLS will not work on the default rule because the certificates would have to be issued for all the possible sub-domains. Therefore, `hosts` in the `tls` section need to explicitly match the `host` in the `rules` section.

[service/networking/tls-example-ingress.yaml](#)

```

apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: tls-example-ingress
spec:
  tls:
    - hosts:
        - https-example.foo.com
      secretName: testsecret-tls
  rules:
    - host: https-example.foo.com
      http:
        paths:
          - path: /
            pathType: Prefix
            backend:
              service:
                name: service1
                port:
                  number: 80

```

Note: There is a gap between TLS features supported by various Ingress controllers. Please refer to documentation on [nginx](#), [GCE](#), or any other platform specific Ingress controller to understand how TLS works in your environment.

Load balancing

An Ingress controller is bootstrapped with some load balancing policy settings that it applies to all Ingress, such as the load balancing algorithm, backend weight scheme, and others. More advanced load balancing concepts (e.g. persistent

sessions, dynamic weights) are not yet exposed through the Ingress. You can instead get these features through the load balancer used for a Service.

It's also worth noting that even though health checks are not exposed directly through the Ingress, there exist parallel concepts in Kubernetes such as [readiness probes](#) that allow you to achieve the same end result. Please review the controller specific documentation to see how they handle health checks (for example: [nginx](#), or [GCE](#)).

Updating an Ingress

To update an existing Ingress to add a new Host, you can update it by editing the resource:

```
kubectl describe ingress test
Name:          test
Namespace:     default
Address:       178.91.123.132
Default backend: default-http-backend:80 (10.8.2.3:8080)
Rules:
  Host          Path  Backends
  ----          -
  foo.bar.com   /foo  service1:80 (10.8.0.90:80)
Annotations:
  nginx.ingress.kubernetes.io/rewrite-target: /
Events:
  Type    Reason    Age           From              Message
  ----    -
  Normal  ADD       35s          loadbalancer-controller
default/test
kubectl edit ingress test
```

This pops up an editor with the existing configuration in YAML format. Modify it to include the new Host:

```
spec:
  rules:
  - host: foo.bar.com
    http:
      paths:
      - backend:
          service:
            name: service1
            port:
              number: 80
        path: /foo
        pathType: Prefix
```

```

- host: bar.baz.com
  http:
    paths:
      - backend:
          service:
            name: service2
            port:
              number: 80
          path: /foo
          pathType: Prefix
    ..

```

After you save your changes, `kubectl` updates the resource in the API server, which tells the Ingress controller to reconfigure the load balancer.

Verify this:

```

kubectl describe ingress test
Name:          test
Namespace:     default
Address:       178.91.123.132
Default backend: default-http-backend:80 (10.8.2.3:8080)
Rules:
  Host          Path  Backends
  ----          -
foo.bar.com    /foo  service1:80 (10.8.0.90:80)
bar.baz.com    /foo  service2:80 (10.8.0.91:80)
Annotations:
  nginx.ingress.kubernetes.io/rewrite-target: /
Events:
  Type    Reason    Age    From                      Message
  ----    -
Normal   ADD       45s    loadbalancer-controller   default/test

```

You can achieve the same outcome by invoking `kubectl replace -f` on a modified Ingress YAML file.

Failing across availability zones

Techniques for spreading traffic across failure domains differ between cloud providers. Please check the documentation of the relevant [Ingress controller](#) for details.

Alternatives

You can expose a Service in multiple ways that don't directly involve the `Ingress` resource:

- ❑ Use [Service.Type=LoadBalancer](#)
- ❑ Use [Service.Type=NodePort](#)

What's next

- ❑ Learn about the [Ingress](#) API
- ❑ Learn about [Ingress controllers](#)
- ❑ [Set up Ingress on Minikube with the NGINX Controller](#)