Server Load Balancer

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Introduction

- ❑ More users, more resources needed
  - CPU, RAM, HDD …
- ❑ Scale Up & Scale Out
  - One powerful server to service more users; or
  - Multiple servers to service more users
- ❑ Pros & Cons ?
- ❑ C10K Problem

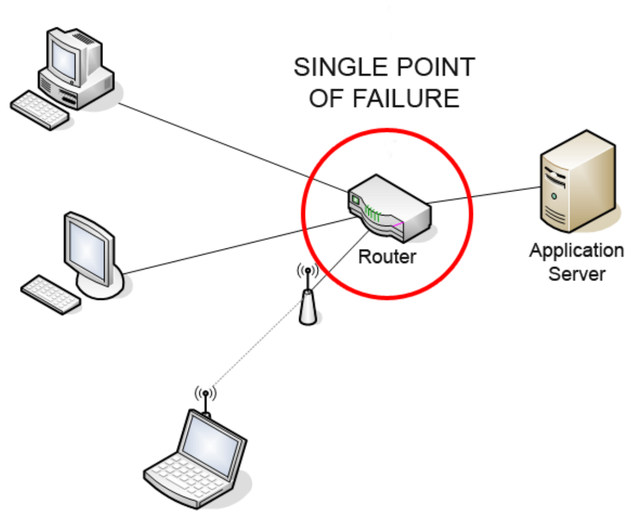
Introduction

- High Availability
  - A characteristic of a system, which aims to ensure an agreed level of operational performance, usually uptime, for a higher than normal period.

- Availability (per year)
  - 99%: 3.65days
  - 99.9%: 8.77 hours (3 nines)
  - 99.99%: 52.60 minutes (4 nines)
  - 99.999%: 5.26 minutes (5 nines)

High Availability

- ❑ Principles
  - Elimination of single points of failure.
  - Reliable crossover.
    - ➢ Reliable configuration / topology change
  - Detection of failures as they occur.



- ❑ Graceful Degradation
  - the ability of a computer, machine, electronic system or network to maintain limited functionality even when a large portion of it has been destroyed or rendered inoperative.

Load Balancing

❑ Client Side
- e.g: DNS round-robin
- Pros & Cons

❑ Server Side
- Server Load Balancer

Server Load Balancer (1)

- ❑ Provide "Scale-Out" and HA features
- ❑ Share loading among all backend nodes with some algorithms
  - Static Algorithms: does not take into account the state of the system for the distribution of tasks.
  - Dynamic Algorithms

Server Load Balancer (2)

- Layer 4 or Layer 7
  - Layer 4 Switch
- Distribution Algorithms
  - Round-robin
  - Random
  - Ratio
  - Hash Table
  - Least-connections
  - Persistence
    - Session-ID (e.g. HTTP Cookie)

Server Load Balancer (3)

- Persistence (Stickiness)
  - "The Server" in OLG
  - How to handle information that must be kept across the multiple requests in a user's session.

- Session ID?
  - Cookie
  - IP Address
  - TCP Connection

- Pros & Cons ?

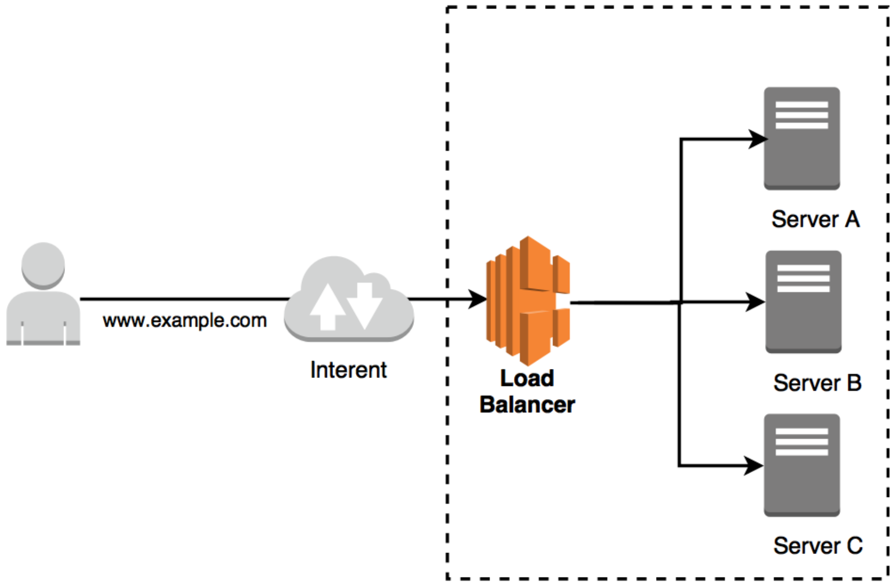
Server Load Balancer (4)

❑ SSL offloading (SSL/TLS termination)

- Pros?

❑ Problems of Server Load Balancer

- SPoF
- Capacity Limit
- Latency



Haproxy

- http://www.haproxy.org

- Reliable & High Performance TCP/HTTP Load Balancer
    - Layer 4 (TCP) and Layer 7 (HTTP) load balancing
    - SSL/TLS termination
    - Gzip compression
    - Health checking
    - HTTP/2

Haproxy - Installation

- ❑ pkg install haproxy
- ❑ You can also build it from ports
- ❑ Config file: /usr/local/etc/haproxy.conf

Haproxy - Configuration

```
global
  daemon
  log 127.0.0.1 local0
  log 127.0.0.1 local1 notice
  maxconn 4096
  tune.ssl.default-dh-param 2048

defaults
  log                 global
  retries             3
  maxconn             2000
  timeout connect     5s
  timeout client      50s
  timeout server      50s

listen stats
  bind 127.0.0.1:9090
  balance
  mode http
  stats enable
  stats auth admin:admin
```

Haproxy - Configuration

```

frontend www_csie_nctu
  bind 140.113.208.102:80
  mode http
  use_backend www_csie_nctu_server

frontend cscc_csie_nctu
  bind 140.113.208.103:80
  mode http
  use_backend cscc_csie_nctu_server

frontend game_server
  bind 140.113.208.104:9876
  mode tcp

backend www_csie_nctu_server
  balance roundrobin
  mode http
  option forwardfor
  http-request set-header X-Forwarded-Port %[dst_port]
  http-request add-header X-Forwarded-Proto https if { ssl_fc }
  server www1 192.168.99.1:80
  server www2 192.168.99.2:80
```

Haproxy - Configuration

```
backend cscc_csie_nctu_server
  balance roundrobin
  mode http
  option httpchk HEAD /health_check.php HTTP/1.1\r\nHost:\ cscc.cs.nctu.edu.tw
  option forwardfor
  http-request set-header X-Forwarded-Port %[dst_port]
  http-request add-header X-Forwarded-Proto https if { ssl_fc }
  server www1 192.168.99.101:80 check fall 3 rise 2
  server www2 192.168.99.102:80 check fall 3 rise 2
```

Haproxy Configuration

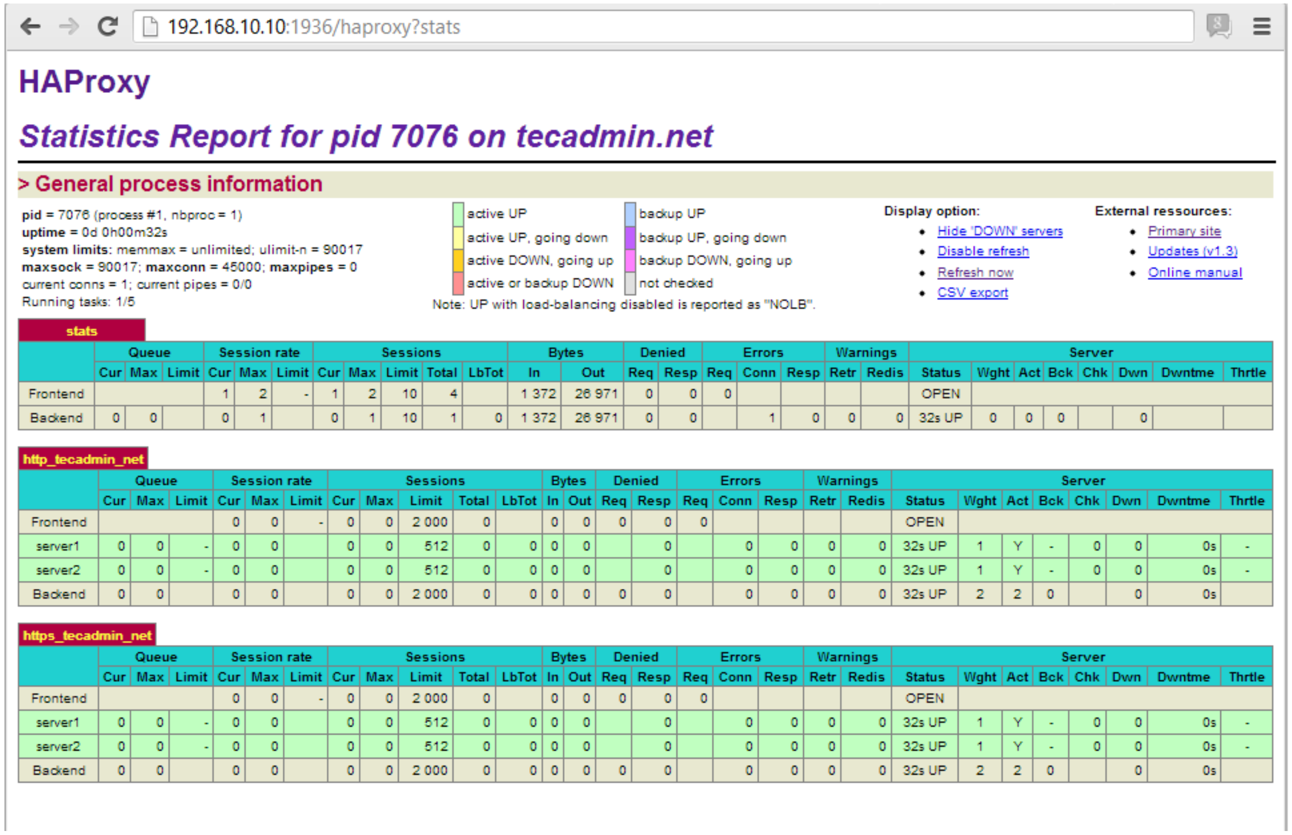
- global
  - log
  - chroot
  - uid / gid
  - pidfile

Haproxy Configuration

- defaults
  - log
  - option
  - retries
  - timeout

Haproxy Configuration

- listen
  - stats



192.168.10.10:1936/haproxy?stats

HAProxy

Statistics Report for pid 7076 on tecadmin.net

> General process information

pid = 7076 (process #1, nbproc = 1)
uptime = 0d 0h00m32s
system limits: memmax = unlimited; ulimit-n = 90017
maxsock = 90017; **maxconn** = 45000; **maxpipes** = 0
current conns = 1; current pipes = 0/0
Running tasks: 1/5

🟩	active UP	🟦	backup UP
🟨	active UP, going down	🟪	backup UP, going down
🟧	active DOWN, going up	🟪	backup DOWN, going up
🟥	active or backup DOWN	⬜	not checked

Note: UP with load-balancing disabled is reported as "NOLB".

Display option:
- Hide 'DOWN' servers
- Disable refresh
- Refresh now
- CSV export

External ressources:
- Primary site
- Updates (v1.3)
- Online manual

stats

	Queue			Session rate			Sessions					Bytes		Denied		Errors			Warnings		Server							
	Cur	Max	Limit	Cur	Max	Limit	Cur	Max	Limit	Total	LbTot	In	Out	Req	Resp	Req	Conn	Resp	Retr	Redis	Status	Wght	Act	Bck	Chk	Dwn	Dwntme	Thrtle
Frontend				1	2	-	1	2	10	4		1 372	26 971	0	0	0					OPEN							
Backend	0	0		0	1		0	1	10	1	0	1 372	26 971	0	0		1	0	0	0	32s UP	0	0	0		0		

http_tecadmin_net

	Queue			Session rate			Sessions					Bytes		Denied		Errors			Warnings		Server							
	Cur	Max	Limit	Cur	Max	Limit	Cur	Max	Limit	Total	LbTot	In	Out	Req	Resp	Req	Conn	Resp	Retr	Redis	Status	Wght	Act	Bck	Chk	Dwn	Dwntme	Thrtle
Frontend				0	0	-	0	0	2 000	0		0	0	0	0	0					OPEN							
server1	0	0	-	0	0		0	0	512	0	0	0	0		0		0	0	0	0	32s UP	1	Y	-	0	0	0s	-
server2	0	0	-	0	0		0	0	512	0	0	0	0		0		0	0	0	0	32s UP	1	Y	-	0	0	0s	-
Backend	0	0		0	0		0	0	2 000	0	0	0	0	0	0		0	0	0	0	32s UP	2	2	0		0	0s	

https_tecadmin_net

	Queue			Session rate			Sessions					Bytes		Denied		Errors			Warnings		Server							
	Cur	Max	Limit	Cur	Max	Limit	Cur	Max	Limit	Total	LbTot	In	Out	Req	Resp	Req	Conn	Resp	Retr	Redis	Status	Wght	Act	Bck	Chk	Dwn	Dwntme	Thrtle
Frontend				0	0	-	0	0	2 000	0		0	0	0	0	0					OPEN							
server1	0	0	-	0	0		0	0	512	0	0	0	0		0		0	0	0	0	32s UP	1	Y	-	0	0	0s	-
server2	0	0	-	0	0		0	0	512	0	0	0	0		0		0	0	0	0	32s UP	1	Y	-	0	0	0s	-
Backend	0	0		0	0		0	0	2 000	0	0	0	0	0	0		0	0	0	0	32s UP	2	2	0		0	0s	

Haproxy Configuration

- frontend
  - bind
  - mode
  - option
  - use_backend

Haproxy Configuration

- backend
  - balance
    - roundrobin, leastconn, hdr(param)
  - mode
  - http-request
  - server
    - check
    - fall
    - rise
    - inter
    - cookie

Haproxy - run

- /etc/rc.conf.local
  - haproxy_enable="YES"
- /usr/local/etc/rc.d/haproxy start
- Question: how to setup a backup node for haproxy?

Haproxy - Reference

- http://cbonte.github.io/haproxy-dconv/2.1/configuration.html

Envoy

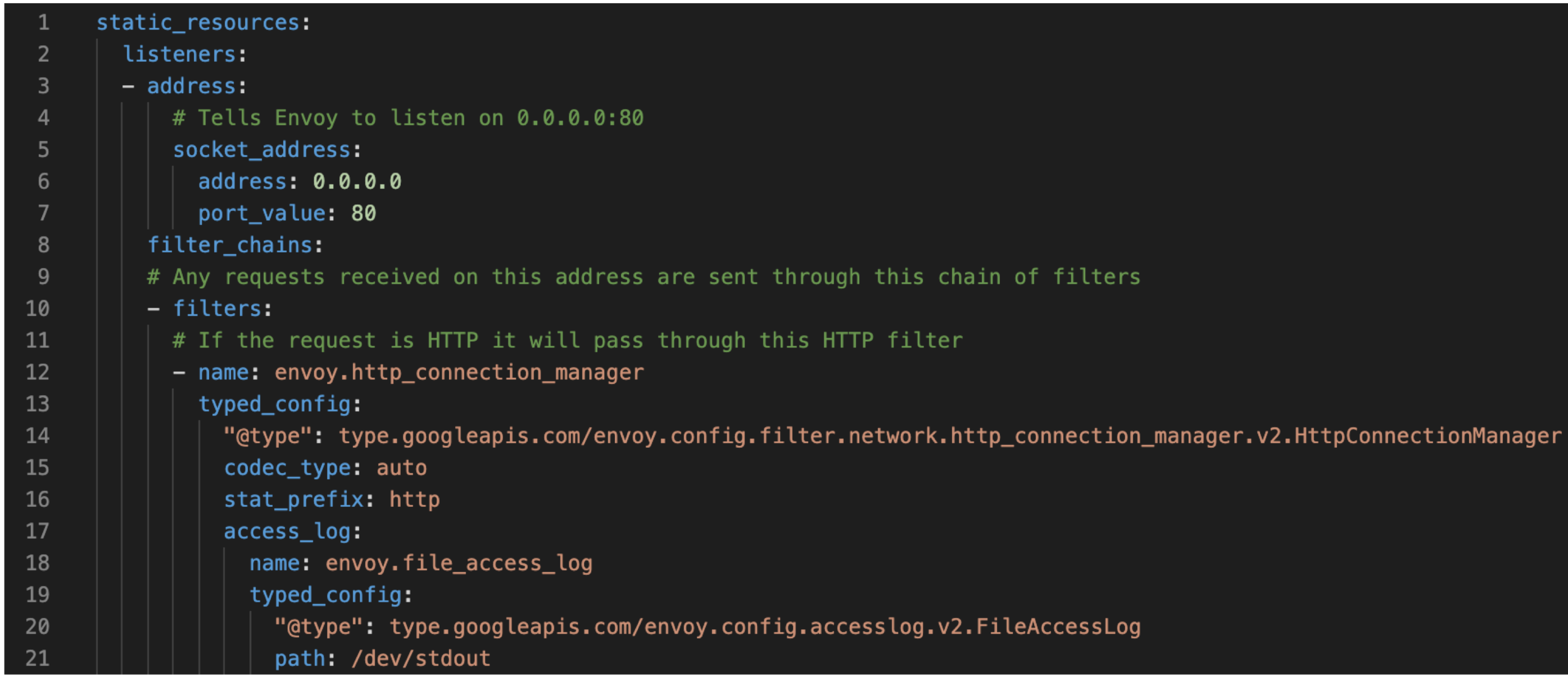
- ❑ https://www.envoyproxy.io
- ❑ Developed by Lyft (a ride-sharing company like Uber) and opensourced in 2017
  - Apache License 2.0
- ❑ Features
  - Dynamic APIs for configuration
  - Service Discovery
  - gRPC / MongoDB / HTTP support

Envoy - Installation

- Broken in FreeBSD now
  - You can install it on Linux instead

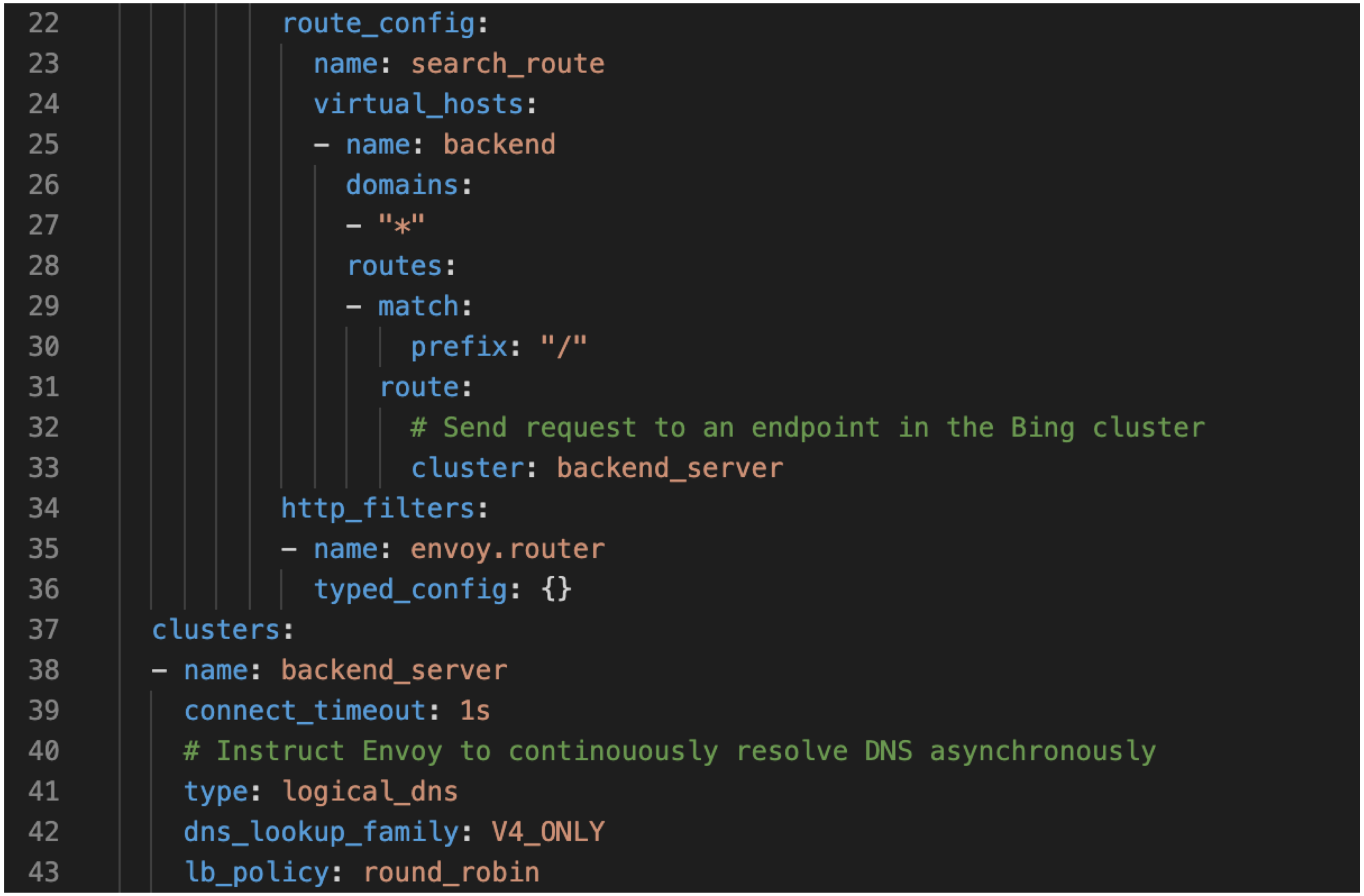
- https://www.getenvoy.io
  - Debian: https://www.getenvoy.io/install/envoy/debian/
  - Ubuntu: https://www.getenvoy.io/install/envoy/ubuntu/
  - Centos: https://www.getenvoy.io/install/envoy/centos/

Envoy - Configuration



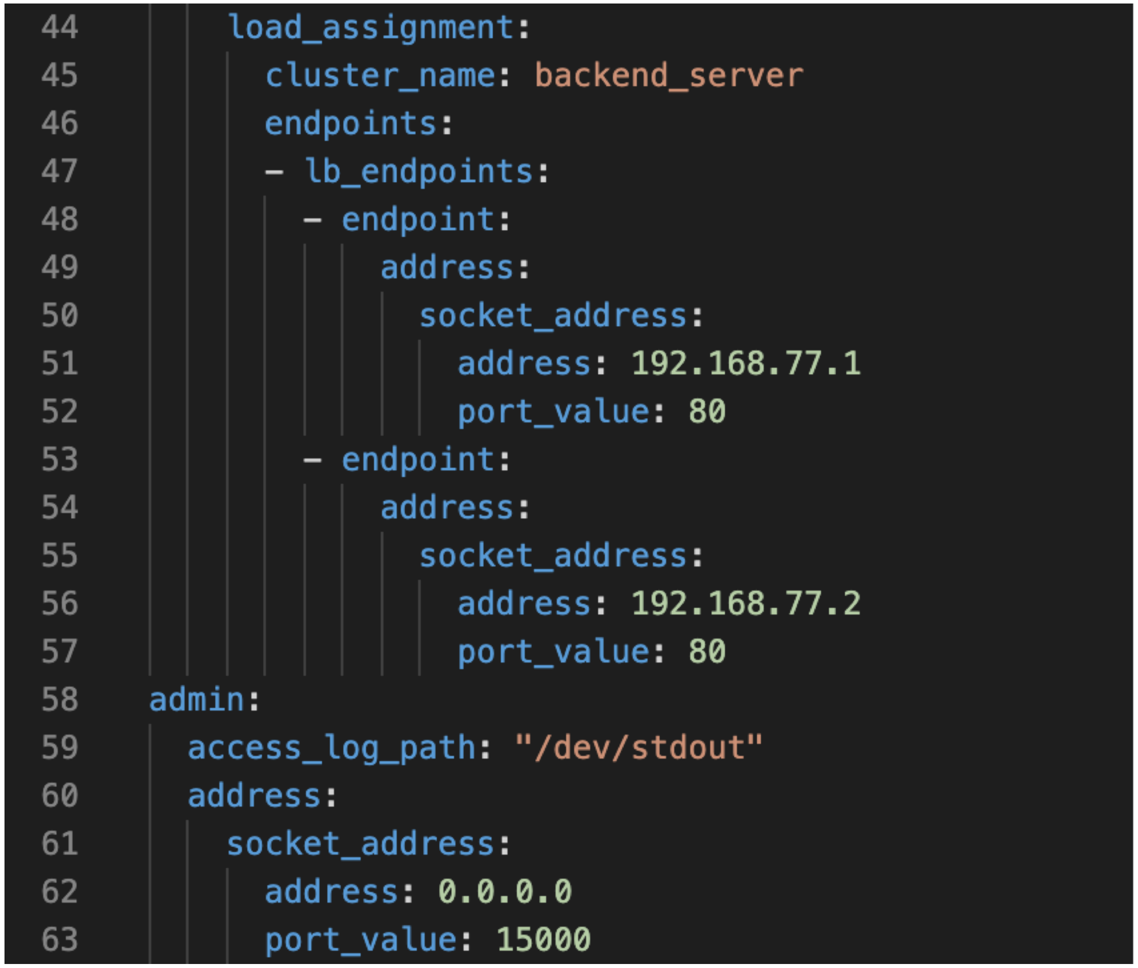
```yaml
static_resources:
  listeners:
  - address:
      # Tells Envoy to listen on 0.0.0.0:80
      socket_address:
        address: 0.0.0.0
        port_value: 80
    filter_chains:
    # Any requests received on this address are sent through this chain of filters
    - filters:
      # If the request is HTTP it will pass through this HTTP filter
      - name: envoy.http_connection_manager
        typed_config:
          "@type": type.googleapis.com/envoy.config.filter.network.http_connection_manager.v2.HttpConnectionManager
          codec_type: auto
          stat_prefix: http
          access_log:
            name: envoy.file_access_log
            typed_config:
              "@type": type.googleapis.com/envoy.config.accesslog.v2.FileAccessLog
              path: /dev/stdout
```

Envoy - Configuration



```yaml
          route_config:
            name: search_route
            virtual_hosts:
            - name: backend
              domains:
              - "*"
              routes:
              - match:
                  prefix: "/"
                route:
                  # Send request to an endpoint in the Bing cluster
                  cluster: backend_server
          http_filters:
          - name: envoy.router
            typed_config: {}
  clusters:
  - name: backend_server
    connect_timeout: 1s
    # Instruct Envoy to continouously resolve DNS asynchronously
    type: logical_dns
    dns_lookup_family: V4_ONLY
    lb_policy: round_robin
```

Envoy - Configuration



```yaml
        load_assignment:
          cluster_name: backend_server
          endpoints:
          - lb_endpoints:
            - endpoint:
                address:
                  socket_address:
                    address: 192.168.77.1
                    port_value: 80
            - endpoint:
                address:
                  socket_address:
                    address: 192.168.77.2
                    port_value: 80
admin:
  access_log_path: "/dev/stdout"
  address:
    socket_address:
      address: 0.0.0.0
      port_value: 15000
```

Envoy - Configuration

- YAML file format

- Basic concept is same as haproxy
  - Listen (frontend) address
  - Backend addresses
  - Healthy Checks
    - https://www.envoyproxy.io/learn/health-check
  - Routes

Envoy - Run

- envoy -c config.yaml

Envoy - Reference

- https://www.envoyproxy.io/docs/envoy/latest/
- https://blog.getambassador.io/envoy-vs-nginx-vs-haproxy-why-the-open-source-ambassador-api-gateway-chose-envoy-23826aed79ef