0. 环境配置

0.1 虚拟机与Docker配置

- Ubuntu-Seed 16.04
- 攻击机IP：172.18.0.1（主机，对应网卡为br-e4a075733e38）
- 用户机IP：172.18.0.2（docker容器DNS_User，注意创建时不带--privileged选项）
- 服务机IP：172.18.0.3（docker容器DNS_Server，注意创建时不带--privileged选项）
- 容器的创建和使用：

```
# 查看容器
sudo docker ps -a
# 创建子网（避免容器的 IP 因启动顺序不同而变化）
sudo docker network create --subnet=172.18.0.0/16 net_xba
# 创建并运行容器
sudo docker run -it --name=DNS_User --hostname=DNS_User --net net_xba --ip 172.18.0.2
"seedubuntu" /bin/bash
sudo docker run -it --name=DNS_Server --hostname=DNS_Server --net net_xba --ip 172.18.0.3
# 运行容器
sudo docker start DNS_User
sudo docker exec -it DNS_User /bin/bash
sudo docker start DNS_Server
sudo docker exec -it DNS_Server /bin/bash
# 关闭容器
sudo docker stop DNS_User
sudo docker stop DNS_Server
# 删除容器
sudo docker rm DNS_User
sudo docker rm DNS_Server
# 主机和容器之间拷贝数据
docker cp 容器名称:路径 主机路径
docker cp 主机路径 容器名称:路径
```

0.2 配置用户计算机

- 修改文件/etc/resolv.conf，将服务器172.17.0.5添加为文件中的第一个nameserver，即将此服务器作为主 DNS服务器。
- 修改后的/etc/resolv.conf如下所示：

```
root@DNS_User:/# cat /etc/resolv.conf
search localdomain
nameserver 172.18.0.3
# nameserver 127.0.0.11
options ndots:0
```

0.3 配置本地DNS服务器

0.3.1 BIND及其配置文件

- 使用BIND作为DNS服务软件，其主要配置文件为/etc/bind/named.conf，实际配置文件存储在该配置文件中的include条目对应的文件中，以下修改的配置文件为/etc/bind/named.conf.options。
- /etc/bind/named.conf文件内容如下：

```
root@DNS_Server:/# cat /etc/bind/named.conf
// This is the primary configuration file for the BIND DNS server named.
//
// Please read /usr/share/doc/bind9/README.Debian.gz for information on the
// structure of BIND configuration files in Debian, *BEFORE* you customize
// this configuration file.
//
// If you are just adding zones, please do that in /etc/bind/named.conf.local

include "/etc/bind/named.conf.options";
include "/etc/bind/named.conf.local";
include "/etc/bind/named.conf.default-zones";
```

0.3.2 设置DNS缓存

- 向 /etc/bind/named.conf.options 中选项块 options 中添加 dump-file 来设置 DNS 缓存。若指定该选项，则 BIND 则会将其缓存转存到指定的位置；若未指定该选项，则默认转存到 /var/cache/bind/named_dump.db 中。
- DNS 缓存相关命令：

```
sudo rndc dumpdb -cache // Dump the cache to the sepcified file
sudo rndc flush         // Flush the DNS cache
```

0.3.3 关闭DNSSEC

- 引入 DNSSEC 是为了防止对 DNS 服务器的 spoofing 攻击，通过修改配置文件 /etc/bind/named.conf.options 来关闭 DNSSEC：注释 dnssec-validation auto 条目，并添加 dnssec-enable no; 条目。
- 设置 DNS 缓存和关闭 DNSSEC 后的配置文件如下（即 Ubuntu-Seed 的默认配置）：

```
root@DNS_Server:/# cat /etc/bind/named.conf.options
options {
    directory "/var/cache/bind";

    // If there is a firewall between you and nameservers you want
    // to talk to, you may need to fix the firewall to allow multiple
    // ports to talk.  See http://www.kb.cert.org/vuls/id/800113

    // If your ISP provided one or more IP addresses for stable
    // nameservers, you probably want to use them as forwarders.
    // Uncomment the following block, and insert the addresses replacing
    // the all-0's placeholder.

    // forwarders {
    //  0.0.0.0;
    // };

    //========================================================================
    // If BIND logs error messages about the root key being expired,
    // you will need to update your keys.  See https://www.isc.org/bind-keys
    //========================================================================
    // dnssec-validation auto;
    dnssec-enable no;
    dump-file "/var/cache/bind/dump.db";
    auth-nxdomain no;    # conform to RFC1035

    query-source port       33333;
    listen-on-v6 { any; };
};
```

0.3.4 启动DNS服务器

- 每次对 DNS 配置进行修改时，都需要重新启动 DNS 服务器。

```
sudo service bind9 restart      # 启动或重新启动 BIND 9 DNS 服务器
netstat -nau                    # 查看网络状态
sudo named -d 3 -f -g           # 查看 BIND 错误信息
```

- 启动DNS服务器并查看其运行状态如下：

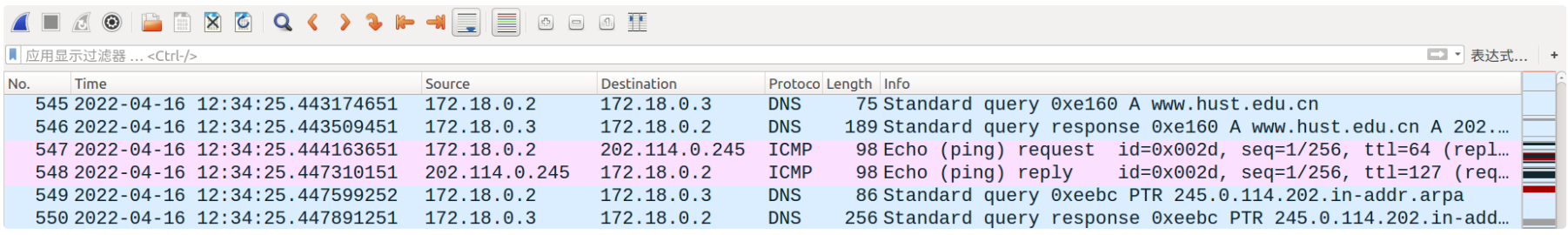
```
root@DNS_Server:/# sudo service bind9 start
 * Starting domain name service... bind9                                [ OK ]
root@DNS_Server:/# netstat -nau
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
udp        0      0 127.0.0.11:48044        0.0.0.0:*
udp        0      0 0.0.0.0:33333           0.0.0.0:*
udp        0      0 172.18.0.3:53           0.0.0.0:*
udp        0      0 127.0.0.1:53            0.0.0.0:*
udp6       0      0 :::53                   :::*
```

0.3.5 测试DNS服务器

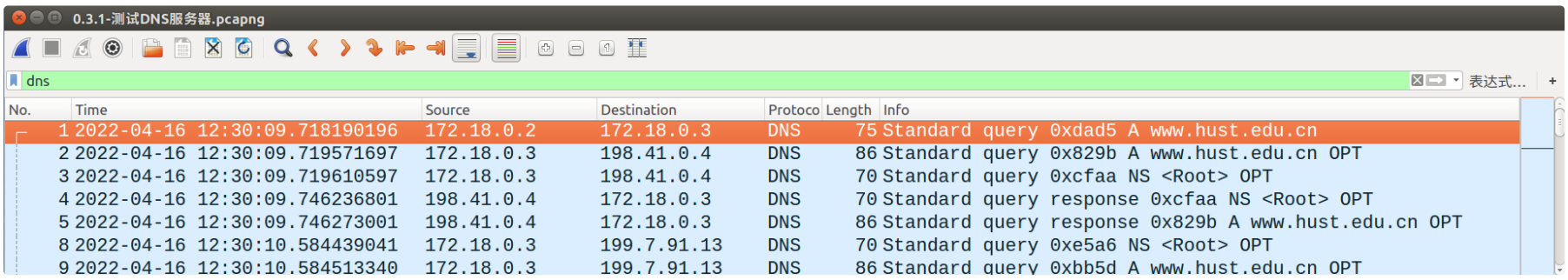
- 在DNS_User执行ping www.hust.edu.cn -c 2，前四次执行该指令时所需时间较长，甚至可能无法在超时时间内获得该域名对应的IP地址，在多次尝试并能成功ping通后，ping命令的执行速度大幅提高：

```
root@DNS_User: 172.18.0.2
root@DNS_User:/# ping www.hust.edu.cn -c 2
ping: unknown host www.hust.edu.cn
root@DNS_User:/# ping www.hust.edu.cn -c 2
ping: unknown host www.hust.edu.cn
root@DNS_User:/# ping www.hust.edu.cn -c 2
ping: unknown host www.hust.edu.cn
root@DNS_User:/# ping www.hust.edu.cn -c 2
PING www.hust.edu.cn (202.114.0.245) 56(84) bytes of data.
64 bytes from 245.0.114.202.hust.edu.cn.0.114.202.in-addr.arpa (202.114.0.245): icmp_seq=1
ttl=127 time=4.29 ms
64 bytes from 245.0.114.202.hust.edu.cn.0.114.202.in-addr.arpa (202.114.0.245): icmp_seq=2
ttl=127 time=1.49 ms

--- www.hust.edu.cn ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 6381ms
rtt min/avg/max/mdev = 1.493/2.892/4.292/1.400 ms
root@DNS_User:/# ping www.hust.edu.cn -c 1
PING www.hust.edu.cn (202.114.0.245) 56(84) bytes of data.
64 bytes from 245.0.114.202.hust.edu.cn.0.114.202.in-addr.arpa (202.114.0.245): icmp_seq=1
ttl=127 time=3.18 ms

--- www.hust.edu.cn ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 3.180/3.180/3.180/0.000 ms
```

- 在可以ping通后，在一开始执行ping命令时DNS服务器使用了正向DNS缓存，以获得域名对应的IP；在接收到第一个ICMP Reply报文后，服务器使用了反向DNS缓存，以获得IP对应的域名：



- 使用Wireshark得到文件0.3.1-测试DNS服务器.pcapng，可以看到在执行ping命令时，客户机先向服务器发送DNS询问请求，前四次执行ping命令对应第1~468个报文，第五次执行ping命令对应第545~548个报文。



0.4 在本地DNS服务器中建一个区域

假设我们拥有一个域名，我们将负责提供有关该域名的响应。我们将使用本地 DNS 服务器作为域的权威名称服务器。在本实验中，我们将为 example.com 域设置为权威服务器。 此域名保留用于文档，并且不由任何人拥有，因此使用它是安全的。

0.4.1 创建区域

- 我们需要在 DNS 服务器中创建两个区域条目，方法是将以下内容添加到 /etc/bind/named.conf.default-zones 或 /etc/bind/named.conf 中。第一个区域用于正向查找（从主机名到 IP），第二个区域用于反向查找（从 IP 到主机名）。

```
zone "xubiang.com" {
    type master;
    file "/etc/bind/xubiang.com.db";
};

zone "0.168.192.in-addr.arpa" {
    type master;
    file "/etc/bind/192.168.0.db";
};
```

- 修改后的 /etc/bind/named.conf 如下：

```
root@DNS_Server:/# cat /etc/bind/named.conf
// This is the primary configuration file for the BIND DNS server named.
//
// Please read /usr/share/doc/bind9/README.Debian.gz for information on the
// structure of BIND configuration files in Debian, *BEFORE* you customize
// this configuration file.
//
// If you are just adding zones, please do that in /etc/bind/named.conf.local

include "/etc/bind/named.conf.options";
include "/etc/bind/named.conf.local";
include "/etc/bind/named.conf.default-zones";

zone "xubiang.com" {
    type master;
    file "/etc/bind/xubiang.com.db";
};

zone "0.168.192.in-addr.arpa" {
    type master;
    file "/etc/bind/192.168.0.db";
};
```

root@DNS_Server: 172.18.0.3

```
root@DNS_Server:/# cat /etc/bind/named.conf
// This is the primary configuration file for the BIND DNS server named.
//
// Please read /usr/share/doc/bind9/README.Debian.gz for information on the
// structure of BIND configuration files in Debian, *BEFORE* you customize
// this configuration file.
//
// If you are just adding zones, please do that in /etc/bind/named.conf.local

include "/etc/bind/named.conf.options";
include "/etc/bind/named.conf.local";
include "/etc/bind/named.conf.default-zones";

zone "xubiang.com" {
        type master;
        file "/etc/bind/xubiang.com.db";
};

zone "0.168.192.in-addr.arpa" {
        type master;
        file "/etc/bind/192.168.0.db";
};
```

0.4.2 设置正向查找区域文件

- 上述区域定义中 `file` 关键字之后的文件名为区域文件，这是存储实际 `DNS` 解析的位置。 创建以下 `xubiang.com.db` 区域文件：

```
$TTL 3D                 ; Default expiration time

@           IN    SOA   ns.xubiang.com. admin.xubiang.com. (
            2001032701  ; Serial
            8H          ; Refresh
            2H          ; Retry
            4W          ; Exprire
            1D)         ; Minimum

@           IN     NS   ns.xubiang.com.
@           IN     MX   10 mail.xubiang.com.

www         IN      A   192.168.0.101
mail        IN      A   192.168.0.102
ns          IN      A   192.168.0.10
*.xubiang.com.  IN  A   192.168.0.100
```

- 使用 `docker` 的文件复制指令将其放置到 `DNS_Server` 的 `/etc/bind/` 目录中：

```
sudo docker cp xubiang.com.db DNS_Server:/etc/bind/xubiang.com.db
```

```
root@DNS_Server: 172.18.0.3
root@DNS_Server:/# cat /etc/bind/xubiang.com.db
$TTL 3D                 ; Default expiration time

@           IN    SOA   ns.xubiang.com. admin.xubiang.com. (
            2001032701  ; Serial
            8H          ; Refresh
            2H          ; Retry
            4W          ; Exprire
            1D)         ; Minimum

@           IN     NS   ns.xubiang.com.
@           IN     MX   10 mail.xubiang.com.

www         IN      A   192.168.0.101
mail        IN      A   192.168.0.102
ns          IN      A   192.168.0.10
*.xubiang.com.  IN  A   192.168.0.100
```

0.4.3 设置反向查找区域文件

- 为了支持 `DNS` 反向查找，即从 `IP` 地址到主机名，我们还需要设置 `DNS` 反向查找文件。为 `xubiang.com` 域创建以下反向 `DNS` 查找文件 `192.168.0.db`：

```
$TTL 3D
@   IN  SOA ns.xubiang.com. admin.xubiang.com. (
        2001032701
        8H
        2H
        4W
        1D)
@   IN  NS  ns.xubiang.com.

101 IN  PTR www.xubiang.com.
102 IN  PTR mail.xubiang.com.
10  IN  PTR ns.xubiang.com.
```

- 使用 `docker` 的文件复制指令将其放置到 `DNS_Server` 的 `/etc/bind/` 目录中：

```
sudo docker cp 192.168.0.db DNS_Server:/etc/bind/192.168.0.db
```

```
root@DNS_Server: 172.18.0.3
root@DNS_Server:/# cat /etc/bind/192.168.0.db
$TTL 3D
@       IN      SOA     ns.xubiang.com. admin.xubiang.com. (
        2001032701
        8H
        2H
        4W
        1D)
@       IN      NS      ns.xubiang.com.

101     IN      PTR     www.xubiang.com.
102     IN      PTR     mail.xubiang.com.
10      IN      PTR     ns.xubiang.com.
```

0.4.4 检查区域文件的属性设置

- 在实验过程中，发现设置好 bind9 配置文件、正向查找区域文件、反向查找区域文件后，启用 bind9 服务后使用客户机执行 dig www.xubiang.com，得到的结果中没有应答信息：

```
root@DNS_Server: 172.18.0.3
root@DNS_Server:/# service bind9 start
 * Starting domain name service... bind9                              [ OK ]
root@DNS_Server:/# service bind9 status
 * bind9 is running
root@DNS_Server:/#
```

```
root@DNS_User: 172.18.0.2
root@DNS_User:/# dig www.xubiang.com

; <<>> DiG 9.10.3-P4-Ubuntu <<>> www.xubiang.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: SERVFAIL, id: 55750
;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.xubiang.com.               IN      A

;; Query time: 1 msec
;; SERVER: 172.18.0.3#53(172.18.0.3)
;; WHEN: Fri Apr 22 21:22:04 CST 2022
;; MSG SIZE  rcvd: 44
```

- 而使用 named 的 -f 或 -g 指令使 named 在前台运行时再使用客户机执行 dig www.xubiang.com，可以得到预期的 DNS 解析信息：

```
root@DNS_Server: 172.18.0.3
root@DNS_Server:/# named -f
```

root@DNS_User: 172.18.0.2

```
root@DNS_User:/# dig www.xubiang.com

; <<>> DiG 9.10.3-P4-Ubuntu <<>> www.xubiang.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 55085
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL:
2

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.xubiang.com.               IN      A

;; ANSWER SECTION:
www.xubiang.com.        259200  IN      A       192.168.0.101

;; AUTHORITY SECTION:
xubiang.com.            259200  IN      NS      ns.xubiang.com.

;; ADDITIONAL SECTION:
ns.xubiang.com.         259200  IN      A       192.168.0.10

;; Query time: 0 msec
;; SERVER: 172.18.0.3#53(172.18.0.3)
;; WHEN: Fri Apr 22 21:22:32 CST 2022
;; MSG SIZE  rcvd: 93
```

- 经过问题排查，在`named -g`的输出信息中发现如下内容：

```
root@DNS_Server:/# named -g
...
22-Apr-2022 21:25:55.045 configuring command channel from '/etc/bind/rndc.key'
22-Apr-2022 21:25:55.045 open: /etc/bind/rndc.key: permission denied
22-Apr-2022 21:25:55.045 couldn't add command channel 127.0.0.1#953: permission denied
22-Apr-2022 21:25:55.045 configuring command channel from '/etc/bind/rndc.key'
22-Apr-2022 21:25:55.045 open: /etc/bind/rndc.key: permission denied
22-Apr-2022 21:25:55.045 couldn't add command channel ::1#953: permission denied
...
```

root@DNS_Server: 172.18.0.3

```
22-Apr-2022 21:25:55.045 configuring command channel from '/etc/bind/rndc.key'
22-Apr-2022 21:25:55.045 open: /etc/bind/rndc.key: permission denied
22-Apr-2022 21:25:55.045 couldn't add command channel 127.0.0.1#953: permission denied
22-Apr-2022 21:25:55.045 configuring command channel from '/etc/bind/rndc.key'
22-Apr-2022 21:25:55.045 open: /etc/bind/rndc.key: permission denied
22-Apr-2022 21:25:55.045 couldn't add command channel ::1#953: permission denied
22-Apr-2022 21:25:55.045 not using config file logging statement for logging due to -g op
tion
```

- 因此检查`/etc/bind/rndc.key`文件的权限，发现其他用户对该文件没有任何权限：

```
root@DNS_Server:/# ls -l /etc/bind
total 60
-rw------- 1 root root  225 Apr 22 21:15 192.168.0.db
-rw-r--r-- 1 root root 2389 Jun 29  2017 bind.keys
-rw-r--r-- 1 root root  237 Jun 29  2017 db.0
-rw-r--r-- 1 root root  271 Jun 29  2017 db.127
-rw-r--r-- 1 root root  237 Jun 29  2017 db.255
-rw-r--r-- 1 root root  353 Jun 29  2017 db.empty
-rw-r--r-- 1 root root  270 Jun 29  2017 db.local
-rw-r--r-- 1 root root 3171 Jun 29  2017 db.root
-rw-r--r-- 1 root bind  624 Apr 22 21:07 named.conf
```

```
-rw-r--r-- 1 root bind  665 Apr 22 21:07 named.conf.default-zones
-rw-r--r-- 1 root bind  165 Jun 29  2017 named.conf.local
-rw-r--r-- 1 bind bind  978 Jul 26  2017 named.conf.options
-rw-r----- 1 bind bind   77 Jul 26  2017 rndc.key
-rw------- 1 root root  516 Apr 22 21:15 xubiang.com.db
-rw-r--r-- 1 root root 1317 Jun 29  2017 zones.rfc1918
```

```
root@DNS_Server: 172.18.0.3
root@DNS_Server:/# ls -l /etc/bind
total 60
-rw------- 1 root root  225 Apr 22 21:15 192.168.0.db
-rw-r--r-- 1 root root 2389 Jun 29  2017 bind.keys
-rw-r--r-- 1 root root  237 Jun 29  2017 db.0
-rw-r--r-- 1 root root  271 Jun 29  2017 db.127
-rw-r--r-- 1 root root  237 Jun 29  2017 db.255
-rw-r--r-- 1 root root  353 Jun 29  2017 db.empty
-rw-r--r-- 1 root root  270 Jun 29  2017 db.local
-rw-r--r-- 1 root root 3171 Jun 29  2017 db.root
-rw-r--r-- 1 root bind  624 Apr 22 21:07 named.conf
-rw-r--r-- 1 root bind  665 Apr 22 21:07 named.conf.default-zones
-rw-r--r-- 1 root bind  165 Jun 29  2017 named.conf.local
-rw-r--r-- 1 bind bind  978 Jul 26  2017 named.conf.options
-rw-r----- 1 bind bind   77 Jul 26  2017 rndc.key
-rw------- 1 root root  516 Apr 22 21:15 xubiang.com.db
-rw-r--r-- 1 root root 1317 Jun 29  2017 zones.rfc1918
```

- 给其添加读权限，并再次使用`named -g`查看输出信息，此时错误消失，且在前台运行时依然能够获得正确的解析结果：

```
root@DNS_Server:/# chmod +r /etc/bind/rndc.key
root@DNS_Server:/# named -g
...
22-Apr-2022 21:30:09.493 configuring command channel from '/etc/bind/rndc.key'
22-Apr-2022 21:30:09.493 command channel listening on 127.0.0.1#953
22-Apr-2022 21:30:09.493 configuring command channel from '/etc/bind/rndc.key'
22-Apr-2022 21:30:09.493 command channel listening on ::1#953
...
```

```
root@DNS_Server: 172.18.0.3
22-Apr-2022 21:30:09.493 configuring command channel from '/etc/bind/rndc.key'
22-Apr-2022 21:30:09.493 command channel listening on 127.0.0.1#953
22-Apr-2022 21:30:09.493 configuring command channel from '/etc/bind/rndc.key'
22-Apr-2022 21:30:09.493 command channel listening on ::1#953
22-Apr-2022 21:30:09.493 not using config file logging statement for logging due to -g opti
on
```

- 此时使用`bind9`进行测试，仍然无法得到正确的解析结果
- 再经过一些尝试后，类比`rndc.key`文件的错误，观察到组用户和其他用户对物理机编辑得到的`xubiang.com.db`及`192.168.0.db`文件没有任何权限，从而使用`docker`的复制语句复制到容器中后也缺少对应权限，从而导致`bind9`作为守护进程时读取文件失败：

```
[04/22/22]seed@VM:~/.../2022.04.15.DNS$ ls -l
总用量 236
-rw------- 1 seed seed 112396 4月  16 12:34 0.1.测试DNS服务器.pcapng
-rw------- 1 seed seed    225 4月  22 21:15 192.168.0.db
-rw-r--r-- 1 root root 105239 4月  21 23:30 name_d3_log.txt
-rw-r--r-- 1 root root  11366 4月  21 23:26 named_log.txt
-rw------- 1 seed seed    516 4月  22 21:15 xubiang.com.db
```

```
root@DNS_Server:/# ls -l /etc/bind
total 60
-rw------- 1 root root  225 Apr 22 21:15 192.168.0.db
-rw-r--r-- 1 root root 2389 Jun 29  2017 bind.keys
-rw-r--r-- 1 root root  237 Jun 29  2017 db.0
-rw-r--r-- 1 root root  271 Jun 29  2017 db.127
-rw-r--r-- 1 root root  237 Jun 29  2017 db.255
-rw-r--r-- 1 root root  353 Jun 29  2017 db.empty
```

```
-rw-r--r-- 1 root root  270 Jun 29  2017 db.local
-rw-r--r-- 1 root root 3171 Jun 29  2017 db.root
-rw-r--r-- 1 root bind  624 Apr 22 21:07 named.conf
-rw-r--r-- 1 root bind  665 Apr 22 21:07 named.conf.default-zones
-rw-r--r-- 1 root bind  165 Jun 29  2017 named.conf.local
-rw-r--r-- 1 bind bind  978 Jul 26  2017 named.conf.options
-rw-r--r-- 1 bind bind   77 Jul 26  2017 rndc.key
-rw------- 1 root root  516 Apr 22 21:15 xubiang.com.db
-rw-r--r-- 1 root root 1317 Jun 29  2017 zones.rfc1918
```

```
seed@Attacker: 172.18.0.1
[04/22/22]seed@VM:~/.../2022.04.15.DNS$ ls -l
总用量 236
-rw------- 1 seed seed 112396 4月  16 12:34 0.1.测试DNS服务器.pcapng
-rw------- 1 seed seed    225 4月  22 21:15 192.168.0.db
-rw-r--r-- 1 root root 105239 4月  21 23:30 name_d3_log.txt
-rw-r--r-- 1 root root  11366 4月  21 23:26 named_log.txt
-rw------- 1 seed seed    516 4月  22 21:15 xubiang.com.db
```

```
root@DNS_Server: 172.18.0.3
root@DNS_Server:/# ls -l /etc/bind
total 60
-rw------- 1 root root  225 Apr 22 21:15 192.168.0.db
-rw-r--r-- 1 root root 2389 Jun 29  2017 bind.keys
-rw-r--r-- 1 root root  237 Jun 29  2017 db.0
-rw-r--r-- 1 root root  271 Jun 29  2017 db.127
-rw-r--r-- 1 root root  237 Jun 29  2017 db.255
-rw-r--r-- 1 root root  353 Jun 29  2017 db.empty
-rw-r--r-- 1 root root  270 Jun 29  2017 db.local
-rw-r--r-- 1 root root 3171 Jun 29  2017 db.root
-rw-r--r-- 1 root bind  624 Apr 22 21:07 named.conf
-rw-r--r-- 1 root bind  665 Apr 22 21:07 named.conf.default-zones
-rw-r--r-- 1 root bind  165 Jun 29  2017 named.conf.local
-rw-r--r-- 1 bind bind  978 Jul 26  2017 named.conf.options
-rw-r--r-- 1 bind bind   77 Jul 26  2017 rndc.key
-rw------- 1 root root  516 Apr 22 21:15 xubiang.com.db
-rw-r--r-- 1 root root 1317 Jun 29  2017 zones.rfc1918
```

- 因此赋予其对应权限，再重启`bind9`服务，此时使用客户机执行`dig www.xubiang.com`，可以得到预期的`DNS`解析信息：

```
root@DNS_Server:/# chmod +r /etc/bind/xubiang.com.db
root@DNS_Server:/# chmod +r /etc/bind/192.168.0.db
root@DNS_Server:/# service bind9 restart
 * Stopping domain name service... bind9
 waiting for pid 497 to die
                                                          [ OK ]
 * Starting domain name service... bind9                  [ OK ]
```

```
root@DNS_User:/# dig www.xubiang.com

; <<>> DiG 9.10.3-P4-Ubuntu <<>> www.xubiang.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 17559
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 2

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.xubiang.com.       IN  A

;; ANSWER SECTION:
www.xubiang.com.    259200  IN  A   192.168.0.101
```

```
16
17 ;; AUTHORITY SECTION:
18 xubiang.com.        259200  IN  NS  ns.xubiang.com.
19
20 ;; ADDITIONAL SECTION:
21 ns.xubiang.com.     259200  IN  A   192.168.0.10
22
23 ;; Query time: 14 msec
24 ;; SERVER: 172.18.0.3#53(172.18.0.3)
25 ;; WHEN: Fri Apr 22 22:41:07 CST 2022
26 ;; MSG SIZE  rcvd: 93
```

```
root@DNS_Server: 172.18.0.3
root@DNS_Server:/# chmod +r /etc/bind/xubiang.com.db
root@DNS_Server:/# chmod +r /etc/bind/192.168.0.db
root@DNS_Server:/# service bind9 restart
 * Stopping domain name service... bind9
waiting for pid 497 to die
                                                        [ OK ]
 * Starting domain name service... bind9                [ OK ]
```

```
root@DNS_User: 172.18.0.2
root@DNS_User:/# dig www.xubiang.com

; <<>> DiG 9.10.3-P4-Ubuntu <<>> www.xubiang.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 17559
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL:
2

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;www.xubiang.com.               IN      A

;; ANSWER SECTION:
www.xubiang.com.        259200  IN      A       192.168.0.101

;; AUTHORITY SECTION:
xubiang.com.            259200  IN      NS      ns.xubiang.com.

;; ADDITIONAL SECTION:
ns.xubiang.com.         259200  IN      A       192.168.0.10

;; Query time: 14 msec
;; SERVER: 172.18.0.3#53(172.18.0.3)
;; WHEN: Fri Apr 22 22:41:07 CST 2022
;; MSG SIZE  rcvd: 93
```

0.4.5 重新启动BIND服务器并进行测试

- 重启BIND服务后，使用dig www.xubiang.com命令向本地DNS服务器询问www.xubiang.com的IP地址，结果见上图，能够正确解析。