Load balancer setup based on HAProxy

HAProxy is a reliable open source tool to implement reverse proxy server and load balancers. Most of well known load balancers, AWS LB for example, are based on HAProxy modified source code. Let's see how to setup a custom load balancer using HAProxy.

Prerequsites

To deploy load balancer, prepare the following:

- a couple of servers with WCS installed and configured (cloud or hardware)
- a dedicated server to be enrty point for clients incoming connections
- a domain name and SSL certificate

If WCS servers supposed to be in CDN, CDN setup should be done before. For example, if the goal is to balance publishers to a number of Origin servers, or subscribers to a number of Edges, all thosew instances should be configured before deploying the load balancer.

WCS servers setup

1. Incoming connections ports

Open all the necessary ports for incoming connections on every WCS server (if this is not already done). Look at the minimal ports setup example for AWS EC2 instance

Port range	Protocol	Source
22	TCP	0.0.0.0/0
8080 - 8084	TCP	0.0.0.0/0
443	TCP	0.0.0.0/0
8888	TCP	0.0.0.0/0
30000 - 33000	UDP	0.0.0.0/0
8443 - 8445	TCP	0.0.0.0/0
1935	UDP	0.0.0.0/0
9091	TCP	0.0.0.0/0
80	TCP	0.0.0.0/0
9707	TCP	0.0.0.0/0

Note that TCP port 9707 should be added. This port will be used by HAProxy to check a current server state.

Media traffic ports (30000-33000 in the example above) should be available from outside networks if server is behind a NAT, because HAProxy may proxy Websocket connectinos only, but not WebRTC.

2. WCS setup

Add the following parameters to `flashphoner.properties` file to use a real client IP addresses in session identifiers

```
ws.map_custom_headers=true
ws.ip_forward_header=X-Client-IP
```

If servers load supposed to be balanced depenfing on channel bandwidth, add the following setting too

```
global_bandwidth_check_enabled=true
```

Then restart WCS

```
sudo systemctl restart webcallserver
```

3. HAProxy agent setup

3.1. Install all the necessary dependencies to the server

```
yum install jq bc xinetd telnet
```

3.2. Copy the necessary scripts to the server

Copy the scripts `haproxy-agent-check.sh` and `haproxy-agent-check-launch.sh` to `/usr/local/bin` folder and allow execution

```
sudo cp haproxy-agent-check* /usr/local/bin/
sudo chmod +x /usr/local/bin/haproxy-agent-check*
```

haproxy-agent-check-launch.sh

haproxy-agent-check.sh

The `haproxy-agent-check.sh` is used to check server state according to system information and WCS statistics. If any of thresholds passed to the script is reached, the script will return `down` state. HAProxy, in its turn, will not dispatch a new connections to the server until the agent script returns `up` .

The following tresholds are supported:

- `cpu` - maximum CPU load average in percents, `90` by default
- `publishers` - maximum publishers count per server, including WebRTC, RTMP, RTSP streams, `100` by default
- `subscribers` - maximum subscribers count per server, including WebRTC, RTMP, RTSP players, `100` by default
- `hls` - maximum HLS streams count per server, `100` by default
- `band-in` - maximum incoming channel bandwidth occupied, `100` Mbps by default
- `band-out` - maximum outgoing channel bandwidth occupied, `100` Mbps by default

For example, to check if CPU LA is below 70%, the script sholud be launched as

```
/usr/local/bin/haproxy-agent-check.sh cpu 70
```

3.3. Add the agent port to server setup

Add the following string to `/etc/services` file

```
haproxy-agent-check 9707/tcp # haproxy-agent-check
```

3.4. Configure xinetd

Add the file `haproxy-agent-check` with the following content to the folder `/etc/xinetd.d`

```
# default: on
# description: haproxy-agent-check
service haproxy-agent-check
{
        disable         = no
        flags           = REUSE
        socket_type     = stream
        port            = 9707
        wait            = no
        user            = nobody
        server          = /usr/local/bin/haproxy-agent-check-launch.sh
        log_on_failure  += USERID
        only_from       = 172.31.42.154 127.0.0.1
        per_source      = UNLIMITED
}
```

The helper script `haproxy-agent-check-launch.sh` is used because xinetd does not support any command line keys in `server` parameter

The `only_from` parameters allows connections to the port 9707 only from load balancer server where HAProxy will be installed, and from localhost for testing purposes.

3.5. Allow `haproxy-agent-check` execution

```
sudo chmod +x /etc/xinetd/haproxy-agent-check
```

3.6. Restart xinetd

```
sudo systemctl restart xinetd
```

3.7. Test the agent work

```
telnet localhost 9707
```

```
[ec2-user@ip-172-31-44-243 ~]$ telnet localhost 9707
Trying 127.0.0.1...
Connected to localhost.
Escape character is '^]'.
up 100%
Connection closed by foreign host.
```

Load balancer setup

1. Configure nginx to serve example applications (or any other frontend task)

1.1. Install nginx

```
sudo yum install nginx
```

1.2 Configure nginx

Change default port in `/etc/nginx/nginx.conf` file, and set the server name as `localhost`

```
server {
    listen       8180;
    listen       [::]:8180;
    server_name  localhost;
    root         /usr/share/nginx/html;

    # Load configuration files for the default server block.
    include /etc/nginx/default.d/*.conf;

    error_page 404 /404.html;
    location = /404.html {
    }

    error_page 500 502 503 504 /50x.html;
    location = /50x.html {
    }
}
```

nginx will be available only locally because HAProxy will provide an entry point for clients.

1.3. Restart nginx

```
sudo systemctl restart nginx
```

1.4. Download WebSDK actual build bundle

Download WebSDK actual build bundle

```
wget https://flashphoner.com/downloads/builds/flashphoner_client/wcs_api-
2.0/flashphoner-api-2.0.206-7d9863ae4de631a59ff8793ddecd104ca2fd4a22.tar.gz
```

and unpack it to the `/usr/share/nginx/html/wcs` folder

```
sudo mkdir /usr/share/nginx/html/wcs
cd /usr/share/nginx/html/wcs
sudo tar -xzf ~/flashphoner-api-2.0.206-
7d9863ae4de631a59ff8793ddecd104ca2fd4a22.tar.gz --strip-components=2
```

2. SSL certificates setup for HAProxy

2.1. Create a full certificate file in PEM format

2.1. Create a full certificate file in PEM format (must include all the certificates and a private key) and copy to a folder whele certificate file should be available

```
cat cert.crt ca.crt cert.key >> cert.pem
sudo mkdir -p /etc/pki/tls/mydomain.com
sudo cp cert.pem /etc/pki/tls/mydomain.com
```

3. HAProxy configuration

3.1. Install HAProxy

```
sudo yum install haproxy
```

3.2. Configure HAProxy

Edit the file `/etc/haproxy/haproxy.cfg`

haproxy.cfg

All the parameters in `global` and `defaults` sections may be left by default. Configure frontend

```
frontend wcs-balancer
    bind *:443 ssl crt /etc/pki/tls/mydomain.com/cert.pem
    acl is_websocket hdr(Upgrade) -i WebSocket
    acl is_websocket hdr(Sec-WebSocket-Key) -m found
    use_backend wcs_back if is_websocket
    default_backend wcs_web_admin
```

Set nginx with WebSDK examples as default backend

```
backend wcs_web_admin
    server wcs_web_http localhost:8180 maxconn 100 check
```

Backend to balance a load between two instances (IP addresses are private and shown for example only)

```
backend wcs_back
    http-request add-header X-Client-IP %ci:%cp
    balance     roundrobin
    server wcs1_ws 172.31.44.243:8080 maxconn 100 weight 100 check agent-
check agent-inter 5s agent-port 9707
    server wcs2_ws 172.31.33.112:8080 maxconn 100 weight 100 check agent-
check agent-inter 5s agent-port 9707
```

```
#---------------------------------------------------------------------
# main frontend which proxys to the backends
#---------------------------------------------------------------------
frontend wcs-balancer
    bind *:443 ssl crt /etc/pki/tls/fpntest.com/cert.pem
    acl is_websocket hdr(Upgrade) -i WebSocket
    acl is_websocket hdr(Sec-WebSocket-Key) -m found
    use_backend wcs_back if is_websocket
    default_backend wcs_web_admin

#---------------------------------------------------------------------
# round robin balancing between the various backends
#---------------------------------------------------------------------
backend wcs_back
    http-request add-header X-Client-IP %ci:%cp
    balance     roundrobin
    server wcs1_ws 172.31.44.243:8080 maxconn 100 weight 100 check agent-check agent-inter 5s agent-port 9707
    server wcs2_ws 172.31.33.112:8080 maxconn 100 weight 100 check agent-check agent-inter 5s agent-port 9707

#---------------------------------------------------------------------
# WCS web admin dashboard
#---------------------------------------------------------------------
backend wcs_web_admin
    server wcs_web_http localhost:8180 maxconn 100 check
```

Session stickiness may be set up as follows

```
backend wcs_back
    http-request add-header X-Client-IP %ci:%cp
    balance     roundrobin
    cookie SERVERID insert indirect nocache
    server wcs1_ws 172.31.44.243:8080 maxconn 100 weight 100 check agent-
check agent-inter 5s agent-port 9707 cookie wcs1_ws
    server wcs2_ws 172.31.33.112:8080 maxconn 100 weight 100 check agent-
check agent-inter 5s agent-port 9707 cookie wcs1_ws
```

In this case, all the connections from a certain client will be redirected to the same server unless it returns `down` state

Load balancing by maximum client connections to the server may be configured as follows

```
backend wcs_back
    http-request add-header X-Client-IP %ci:%cp
    balance     leastconn
    server wcs1_ws 172.31.44.243:8080 maxconn 100 weight 100 check agent-
check agent-inter 5s agent-port 9707
    server wcs2_ws 172.31.33.112:8080 maxconn 100 weight 100 check agent-
check agent-inter 5s agent-port 9707
```

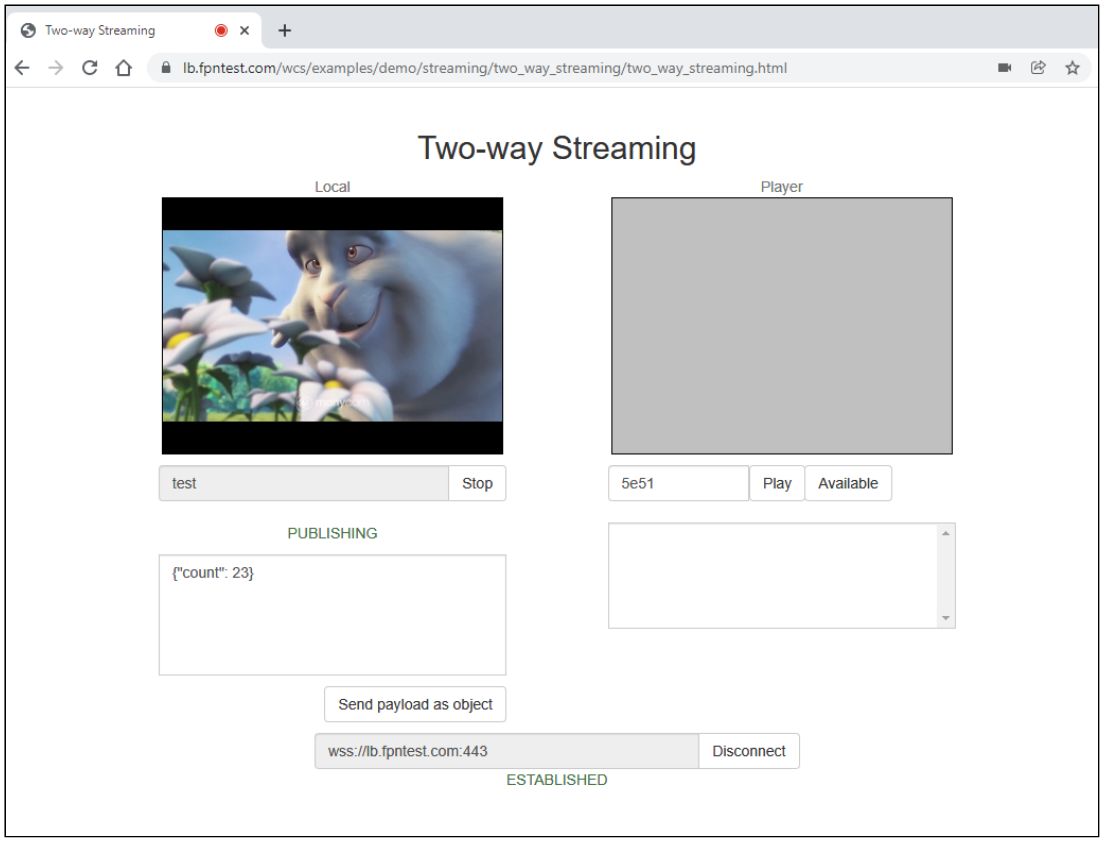
In this case all the clients will be redirected to the first server until either `maxconn` is reached or or server returns `down` state

3.3. Restart HAProxy

```
sudo systemctl restart haproxy
```

Testing

1. Open `Two Way Streaming` example, set port 443 in Websocket URL input field and publish a stream



2. Check the statistics page on the first WCS server

```
[ec2-user@ip-172-31-44-243 ~]$ curl -s http://localhost:8081/?action=stat
-----Connection Stats-----
connections=1
connections_rtmfp=0
connections_websocket=1
connections_hls=0
-----Port Stats-----
ports_media_free=498
ports_media_busy=1
ports_media_quarantine=0
ports_wcs_agents_free=998
ports_wcs_agents_busy=0
ports_wcs_agents_quarantine=0
-----Stream Stats-----
streams_webrtc_in=1
streams_webrtc_out=0
streams_websocket_out=0
streams_rtmfp_in=0
streams_rtmfp_out=0
streams_rtmp_in=0
streams_rtmp_out=0
streams_hls=0
streams_viewers=test/0
streams_synchronization=test/-37
stats_size=0
streams_rtsp_in=0
streams_rtsp_out=0
streams_rtsp_push_in=0
streams_rtsp_push_out=0
streams_rtmp_client_out=0
streams_play_rate=0
streams_stop_rate=0
```

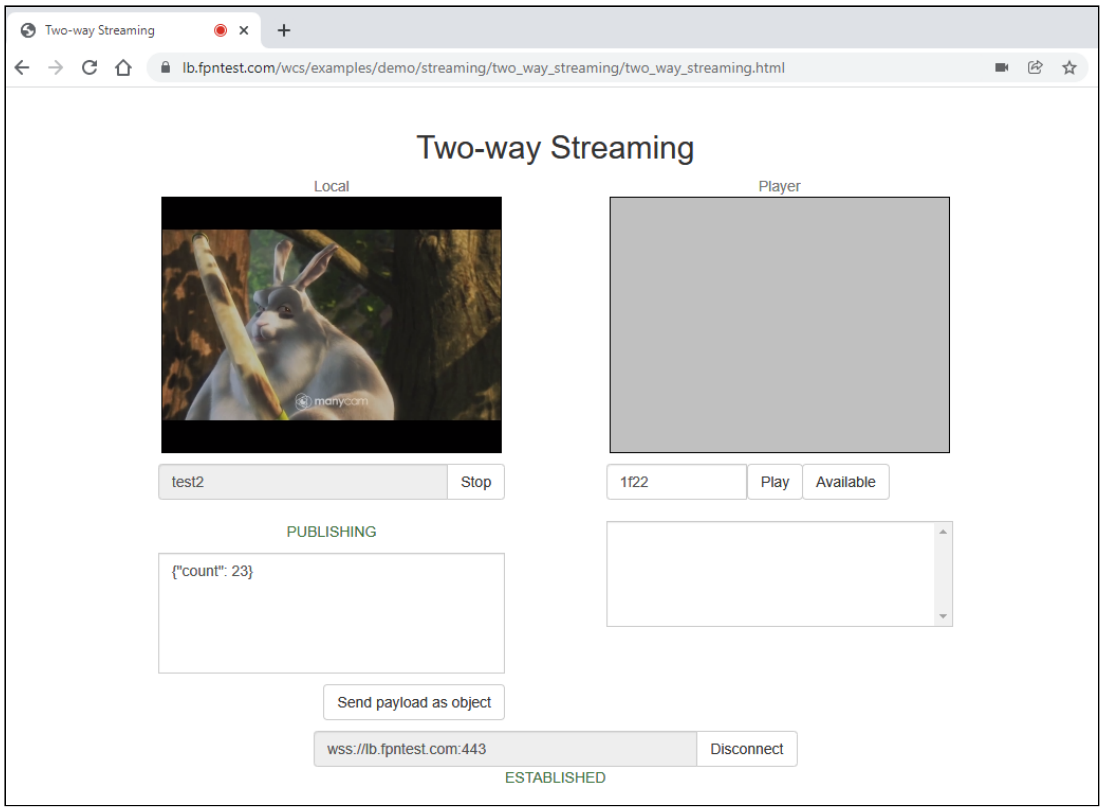
One Websocket connection (1), one incoming stream (2) named `test` (3) are displayed

3. Check session Id

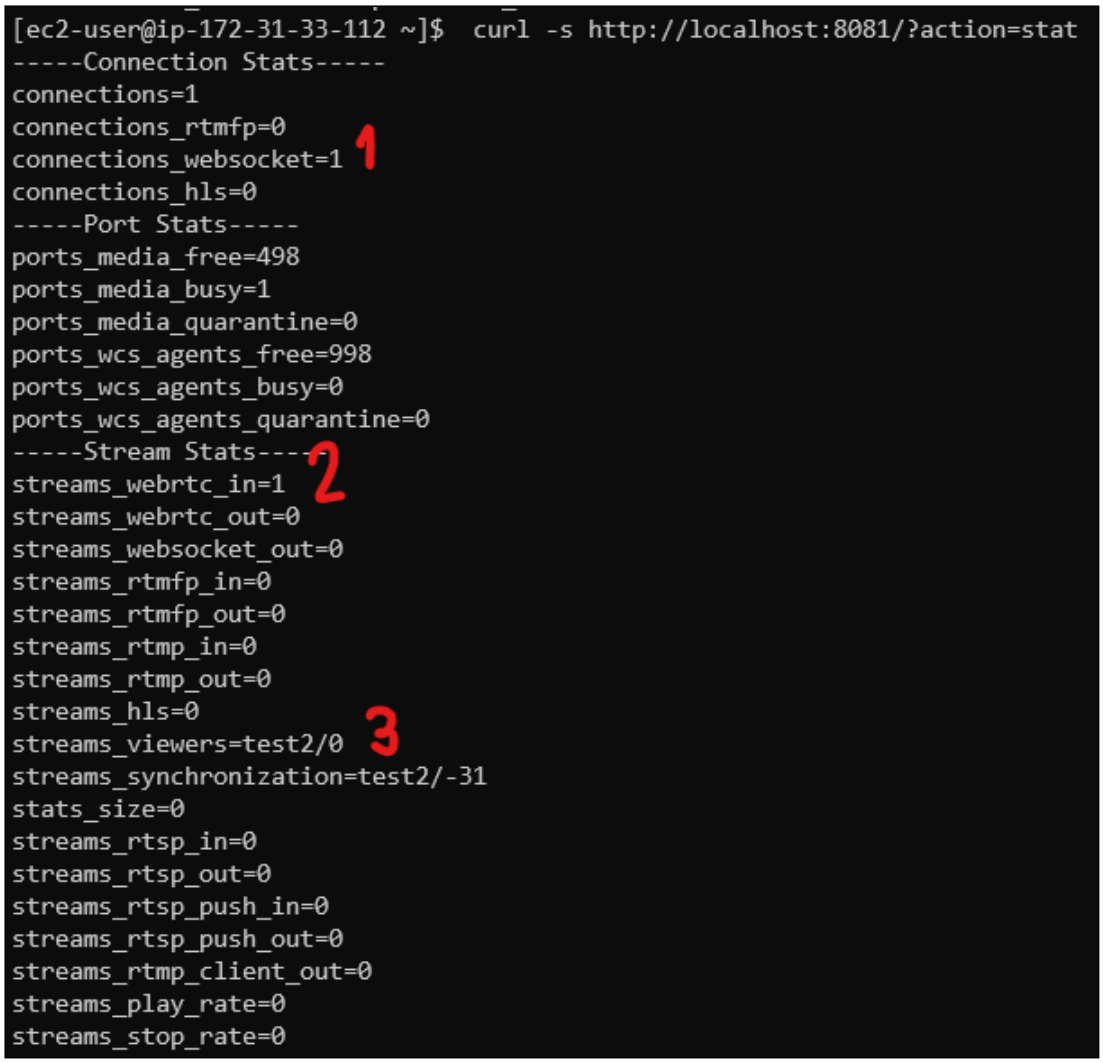
```
[ec2-user@ip-172-31-44-243 ~]$ curl -s -H "Content-Type: application/json" -X POST http://localhost:8081/rest-api/stream/find -d '{"published":true}' | jq .[].sessionId
"/[redacted].23.83:53512/172.31.44.243:8080-df8c1c26-7758-4ca0-acda-1cc9a48a4d21"
```

Client IP address and port are used in session Id.

4. Open `Two Way Streaming` example in another browser window, set port 443 in Websocket URL input field and publish a second stream


Two-way Streaming
lb.fpntest.com/wcs/examples/demo/streaming/two_way_streaming/two_way_streaming.html
Two-way Streaming
Local
Player
test2
Stop
1f22
Play
Available
PUBLISHING
{"count": 23}
Send payload as object
wss://lb.fpntest.com:443
Disconnect
ESTABLISHED

5. Check the statistics page on the second WCS server



One Websocket connection (1), one incoming stream (2) named `test2` (3) are displayed