University of Bamberg
Professorship for Computer Science

Foundations of Internet Communication
KTR-GIK-M
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Assignment 3

Domain Name System (DNS) and Load Balancing

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Prelab

1. Remember the lectures about the Domain Name System (DNS) and get yourself an overview of CoreDNS.
2. Inform yourself about load balancing with DNS.
3. Discover the functionality of *dig* (domain information groper).
4. Get yourself familiar with a software load balancer called traefik.

1 The Domain Information Groper (dig)

For the beginning, we'll make extensive use of the tool *dig* (domain information groper), which is available in most Linux/Unix platforms today, or as Web interface[1]. Moreover, it is integrated in our Docker image, where you can use it with `docker run unibaktr/alpine:busybox dig`.

Now it is time for you to solve the following tasks with the help of `dig`:

1. Determine the authoritative DNS servers for the top level domain *ru*.
2. Determine the addresses of the Internet DNS root servers.
3. Run `dig` to display the nameservers for the domain `uni-bamberg.de`

2 DNS Configuration with CoreDNS

We can setup Kathará nodes to reach a DNS server by modifying the file `/etc/resolv.conf`. However, due to some restrictions introduced by Docker, we cannot setup this file via DHCP and thus use a static IP configuration in this assignment.

1. At first, add the addtional "cables" as shown in Figure 1 below by adjusting Kathará's `lab.conf` file from assignment 2 and specify the Docker images, which should be used in your environment according to Table 1.
2. Then, configure all the interfaces as shown in Table 1. You may also use `startup` scripts to ease the configuration.
3. Add the static routes to the topology, wherever needed, to ensure the connectivity.
4. On node `dns_root` setup a DNS server
   - as an authoritative server for the root domain

[1] http://www.digwebinterface.com/

    - and additionally for the domain `de`
    - where a name entry (A record) `gik.de` is pointing to webserver `web1`.

5. Add a nameserver entry to `/etc/resolv.conf` on `pcX`, which points to `dns_root` and ensure that `curl gik.de` delivers a result.
6. With Wireshark capture the name resolution on CD A and explain the DNS procedure.
7. Use `dig` to determine the authoritative server for the root domain.
8. On node `dns_lb` setup a DNS servers
    - as an authoritative server for the domain `org`
    - with the name entry `gik.org` pointing to the webservers `web_bernadette`, `web_amy`, and `web_penny`.
9. Modify `dns_root` to forward the name resolution of `org` to `dns_lb`
10. Now configure CoreDNS on `dns_lb` to load balance the entry `gik.org` and run `curl gik.org` several times. What do you observe? What are the pitfalls of DNS load balancing?
11. Run `dig` once more to determine the entries for `gik.org`.

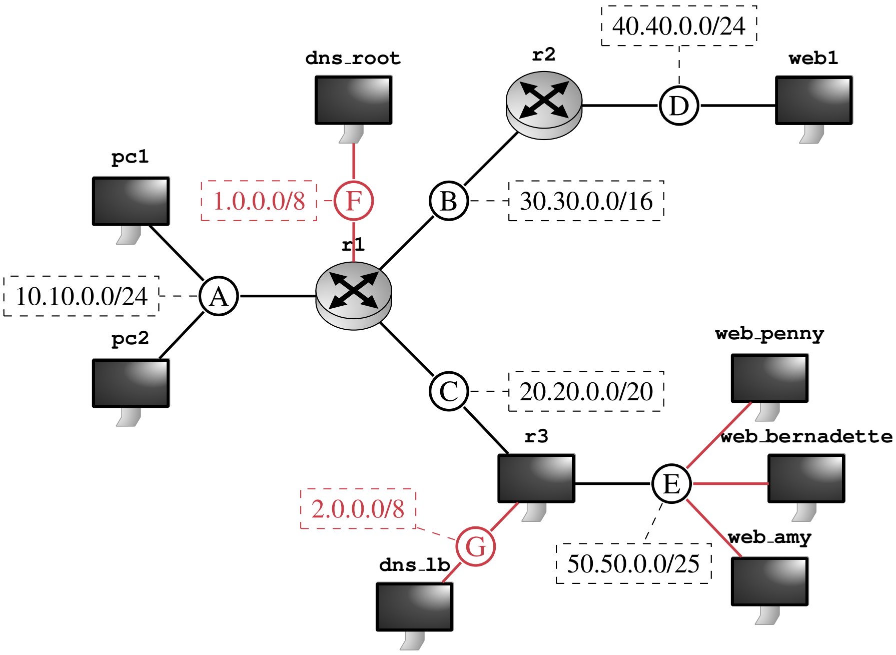

Figure 1: Experiment configuration with CoreDNS

Name	Docker Image	IP Address	Interface	CD
pc1	unibaktr/alpine:busybox	10.10.0.10/24	eth0	A
pc2	unibaktr/alpine:busybox	10.10.0.11/24	eth0	A
r1	unibaktr/vyos	10.10.0.1/24	eth0	A
r1	unibaktr/vyos	30.30.0.1/16	eth1	B
r1	unibaktr/vyos	20.20.0.1/20	eth2	C
r1	unibaktr/vyos	1.0.0.1/8	eth3	F
r2	unibaktr/vyos	30.30.0.2/16	eth0	B
r2	unibaktr/vyos	40.40.0.2/24	eth1	D
r3	alpine	20.20.0.3/20	eth0	C
r3	alpine	50.50.0.3/25	eth1	E
r3	alpine	2.0.0.3/8	eth2	G
dns_root	unibaktr/alpine:coredns	1.1.1.1/8	eth0	F
dns_lb	unibaktr/alpine:coredns	2.2.2.2/8	eth0	G
web1	unibaktr/alpine:whoami	40.40.0.100/24	eth0	D
web_penny	unibaktr/alpine:whoami	50.50.0.100/25	eth0	E
web_bernadette	unibaktr/alpine:whoami	50.50.0.101/25	eth0	E
web_amy	unibaktr/alpine:whoami	50.50.0.102/25	eth0	E

Table 1: Experiment configuration with CoreDNS

3 Load Balancing with Traefik

To the configuration of section 2 we add a new server farm, which is load balanced by a software called traefik.

1. First replace `web1` with three webservers `web_sheldon`, `web_leonard` and `web_howard` according to the configuration of Table 2.
2. Add the load balancer `traefik_lb` and configure it to
   - listen on port 80 and use a file provider,
   - which forwards requests on `gik.de` to the new webservers.
3. Adjust the A record of `gik.de` from `dns_root` to point to `traefik_lb`.
4. Confirm the configuration of the domain `gik.de` by using `dig`.
5. Add the static routes to the topology, wherever needed, to ensure the connectivity.
6. Test the load balancing behavior and add a weighted round robin to forward

- 60% of the requests to `web_sheldon`,
- 30% of the requests to `web_leonard`,
- and 10% of the requests to `web_howard`.

7. Describe the differences between DNS and software load balancing by comparing section 2 to section 3. What are the advantages and disadvantages of both concepts?

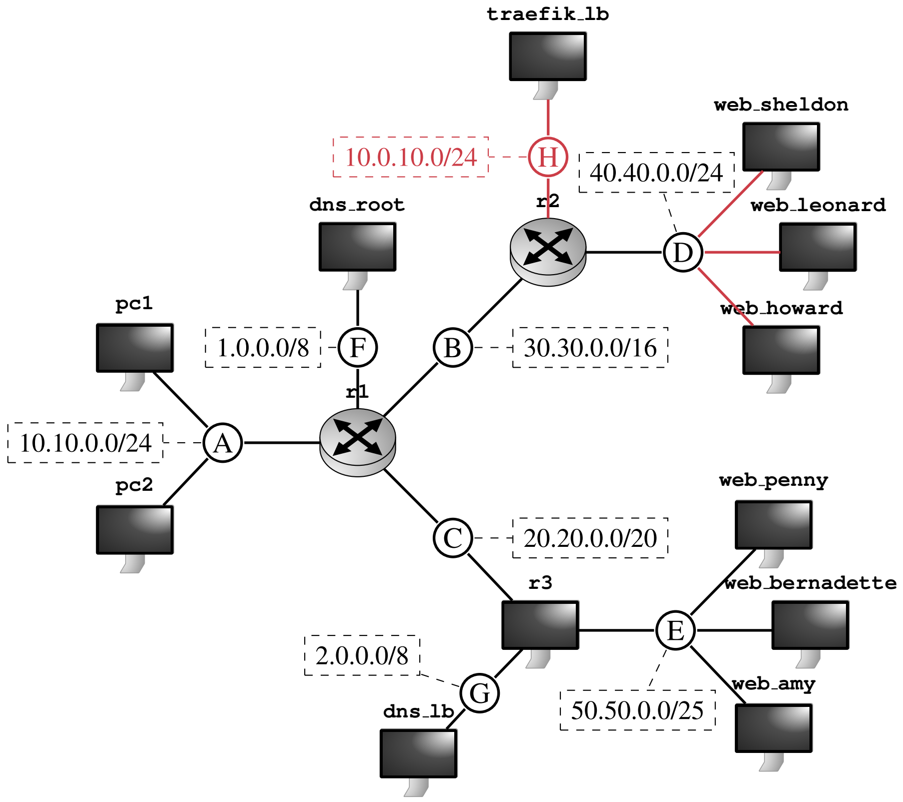

Figure 2: Experiment configuration with traefik

Name	Docker Image	IP Address	Interface	CD
pc1	unibaktr/alpine:busybox	10.10.0.10/24	eth0	A
pc2	unibaktr/alpine:busybox	10.10.0.11/24	eth0	A
r1	unibaktr/vyos	10.10.0.1/24	eth0	A
r1	unibaktr/vyos	30.30.0.1/16	eth1	B
r1	unibaktr/vyos	20.20.0.1/20	eth2	C
r1	unibaktr/vyos	1.0.0.1/8	eth3	F
r2	unibaktr/vyos	30.30.0.2/16	eth0	B

Name	Docker Image	IP Address	Interface	CD
r2	unibaktr/vyos	40.40.0.2/24	eth1	D
r2	unibaktr/vyos	10.0.10.2/24	eth2	H
r3	alpine	20.20.0.3/20	eth0	C
r3	alpine	50.50.0.3/25	eth1	E
r3	alpine	2.0.0.3/8	eth2	G
dns_root	unibaktr/alpine:coredns	1.1.1.1/8	eth0	F
dns_lb	unibaktr/alpine:coredns	2.2.2.2/8	eth0	G
traefik_lb	unibaktr/alpine:traefik	10.0.10.1/24	eth0	H
web_sheldon	unibaktr/alpine:whoami	40.40.0.100/24	eth0	D
web_leonard	unibaktr/alpine:whoami	40.40.0.101/24	eth0	D
web_howard	unibaktr/alpine:whoami	40.40.0.102/24	eth0	D
web_penny	unibaktr/alpine:whoami	50.50.0.100/25	eth0	E
web_bernadette	unibaktr/alpine:whoami	50.50.0.101/25	eth0	E
web_amy	unibaktr/alpine:whoami	50.50.0.102/25	eth0	E

Table 2: Experiment configuration with traefik

Lab Report: Write a short summary of your observations in the experiment and the encountered pitfalls in the exercise, provide screenshots whenever possible to justify your statements. Include the commands and write a short explanation with screenshots.