Spring Cloud Gateway This project provides an API Gateway built on top of the Spring Ecosystem, including: Spring 5, Spring Boot 2 and Project Reactor. Spring Cloud Gateway aims to provide a simple, yet effective way to route to APIs and provide cross cutting concerns to them such as: security, monitoring/metrics, and resiliency.

How to Include Spring Cloud Gateway

To include Spring Cloud Gateway in your project use the starter with group `org.springframework.cloud` and artifact id `spring-cloud-starter-gateway`.

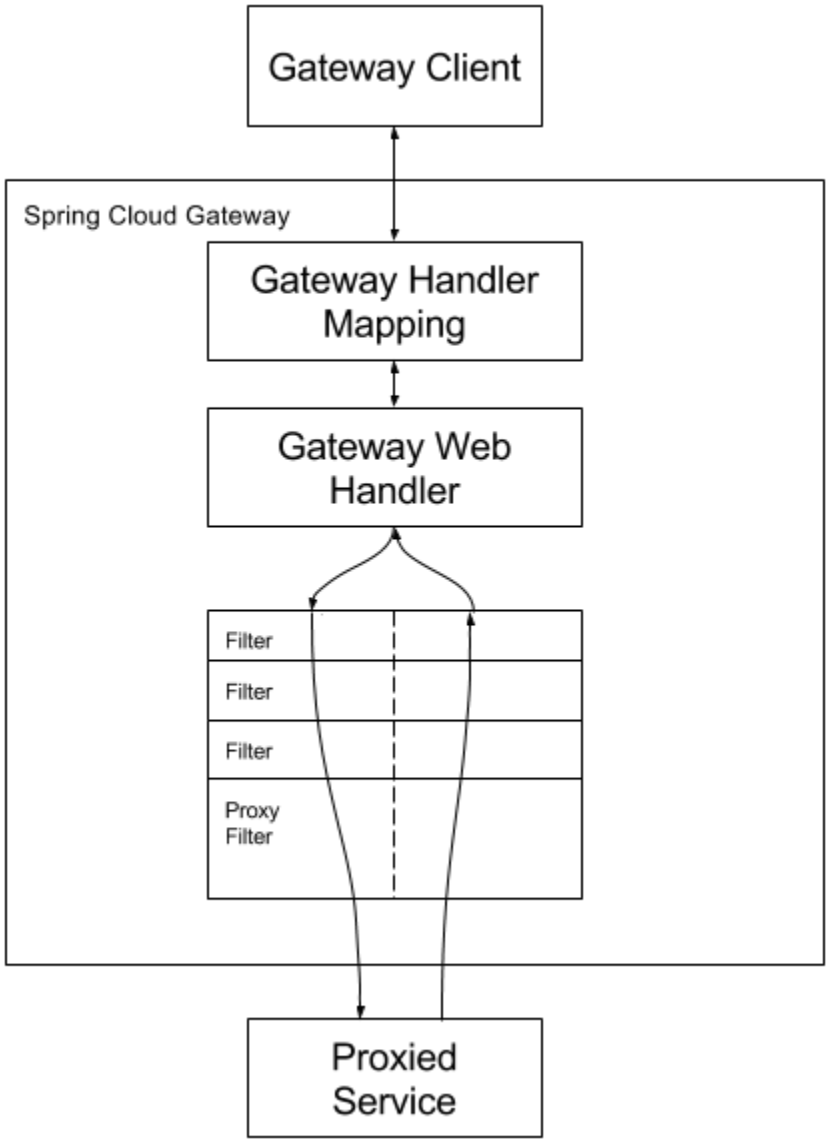
If you include the starter, but, for some reason, you do not want the gateway to be enabled, set `spring.cloud.gateway.enabled=false`.

Important	Spring Cloud Gateway requires the Netty runtime provided by Spring Boot and Spring Webflux. It does not work in a traditional Servlet Container or built as a WAR.

Glossary

- **Route**: Route the basic building block of the gateway. It is defined by an ID, a destination URI, a collection of predicates and a collection of filters. A route is matched if aggregate predicate is true.
- **Predicate**: This is a Java 8 Function Predicate. The input type is a Spring Framework `ServerWebExchange`. This allows developers to match on anything from the HTTP request, such as headers or parameters.
- **Filter**: These are instances Spring Framework `GatewayFilter` constructed in with a specific factory. Here, requests and responses can be modified before or after sending the downstream request.

How It Works



Clients make requests to Spring Cloud Gateway. If the Gateway Handler Mapping determines that a request matches a Route, it is sent to the Gateway Web Handler. This handler runs sends the request through a filter chain that is specific to the request. The reason the filters are divided by the dotted line, is that filters may execute logic before the proxy request is sent or after. All "pre" filter logic is executed, then the proxy request is made. After the proxy request is made, the "post" filter logic is executed.

Note URIs defined in routes without a port will get a default port set to 80 and 443 for HTTP and HTTPS URIs respectively.

Route Predicate Factories

Spring Cloud Gateway matches routes as part of the Spring WebFlux `HandlerMapping` infrastructure. Spring Cloud Gateway includes many built-in Route Predicate Factories. All of these predicates match on different attributes of the HTTP request. Multiple Route Predicate Factories can be combined and are combined via logical `and`.

After Route Predicate Factory

The After Route Predicate Factory takes one parameter, a datetime. This predicate matches requests that happen after the current datetime.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: after_route
        uri: http://example.org
        predicates:
        - After=2017-01-20T17:42:47.789-07:00[America/Denver]
```

This route matches any request after Jan 20, 2017 17:42 Mountain Time (Denver).

Before Route Predicate Factory

The Before Route Predicate Factory takes one parameter, a datetime. This predicate matches requests that happen before the current datetime.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: before_route
        uri: http://example.org
        predicates:
        - Before=2017-01-20T17:42:47.789-07:00[America/Denver]
```

This route matches any request before Jan 20, 2017 17:42 Mountain Time (Denver).

Between Route Predicate Factory

The Between Route Predicate Factory takes two parameters, datetime1 and datetime2. This predicate matches requests that happen after datetime1 and before datetime2. The datetime2 parameter must be after datetime1.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: between_route
        uri: http://example.org
        predicates:
        - Between=2017-01-20T17:42:47.789-07:00[America/Denver], 2017-01-
21T17:42:47.789-07:00[America/Denver]
```

This route matches any request after Jan 20, 2017 17:42 Mountain Time (Denver) and before Jan 21, 2017 17:42 Mountain Time (Denver). This could be useful for maintenance windows.

Cookie Route Predicate Factory

The Cookie Route Predicate Factory takes two parameters, the cookie name and a regular expression. This predicate matches cookies that have the given name and the value matches the regular expression.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: cookie_route
        uri: http://example.org
        predicates:
        - Cookie=chocolate, ch.p
```

This route matches the request has a cookie named `chocolate` who's value matches the `ch.p` regular expression.

Header Route Predicate Factory

The Header Route Predicate Factory takes two parameters, the header name and a regular expression. This predicate matches with a header that has the given name and the value matches the regular expression.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: header_route
        uri: http://example.org
        predicates:
        - Header=X-Request-Id, \d+
```

This route matches if the request has a header named `X-Request-Id` whos value matches the `\d+` regular expression (has a value of one or more digits).

Host Route Predicate Factory

The Host Route Predicate Factory takes one parameter: the host name pattern. The pattern is an Ant style pattern with `.` as the separator. This predicates matches the `Host` header that matches the pattern.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: host_route
        uri: http://example.org
        predicates:
        - Host=**.somehost.org
```

This route would match if the request has a `Host` header has the value `www.somehost.org` or `beta.somehost.org`.

Method Route Predicate Factory

The Method Route Predicate Factory takes one parameter: the HTTP method to match.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: method_route
        uri: http://example.org
        predicates:
        - Method=GET
```

This route would match if the request method was a `GET`.

Path Route Predicate Factory

The Path Route Predicate Factory takes one parameter: a Spring `PathMatcher` pattern.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: host_route
        uri: http://example.org
        predicates:
        - Path=/foo/{segment}
```

This route would match if the request path was, for example: `/foo/1` or `/foo/bar`.

This predicate extracts the URI template variables (like `segment` defined in the example above) as a map of names and values and places it in the `ServerWebExchange.getAttributes()` with a key defined in `PathRoutePredicate.URL_PREDICATE_VARS_ATTR`. Those values are then available for use by GatewayFilter Factories

Query Route Predicate Factory

The Query Route Predicate Factory takes two parameters: a required `param` and an optional `regexp`.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: query_route
        uri: http://example.org
```

```
        predicates:
        - Query=baz
```

This route would match if the request contained a `baz` query parameter.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: query_route
        uri: http://example.org
        predicates:
        - Query=foo, ba.
```

This route would match if the request contained a `foo` query parameter whose value matched the `ba.` regexp, so `bar` and `baz` would match.

RemoteAddr Route Predicate Factory

The RemoteAddr Route Predicate Factory takes a list (min size 1) of CIDR-notation (IPv4 or IPv6) strings, e.g. `192.168.0.1/16` (where `192.168.0.1` is an IP address and `16` is a subnet mask).

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: remoteaddr_route
        uri: http://example.org
        predicates:
        - RemoteAddr=192.168.1.1/24
```

This route would match if the remote address of the request was, for example, `192.168.1.10`.

Modifying the way remote addresses are resolved

By default the RemoteAddr Route Predicate Factory uses the remote address from the incoming request. This may not match the actual client IP address if Spring Cloud Gateway sits behind a proxy layer.

You can customize the way that the remote address is resolved by setting a custom `RemoteAddressResolver`. Spring Cloud Gateway comes with one non-default remote address resolver which is based off of the X-Forwarded-For header, `XForwardedRemoteAddressResolver`.

`XForwardedRemoteAddressResolver` has two static constructor methods which take different approaches to security:

`XForwardedRemoteAddressResolver::trustAll` returns a `RemoteAddressResolver` which always takes the first IP address found in the `X-Forwarded-For` header. This approach

is vulnerable to spoofing, as a malicious client could set an initial value for the `X-Forwarded-For` which would be accepted by the resolver.

`XForwardedRemoteAddressResolver::maxTrustedIndex` takes an index which correlates to the number of trusted infrastructure running in front of Spring Cloud Gateway. If Spring Cloud Gateway is, for example only accessible via HAProxy, then a value of 1 should be used. If two hops of trusted infrastructure are required before Spring Cloud Gateway is accessible, then a value of 2 should be used.

Given the following header value:

```
X-Forwarded-For: 0.0.0.1, 0.0.0.2, 0.0.0.3
```

The `maxTrustedIndex` values below will yield the following remote addresses.

maxTrustedIndex	**result**
[`Integer.MIN_VALUE`,0]	(invalid, `IllegalArgumentException` during initialization)
1	0.0.0.3
2	0.0.0.2
3	0.0.0.1
[4, `Integer.MAX_VALUE`]	0.0.0.1

Using Java config:

GatewayConfig.java

```
RemoteAddressResolver resolver = XForwardedRemoteAddressResolver
    .maxTrustedIndex(1);

...

.route("direct-route",
    r -> r.remoteAddr("10.1.1.1", "10.10.1.1/24")
        .uri("https://downstream1")
.route("proxied-route",
    r -> r.remoteAddr(resolver,  "10.10.1.1", "10.10.1.1/24")
        .uri("https://downstream2")
)
```

GatewayFilter Factories

Route filters allow the modification of the incoming HTTP request or outgoing HTTP response in some manner. Route filters are scoped to a particular route. Spring Cloud Gateway includes many built-in GatewayFilter Factories.

NOTE For more detailed examples on how to use any of the following filters, take a look at the unit tests.

AddRequestHeader GatewayFilter Factory

The AddRequestHeader GatewayFilter Factory takes a name and value parameter.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: add_request_header_route
        uri: http://example.org
        filters:
        - AddRequestHeader=X-Request-Foo, Bar
```

This will add `X-Request-Foo:Bar` header to the downstream request's headers for all matching requests.

AddRequestParameter GatewayFilter Factory

The AddRequestParameter GatewayFilter Factory takes a name and value parameter.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: add_request_parameter_route
        uri: http://example.org
        filters:
        - AddRequestParameter=foo, bar
```

This will add `foo=bar` to the downstream request's query string for all matching requests.

AddResponseHeader GatewayFilter Factory

The AddResponseHeader GatewayFilter Factory takes a name and value parameter.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: add_request_header_route
        uri: http://example.org
        filters:
        - AddResponseHeader=X-Response-Foo, Bar
```

This will add `X-Response-Foo:Bar` header to the downstream response's headers for all matching requests.

Hystrix GatewayFilter Factory

Hystrix is a library from Netflix that implements the circuit breaker pattern. The Hystrix GatewayFilter allows you to introduce circuit breakers to your gateway routes, protecting your services from cascading failures and allowing you to provide fallback responses in the event of downstream failures.

To enable Hystrix GatewayFilters in your project, add a dependency on `spring-cloud-starter-netflix-hystrix` from Spring Cloud Netflix.

The Hystrix GatewayFilter Factory requires a single `name` parameter, which is the name of the `HystrixCommand`.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: hystrix_route
        uri: http://example.org
        filters:
        - Hystrix=myCommandName
```

This wraps the remaining filters in a `HystrixCommand` with command name `myCommandName`.

The Hystrix filter can also accept an optional `fallbackUri` parameter. Currently, only `forward:` schemed URIs are supported. If the fallback is called, the request will be forwarded to the controller matched by the URI.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: hystrix_route
        uri: lb://backing-service:8088
        predicates:
        - Path=/consumingserviceendpoint
        filters:
        - name: Hystrix
          args:
            name: fallbackcmd
            fallbackUri: forward:/incaseoffailureusethis
        - RewritePath=/consumingserviceendpoint, /backingserviceendpoint
```

This will forward to the `/incaseoffailureusethis` URI when the Hystrix fallback is called. Note that this example also demonstrates (optional) Spring Cloud Netflix Ribbon load-balancing via the `lb` prefix on the destination URI.

Hystrix settings (such as timeouts) can be configured with global defaults or on a route by route basis using application properties as explained on the Hystrix wiki.

To set a 5 second timeout for the example route above, the following configuration would be used:

application.yml
```
hystrix.command.fallbackcmd.execution.isolation.thread.timeoutInMilliseconds: 5000
```

PrefixPath GatewayFilter Factory

The PrefixPath GatewayFilter Factory takes a single `prefix` parameter.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: prefixpath_route
        uri: http://example.org
        filters:
        - PrefixPath=/mypath
```

This will prefix `/mypath` to the path of all matching requests. So a request to `/hello`, would be sent to `/mypath/hello`.

PreserveHostHeader GatewayFilter Factory

The PreserveHostHeader GatewayFilter Factory has not parameters. This filter, sets a request attribute that the routing filter will inspect to determine if the original host header should be sent, rather than the host header determined by the http client.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: preserve_host_route
        uri: http://example.org
        filters:
        - PreserveHostHeader
```

RequestRateLimiter GatewayFilter Factory

The RequestRateLimiter GatewayFilter Factory is uses a `RateLimiter` implementation to determine if the current request is allowed to proceed. If it is not, a status of `HTTP 429 - Too Many Requests` (by default) is returned.

This filter takes an optional `keyResolver` parameter and parameters specific to the rate limiter (see below).

`keyResolver` is a bean that implements the `KeyResolver` interface. In configuration, reference the bean by name using SpEL. `#{@myKeyResolver}` is a SpEL expression referencing a bean with the name `myKeyResolver`.

KeyResolver.java
```
public interface KeyResolver {
       Mono<String> resolve(ServerWebExchange exchange);
}
```

The `KeyResolver` interface allows pluggable strategies to derive the key for limiting requests. In future milestones, there will be some `KeyResolver` implementations.

The default implementation of `KeyResolver` is the `PrincipalNameKeyResolver` which retrieves the `Principal` from the `ServerWebExchange` and calls `Principal.getName()`.

Note The RequestRateLimiter is not configurable via the "shortcut" notation. The example below is *invalid*

application.properties
```
# INVALID SHORTCUT CONFIGURATION
spring.cloud.gateway.routes[0].filters[0]=RequestRateLimiter=2, 2,
#{@userkeyresolver}
```

Redis RateLimiter

The redis implementation is based off of work done at Stripe. It requires the use of the `spring-boot-starter-data-redis-reactive` Spring Boot starter.

The algorithm used is the Token Bucket Algorithm.

The `redis-rate-limiter.replenishRate` is how many requests per second do you want a user to be allowed to do, without any dropped requests. This is the rate that the token bucket is filled.

The `redis-rate-limiter.burstCapacity` is the maximum number of requests a user is allowed to do in a single second. This is the number of tokens the token bucket can hold. Setting this value to zero will block all requests.

A steady rate is accomplished by setting the same value in `replenishRate` and `burstCapacity`. Temporary bursts can be allowed by setting `burstCapacity` higher than `replenishRate`. In this case, the rate limiter needs to be allowed some time between bursts (according to `replenishRate`), as 2 consecutive bursts will result in dropped requests (`HTTP 429 - Too Many Requests`).

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: requestratelimiter_route
        uri: http://example.org
        filters:
        - name: RequestRateLimiter
          args:
            redis-rate-limiter.replenishRate: 10
            redis-rate-limiter.burstCapacity: 20
```
Config.java
```
@Bean
KeyResolver userKeyResolver() {
    return exchange ->
Mono.just(exchange.getRequest().getQueryParams().getFirst("user"));
}
```

This defines a request rate limit of 10 per user. A burst of 20 is allowed, but the next second only 10 requests will be available. The `KeyResolver` is a simple one that gets the `user` request parameter (note: this is not recommended for production).

A rate limiter can also be defined as a bean implementing the `RateLimiter` interface. In configuration, reference the bean by name using SpEL. `#{@myRateLimiter}` is a SpEL expression referencing a bean with the name `myRateLimiter`.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: requestratelimiter_route
        uri: http://example.org
        filters:
        - name: RequestRateLimiter
          args:
            rate-limiter: "#{@myRateLimiter}"
            key-resolver: "#{@userKeyResolver}"
```

RedirectTo GatewayFilter Factory

The RedirectTo GatewayFilter Factory takes a `status` and a `url` parameter. The status should be a 300 series redirect http code, such as 301. The url should be a valid url. This will be the value of the `Location` header.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: prefixpath_route
        uri: http://example.org
        filters:
        - RedirectTo=302, http://acme.org
```

This will send a status 302 with a `Location:http://acme.org` header to perform a redirect.

RemoveNonProxyHeaders GatewayFilter Factory

The RemoveNonProxyHeaders GatewayFilter Factory removes headers from forwarded requests. The default list of headers that is removed comes from the IETF.

The default removed headers are:

- Connection
- Keep-Alive
- Proxy-Authenticate
- Proxy-Authorization
- TE
- Trailer
- Transfer-Encoding
- Upgrade

To change this, set the `spring.cloud.gateway.filter.remove-non-proxy-headers.headers` property to the list of header names to remove.

RemoveRequestHeader GatewayFilter Factory

The RemoveRequestHeader GatewayFilter Factory takes a `name` parameter. It is the name of the header to be removed.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: removerequestheader_route
        uri: http://example.org
        filters:
        - RemoveRequestHeader=X-Request-Foo
```

This will remove the `X-Request-Foo` header before it is sent downstream.

RemoveResponseHeader GatewayFilter Factory

The RemoveResponseHeader GatewayFilter Factory takes a `name` parameter. It is the name of the header to be removed.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: removeresponseheader_route
        uri: http://example.org
        filters:
        - RemoveResponseHeader=X-Response-Foo
```

This will remove the `X-Response-Foo` header from the response before it is returned to the gateway client.

RewritePath GatewayFilter Factory

The RewritePath GatewayFilter Factory takes a path `regexp` parameter and a `replacement` parameter. This uses Java regular expressions for a flexible way to rewrite the request path.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: rewritepath_route
        uri: http://example.org
        predicates:
        - Path=/foo/**
        filters:
        - RewritePath=/foo/(?<segment>.*), /$\{segment}
```

For a request path of `/foo/bar`, this will set the path to `/bar` before making the downstream request. Notice the `$\` which is replaced with `$` because of the YAML spec.

SaveSession GatewayFilter Factory

The SaveSession GatewayFilter Factory forces a `WebSession::save` operation *before* forwarding the call downstream. This is of particular use when using something like Spring Session with a lazy data store and need to ensure the session state has been saved before making the forwarded call.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: save_session
        uri: http://example.org
        predicates:
        - Path=/foo/**
        filters:
        - SaveSession
```

If you are integrating Spring Security with Spring Session, and want to ensure security details have been forwarded to the remote process, this is critical.

SecureHeaders GatewayFilter Factory

The SecureHeaders GatewayFilter Factory adds a number of headers to the response at the reccomendation from this blog post.

The following headers are added (allong with default values):

- `X-Xss-Protection:1; mode=block`
- `Strict-Transport-Security:max-age=631138519`
- `X-Frame-Options:DENY`
- `X-Content-Type-Options:nosniff`
- `Referrer-Policy:no-referrer`
- `Content-Security-Policy:default-src 'self' https:; font-src 'self' https: data:; img-src 'self' https: data:; object-src 'none'; script-src https:; style-src 'self' https: 'unsafe-inline'`
- `X-Download-Options:noopen`
- `X-Permitted-Cross-Domain-Policies:none`

To change the default values set the appropriate property in the `spring.cloud.gateway.filter.secure-headers` namespace:

Property to change:

- `xss-protection-header`
- `strict-transport-security`
- `frame-options`
- `content-type-options`
- `referrer-policy`
- `content-security-policy`
- `download-options`
- `permitted-cross-domain-policies`

SetPath GatewayFilter Factory

The SetPath GatewayFilter Factory takes a path `template` parameter. It offers a simple way to manipulate the request path by allowing templated segments of the path. This uses the uri templates from Spring Framework. Multiple matching segments are allowed.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: setpath_route
        uri: http://example.org
        predicates:
        - Path=/foo/{segment}
        filters:
        - SetPath=/{segment}
```

For a request path of `/foo/bar`, this will set the path to `/bar` before making the downstream request.

SetResponseHeader GatewayFilter Factory

The SetResponseHeader GatewayFilter Factory takes `name` and `value` parameters.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: setresponseheader_route
        uri: http://example.org
        filters:
        - SetResponseHeader=X-Response-Foo, Bar
```

This GatewayFilter replaces all headers with the given name, rather than adding. So if the downstream server responded with a `X-Response-Foo:1234`, this would be replaced with `X-Response-Foo:Bar`, which is what the gateway client would receive.

SetStatus GatewayFilter Factory

The SetStatus GatewayFilter Factory takes a single `status` parameter. It must be a valid Spring `HttpStatus`. It may be the integer value `404` or the string representation of the enumeration `NOT_FOUND`.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: setstatusstring_route
        uri: http://example.org
        filters:
        - SetStatus=BAD_REQUEST
```

```
      - id: setstatusint_route
        uri: http://example.org
        filters:
        - SetStatus=401
```

In either case, the HTTP status of the response will be set to 401.

StripPrefix GatewayFilter Factory

The StripPrefix GatewayFilter Factory takes one paramter, `parts`. The `parts` parameter indicated the number of parts in the path to strip from the request before sending it downstream.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: nameRoot
        uri: http://nameservice
        predicates:
        - Path=/name/**
        filters:
        - StripPrefix=2
```

When a request is made through the gateway to `/name/bar/foo` the request made to `nameservice` will look like `http://nameservice/foo`.

Retry GatewayFilter Factory

The Retry GatewayFilter Factory takes `retries`, `statuses`, `methods`, and `series` as parameters.

- `retries`: the number of retries that should be attempted
- `statuses`: the HTTP status codes that should be retried, represented using `org.springframework.http.HttpStatus`
- `methods`: the HTTP methods that should be retried, represented using `org.springframework.http.HttpMethod`
- `series`: the series of status codes to be retried, represented using `org.springframework.http.HttpStatus.Series`

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: retry_test
        uri: http://localhost:8080/flakey
        predicates:
        - Host=*.retry.com
        filters:
        - name: Retry
          args:
            retries: 3
            statuses: BAD_GATEWAY
```

Note At this time a URI using the `forward` protocol does not support using the retry filter.

Global Filters

The `GlobalFilter` interface has the same signature as `GatewayFilter`. These are special filters that are conditionally applied to all routes. (This interface and usage are subject to change in future milestones).

Combined Global Filter and GatewayFilter Ordering

TODO: document ordering

Forward Routing Filter

The `ForwardRoutingFilter` looks for a URI in the exchange attribute `ServerWebExchangeUtils.GATEWAY_REQUEST_URL_ATTR`. If the url has a `forward` scheme (ie `forward:///localendpoint`), it will use the Spring `DispatcherHandler` to handler the request. The path part of the request URL will be overridden with the path in the forward URL. The unmodified original url is appended to the list in the `ServerWebExchangeUtils.GATEWAY_ORIGINAL_REQUEST_URL_ATTR` attribute.

LoadBalancerClient Filter

The `LoadBalancerClientFilter` looks for a URI in the exchange attribute `ServerWebExchangeUtils.GATEWAY_REQUEST_URL_ATTR`. If the url has a `lb` scheme (ie `lb://myservice`), it will use the Spring Cloud `LoadBalancerClient` to resolve the name (`myservice` in the previous example) to an actual host and port and replace the URI in the same attribute. The unmodified original url is appended to the list in the `ServerWebExchangeUtils.GATEWAY_ORIGINAL_REQUEST_URL_ATTR` attribute. The filter will also look in the `ServerWebExchangeUtils.GATEWAY_SCHEME_PREFIX_ATTR` attribute to see if it equals `lb` and then the same rules apply.

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: myRoute
        uri: lb://service
        predicates:
        - Path=/service/**
```

Netty Routing Filter

The Netty Routing Filter runs if the url located in the `ServerWebExchangeUtils.GATEWAY_REQUEST_URL_ATTR` exchange attribute has a `http` or `https` scheme. It uses the Netty `HttpClient` to make the downstream proxy request. The response is put in the `ServerWebExchangeUtils.CLIENT_RESPONSE_ATTR` exchange attribute for use in a later filter. (There is an experimental `WebClientHttpRoutingFilter` that performs the same function, but does not require netty)

Netty Write Response Filter

The `NettyWriteResponseFilter` runs if there is a Netty `HttpClientResponse` in the `ServerWebExchangeUtils.CLIENT_RESPONSE_ATTR` exchange attribute. It is run after all other filters have completed and writes the proxy response back to the gateway client response. (There is an experimental `WebClientWriteResponseFilter` that performs the same function, but does not require netty)

RouteToRequestUrl Filter

The `RouteToRequestUrlFilter` runs if there is a `Route` object in the `ServerWebExchangeUtils.GATEWAY_ROUTE_ATTR` exchange attribute. It creates a new URI, based off of the request URI, but updated with the URI attribute of the `Route` object. The new URI is placed in the `ServerWebExchangeUtils.GATEWAY_REQUEST_URL_ATTR` exchange attribute`.

If the URI has a scheme prefix, such as `lb:ws://serviceid`, the `lb` scheme is stripped from the URI and placed in the `ServerWebExchangeUtils.GATEWAY_SCHEME_PREFIX_ATTR` for use later in the filter chain.

Websocket Routing Filter

The Websocket Routing Filter runs if the url located in the `ServerWebExchangeUtils.GATEWAY_REQUEST_URL_ATTR` exchange attribute has a `ws` or `wss` scheme. It uses the Spring Web Socket infrastructure to forward the Websocket request downstream.

Websockets may be load-balanced by prefixing the URI with `lb`, such as `lb:ws://serviceid`.

Note If you are using SockJS as a fallback over normal http, you should configure a normal HTTP route as well as the Websocket Route.

application.yml

```
spring:
  cloud:
    gateway:
      routes:
      # SockJS route
      - id: websocket_sockjs_route
        uri: http://localhost:3001
        predicates:
        - Path=/websocket/info/**
      # Normwal Websocket route
      - id: websocket_route
        uri: ws://localhost:3001
        predicates:
        - Path=/websocket/**
```

Making An Exchange As Routed

After the Gateway has routed a `ServerWebExchange` it will mark that exchange as "routed" by adding `gatewayAlreadyRouted` to the exchange attributes. Once a request has been marked as routed, other routing filters will not route the request again, essentially skipping the filter. There are convenience methods that you can use to mark an exchange as routed or check if an exchange has already been routed.

- `ServerWebExchangeUtils.isAlreadyRouted` takes a `ServerWebExchange` object and checks if it has been "routed"
- `ServerWebExchangeUtils.setAlreadyRouted` takes a `ServerWebExchange` object and marks it as "routed"

Configuration

Configuration for Spring Cloud Gateway is driven by a collection of `RouteDefinitionLocator`s.

RouteDefinitionLocator.java
```
public interface RouteDefinitionLocator {
        Flux<RouteDefinition> getRouteDefinitions();
}
```

By default, a `PropertiesRouteDefinitionLocator` loads properties using Spring Boot's `@ConfigurationProperties` mechanism.

The configuration examples above all use a shortcut notation that uses positional arguments rather than named ones. The two examples below are equivalent:

application.yml
```
spring:
  cloud:
    gateway:
      routes:
      - id: setstatus_route
        uri: http://example.org
        filters:
        - name: SetStatus
          args:
            status: 401
      - id: setstatusshortcut_route
        uri: http://example.org
        filters:
        - SetStatus=401
```

For some usages of the gateway, properties will be adequate, but some production use cases will benefit from loading configuration from an external source, such as a database. Future milestone versions will have `RouteDefinitionLocator` implementations based off of Spring Data Repositories such as: Redis, MongoDB and Cassandra.

Fluent Java Routes API

To allow for simple configuration in Java, there is a fluent API defined in the `RouteLocatorBuilder` bean.

GatewaySampleApplication.java
```
// static imports from GatewayFilters and RoutePredicates
@Bean
public RouteLocator customRouteLocator(RouteLocatorBuilder builder,
ThrottleGatewayFilterFactory throttle) {
    return builder.routes()
            .route(r -> r.host("**.abc.org").and().path("/image/png")
                .filters(f ->
                        f.addResponseHeader("X-TestHeader", "foobar"))
                .uri("http://httpbin.org:80")
            )
            .route(r -> r.path("/image/webp")
                .filters(f ->
                        f.addResponseHeader("X-AnotherHeader", "baz"))
                .uri("http://httpbin.org:80")
            )
            .route(r -> r.order(-1)
                .host("**.throttle.org").and().path("/get")
                .filters(f -> f.filter(throttle.apply(1,
                        1,
                        10,
                        TimeUnit.SECONDS)))
                .uri("http://httpbin.org:80")
            )
            .build();
}
```

This style also allows for more custom predicate assertions. The predicates defined by `RouteDefinitionLocator` beans are combined using logical `and`. By using the fluent Java API, you can use the `and()`, `or()` and `negate()` operators on the `Predicate` class.

DiscoveryClient Route Definition Locator

The Gateway can be configured to create routes based on services registered with a `DiscoveryClient` compatible service registry.

To enable this, set `spring.cloud.gateway.discovery.locator.enabled=true` and make sure a `DiscoveryClient` implementation is on the classpath and enabled (such as Netflix Eureka, Consul or Zookeeper).

Writing Custom GatewayFilter Factories

In order to write a GatewayFilter you will need to implement `GatewayFilterFactory`. There is an abstract class called `AbstractGatewayFilterFactory` which you can extend.

PreGatewayFilterFactory.java
```
public class PreGatewayFilterFactory extends
AbstractGatewayFilterFactory<PreGatewayFilterFactory.Config> {

        public PreGatewayFilterFactory() {
                super(Config.class);
        }

        @Override
        public GatewayFilter apply(Config config) {
                // grab configuration from Config object
```

```
                return (exchange, chain) -> {
            //If you want to build a "pre" filter you need to manipulate
the
            //request before calling change.filter
            ServerHttpRequest.Builder builder =
exchange.getRequest().mutate();
            //use builder to manipulate the request
            return
chain.filter(exchange.mutate().request(request).build());
                };
        }

        public static class Config {
        //Put the configuration properties for your filter here
        }

}
```

PostGatewayFilterFactory.java

```
public class PostGatewayFilterFactory extends
AbstractGatewayFilterFactory<PostGatewayFilterFactory.Config> {

        public PostGatewayFilterFactory() {
                super(Config.class);
        }

        @Override
        public GatewayFilter apply(Config config) {
                // grab configuration from Config object
                return (exchange, chain) -> {
                        return
chain.filter(exchange).then(Mono.fromRunnable(() -> {
                                ServerHttpReponse response =
exchange.getResponse();
                                //Manipulate the response in some way
                        }));
                };
        }

        public static class Config {
        //Put the configuration properties for your filter here
        }

}
```

Writing Custom Global Filters

TODO: document writing Custom Global Filters

Writing Custom Route Locators and Writers

TODO: document writing Custom Route Locators and Writers

Building a Simple Gateway Using Spring MVC or Webflux

Spring Cloud Gateway provides a utility object called `ProxyExchange` which you can use inside a regular Spring web handler as a method parameter. It supports basic downstream HTTP exchanges via methods that mirror the HTTP verbs. With MVC it also supports forwarding to a local handler via the `forward()` method. To use the `ProxyExchange` just include the right module in your classpath (either `spring-cloud-gateway-mvc` or `spring-cloud-gateway-webflux`).

MVC example (proxying a request to "/test" downstream to a remote server):

```
@RestController
@SpringBootApplication
public class GatewaySampleApplication {

        @Value("${remote.home}")
        private URI home;

        @GetMapping("/test")
        public ResponseEntity<?> proxy(ProxyExchange<byte[]> proxy) throws
Exception {
                return proxy.uri(home.toString() + "/image/png").get();
        }

}
```

The same thing with Webflux:

```
@RestController
@SpringBootApplication
public class GatewaySampleApplication {

        @Value("${remote.home}")
        private URI home;

        @GetMapping("/test")
        public Mono<ResponseEntity<?>> proxy(ProxyExchange<byte[]> proxy)
throws Exception {
                return proxy.uri(home.toString() + "/image/png").get();
        }

}
```

There are convenience methods on the `ProxyExchange` to enable the handler method to discover and enhance the URI path of the incoming request. For example you might want to extract the trailing elements of a path to pass them downstream:

```
@GetMapping("/proxy/path/**")
public ResponseEntity<?> proxyPath(ProxyExchange<byte[]> proxy) throws
Exception {
  String path = proxy.path("/proxy/path/");
  return proxy.uri(home.toString() + "/foos/" + path).get();
}
```

All the features of Spring MVC or Webflux are available to Gateway handler methods. So you can inject request headers and query parameters, for instance, and you can constrain the incoming requests with declarations in the mapping annotation. See the documentation for `@RequestMapping` in Spring MVC for more details of those features.

Headers can be added to the downstream response using the `header()` methods on `ProxyExchange`.

You can also manipulate response headers (and anything else you like in the response) by adding a mapper to the `get()` etc. method. The mapper is a `Function` that takes the incoming `ResponseEntity` and converts it to an outgoing one.

First class support is provided for "sensitive" headers ("cookie" and "authorization" by default) which are not passed downstream, and for "proxy" headers (`x-forwarded-*`).