

Universidade do Minho
Departamento de Informática
Licenciatura em Engenharia Informática

Comunicações por Computador
Trabalho Prático 3
Grupo N° 53

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20 de novembro de 2021

Parte I

Questão a)

Qual o conteúdo do ficheiro */etc/resolv.conf* e para que serve essa informação?

Resposta:

O ficheiro *resolv.conf* contém a informação necessária, organizada em diretivas, para conectar os clientes locais aos servidores DNS, nomeadamente o(s) **nameserver(s)** por omissão para resolução de nomes, e **search**, que define um ou mais *search domains* por omissão para completar um determinado endereço numa *query*, de modo a obter um *fully qualified domain name*, quando não há um sufixo especificado.

```
core@xubuncore:~$ cat /etc/resolv.conf
# This file is managed by man:systemd-resolved(8). Do not edit.
#
# This is a dynamic resolv.conf file for connecting local clients to the
# internal DNS stub resolver of systemd-resolved. This file lists all
# configured search domains.
#
# Run "resolvectl status" to see details about the uplink DNS servers
# currently in use.
#
# Third party programs must not access this file directly, but only through the
# symlink at /etc/resolv.conf. To manage man:resolv.conf(5) in a different way,
# replace this symlink by a static file or a different symlink.
#
# See man:systemd-resolved.service(8) for details about the supported modes of
# operation for /etc/resolv.conf.

nameserver 127.0.0.53
options edns0 trust-ad
search eduroam.uminho.pt
```

1. Conteúdo do ficheiro *resolv.conf*

Questão b)

Os servidores “**www.di.uminho.pt.**” e “**www.europa.eu.**” têm endereços IPv6? Se sim, quais?

Resposta:

O servidor “**www.di.uminho.pt.**” não possui endereços IPv6, como é possível constatar na imagem anexada.

O servidor “**www.europa.eu.**” tem os endereços IPv6 “**2a01:7080:24:100::666:25**” e “**2a01:7080:14:100::666:25**”.

```
core@xubuncore:~$ dig www.di.uminho.pt. AAAA

; <<>> DiG 9.16.1-Ubuntu <<>> www.di.uminho.pt. AAAA
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 59953
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;www.di.uminho.pt.          IN      AAAA

;; ANSWER SECTION:
www.di.uminho.pt.          7793    IN      CNAME   www5.di.uminho.pt.
```

2. Query IPv6 para o endereço “*www.di.uminho.pt.*”

```
core@xubuncore:~$ dig www.europa.eu. AAAA

; <<>> DiG 9.16.1-Ubuntu <<>> www.europa.eu. AAAA
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 64383
;; flags: qr rd ra; QUERY: 1, ANSWER: 3, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;www.europa.eu.           IN      AAAA

;; ANSWER SECTION:
www.europa.eu.           600     IN      CNAME   ip-europa.ec.europa.eu.
ip-europa.ec.europa.eu.  299     IN      AAAA    2a01:7080:24:100::666:25
ip-europa.ec.europa.eu.  299     IN      AAAA    2a01:7080:14:100::666:25
```

3. Query IPv6 para o endereço “*www.europa.eu.*”

Questão c)

Quais os servidores de nomes definidos para os domínios: “gov.pt.” e “.”?

Resposta:

Para “gov.pt.”, os servidores são os seguintes:

```
core@xubuncore:~$ dig gov.pt. NS

; <<>> DiG 9.16.1-Ubuntu <<>> gov.pt. NS
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 4745
;; flags: qr rd ra; QUERY: 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;gov.pt.                                IN      NS

;; ANSWER SECTION:
gov.pt.      151      IN      NS      nsp.dnsnode.net.
gov.pt.      151      IN      NS      ns02.fccn.pt.
gov.pt.      151      IN      NS      dns1.gov.pt.
gov.pt.      151      IN      NS      europe1.dnsnode.net.
gov.pt.      151      IN      NS      a.dns.pt.
```

4. Query NS para o endereço “gov.pt.”

Já para “.” temos os seguintes servidores:

```
core@xubuncore:~$ dig . NS

; <<>> DiG 9.16.1-Ubuntu <<>> . NS
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 44912
;; flags: qr rd ra; QUERY: 1, ANSWER: 13, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;.                                     IN      NS

;; ANSWER SECTION:
.      20113    IN      NS      b.root-servers.net.
.      20113    IN      NS      h.root-servers.net.
.      20113    IN      NS      i.root-servers.net.
.      20113    IN      NS      c.root-servers.net.
.      20113    IN      NS      g.root-servers.net.
.      20113    IN      NS      f.root-servers.net.
.      20113    IN      NS      e.root-servers.net.
.      20113    IN      NS      j.root-servers.net.
.      20113    IN      NS      m.root-servers.net.
.      20113    IN      NS      l.root-servers.net.
.      20113    IN      NS      k.root-servers.net.
.      20113    IN      NS      d.root-servers.net.
.      20113    IN      NS      a.root-servers.net.
```

5. Query NS para o endereço “.”

Questão d)

Existe o domínio “**efiko.academy**”? Com base na informação obtida do DNS, nomeadamente os registos associados a esse nome, diga se o considera um *host* ou um domínio de nomes.

Resposta:

Trata-se de um *host* de endereço “**5.134.7.2**”. O tipo *A* indica que se trata de um endereço IPv4.

```
core@xubuncore:~$ dig efiko.academy.
; <>> DiG 9.16.1-Ubuntu <>> efiko.academy.
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 41796
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;efiko.academy.                IN      A
;; ANSWER SECTION:
efiko.academy.                3600    IN      A      5.134.7.2
```

6. Query para o endereço “**efiko.academy**.”

Questão e)

Qual é o servidor DNS primário definido para o domínio “**gov.pt**”? Este servidor primário (*master*) aceita *queries* recursivas? Porquê?

Resposta:

Analisando o resultado de *nslookup* com o *type* definido como *SOA* (*Start of Authority*), o servidor DNS primário definido para o domínio “**gov.pt**” é “**dnssec.gov.pt**”.

```
core@xubuncore:~$ nslookup
> set type=SOA
> gov.pt.
Server:                127.0.0.53
Address:                127.0.0.53#53

Non-authoritative answer:
gov.pt
    origin = dnssec.gov.pt
    mail addr = dns.ceger.gov.pt
    serial = 2019072064
    refresh = 18000
```

7. Query SOA para o endereço “**gov.pt**.”

No entanto, este servidor não consta da lista dos *nameservers* do domínio (figura 4). Isto indica um potencial erro de configuração do mesmo. Dessa forma, qualquer *query* para este mesmo servidor inevitavelmente falha. Consideremos, então, um dos servidores DNS que obtivemos na figura 4 para o teste da recursividade (arbitrariamente, “**a.dns.pt.**”).

Como se pode observar, o comando *dig* deixa tal bem explícito, onde um *WARNING* indica que a recursividade não está disponível no servidor em questão. Tal era expectável, uma vez que o uso de recursividade acarreta todos os problemas de um serviço DNS centralizado, em particular o elevado volume de tráfego.

```
core@xubuncore:~$ dig @dnssec.gov.pt. gov.pt. NS
dig: couldn't get address for 'dnssec.gov.pt.': not found
core@xubuncore:~$ dig @a.dns.pt gov.pt NS

; <>> DiG 9.16.1-Ubuntu <>> @a.dns.pt gov.pt NS
; (2 servers found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 9938
;; flags: qr aa rd; QUERY: 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 2
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:;; udp: 1232
; COOKIE: 339770d48bd16d35df8d1c9b6196a82f428d0edcd8c02de9 (good)
;; QUESTION SECTION:
;gov.pt.                                IN      NS

;; ANSWER SECTION:
gov.pt.      600      IN      NS      dns1.gov.pt.
gov.pt.      600      IN      NS      europel.dnsnode.net.
gov.pt.      600      IN      NS      a.dns.pt.
gov.pt.      600      IN      NS      ns02.fccn.pt.
gov.pt.      600      IN      NS      nsp.dnsnode.net.

;; ADDITIONAL SECTION:
dns1.gov.pt. 600      IN      A      193.47.185.3
```

8. *Query NS para “gov.pt.” interrogando o servidor primário e um dos servidores secundários*

Questão f)

Obtenha uma resposta “autoritativa” para a questão anterior.

Resposta:

Uma vez que contactamos diretamente um *nameserver* do domínio em questão, a resposta obtida já é autoritativa - de salientar a *flag aa* (*authoritative answer*) na figura 8.

Questão g)

Onde são entregues as mensagens de correio eletrónico dirigidas a “marcelo@presidencia.pt”?

Resposta:

As mensagens dirigidas a “marcelo@presidencia.pt” são entregues nos endereços “mail1.presidencia.pt.” e “mail2.presidencia.pt.”. Este último é o endereço preferencial de entrega, uma vez que o seu valor de preferência é menor.¹

```
core@xubuncore:~$ dig presidencia.pt. MX

; <<> DiG 9.16.1-Ubuntu <<> presidencia.pt. MX
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 56250
;; flags: qr rd ra; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
;presidencia.pt.                IN      MX

;; ANSWER SECTION:
presidencia.pt.      86400   IN      MX      50 mail1.presidencia.pt.
presidencia.pt.      86400   IN      MX      10 mail2.presidencia.pt.
```

9. Query MX para o endereço “presidencia.pt.”

¹ <https://www.linux.com/training-tutorials/check-your-dns-records-dig/>

Questão h)

Que informação é possível obter, via DNS, acerca de “gov.pt.”?

Resposta:

Usando o comando *dig* com a opção ANY podemos extrair toda a informação relativa ao domínio, da qual se destacam os *resource records* dos tipos SOA (*Start of Authority*), que indicam o servidor DNS primário (*master*), bem como informação necessária para a atualização dos servidores secundários (*slaves*), e NS – a lista de *nameservers* do domínio.

```
core@xubuncore:~$ dig gov.pt. ANY | cut -c -100

; <<> DiG 9.16.1-Ubuntu <<> gov.pt. ANY
;; global options: +cmd
;; Got answer:
;; ->HEADER<- opcode: QUERY, status: NOERROR, id: 53806
;; flags: qr rd ra; QUERY: 1, ANSWER: 18, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
;; EDNS: version: 0, flags:; udp: 65494
;; QUESTION SECTION:
gov.pt.                                IN      ANY

;; ANSWER SECTION:
gov.pt.      3582    IN      RRSIG   NSEC3PARAM 10 2 3600 20211126192850 20211112192850 57803 gov.pt. G13nTcPTEb9
gov.pt.      3582    IN      NSEC3PARAM 1 0 1 A1019A7DA7ACAEF4
gov.pt.      582     IN      RRSIG   TXT 10 2 600 20211126192850 20211112192850 57803 gov.pt. Z4TtzJ3boKMzGpmw94J
gov.pt.      582     IN      TXT     "v=spf1 mx ip4:193.47.185.0/24 ip4:185.32.36.9 -all"
gov.pt.      582     IN      RRSIG   SOA 10 2 600 20211126192850 20211112192850 57803 gov.pt. WKW3pgMNFjKyMJEFWVp9
gov.pt.      582     IN      SOA     dnssec.gov.pt. dns.ceger.gov.pt. 2019072064 18000 7200 2419200 86400
gov.pt.      3582    IN      RRSIG   DNSKEY 10 2 86400 20211126192850 20211112192850 51381 gov.pt. B97oIKrJZ98v43
gov.pt.      3582    IN      RRSIG   DNSKEY 10 2 86400 20211126192850 20211112192850 57803 gov.pt. Sx5gvcwuxlyKBZ
gov.pt.      3582    IN      DNSKEY  256 3 10 AwEAAcTlSxtgSNq0zR0rLbLZiK6nFcXJNTEd6oattqkPyldfslXdzakm LKG5or01T
gov.pt.      3582    IN      DNSKEY  257 3 10 AwEAAyp1GwX/VzsfDmYynbtblgGMNAjluTjKa7AaxlwGoElxeXZCMcZx cFNmz8y7x
gov.pt.      2629    IN      RRSIG   DS 13 2 7200 20211124211930 20211114211930 30640 pt. iLVQrFtNehu3gjpK4I7e0MQ
gov.pt.      2629    IN      DS      51381 10 2 3804088045D4F3A870C13A8E45329862D997D1CFB6E6EF94777B195A E0DC95D0
gov.pt.      582     IN      RRSIG   NS 10 2 600 20211126192850 20211112192850 57803 gov.pt. dyszxqpb0zzSV0jihgvY+
gov.pt.      582     IN      NS      europa1.dnsnode.net.
gov.pt.      582     IN      NS      ns02.fccn.pt.
gov.pt.      582     IN      NS      nsp.dnsnode.net.
gov.pt.      582     IN      NS      a.dns.pt.
gov.pt.      582     IN      NS      dns1.gov.pt.
```

10. Query ANY para o endereço “gov.pt.”

Questão i)

Consegue interrogar o DNS sobre o endereço IPv6 “2001:690:2080:8005::38” usando algum dos clientes DNS? Que informação consegue obter? Supondo que teve problemas com esse endereço, consegue obter um contacto do responsável por esse IPv6?

Resposta:

Usando *nslookup* e definindo o tipo para AAAA, obtemos o endereço “smtp01.fccn.pt.”.


```

core@xubuncore:~$ nslookup
> set type=AAAA
> 2001:690:2080:8005::38
Server:      127.0.0.53
Address:     127.0.0.53#53

Non-authoritative answer:
8.3.0.0.0.0.0.0.0.0.0.0.0.0.5.0.0.8.0.8.0.2.0.9.6.0.1.0.0.2.ip6.arpa      name = smtp01.fccn.pt.

Authoritative answers can be found from:
> exit

```

11. Query para o endereço IPv6 “2001:690:2080:8005::38”

Questão j)

Os secundários usam um mecanismo designado por “*Transferência de zona*” para se atualizarem automaticamente a partir do primário, usando os parâmetros definidos no *Record* do tipo *SOA* do domínio. Descreve sucintamente esse mecanismo com base num exemplo concreto (ex: “**uminho.pt.**”).

Resposta:

O *resource record* do tipo *SOA* contém (além do endereço do servidor primário) vários parâmetros usados pelos servidores secundários para se atualizarem.²

```

core@xubuncore:~/Desktop$ nslookup
> set TYPE=SOA
> uminho.pt.
Server:      127.0.0.53
Address:     127.0.0.53#53

Non-authoritative answer:
uminho.pt
    origin = dns.uminho.pt
    mail addr = servicos.scom.uminho.pt
    serial = 2021111501
    refresh = 14400
    retry = 7200
    expire = 1209600
    minimum = 300

Authoritative answers can be found from:

```

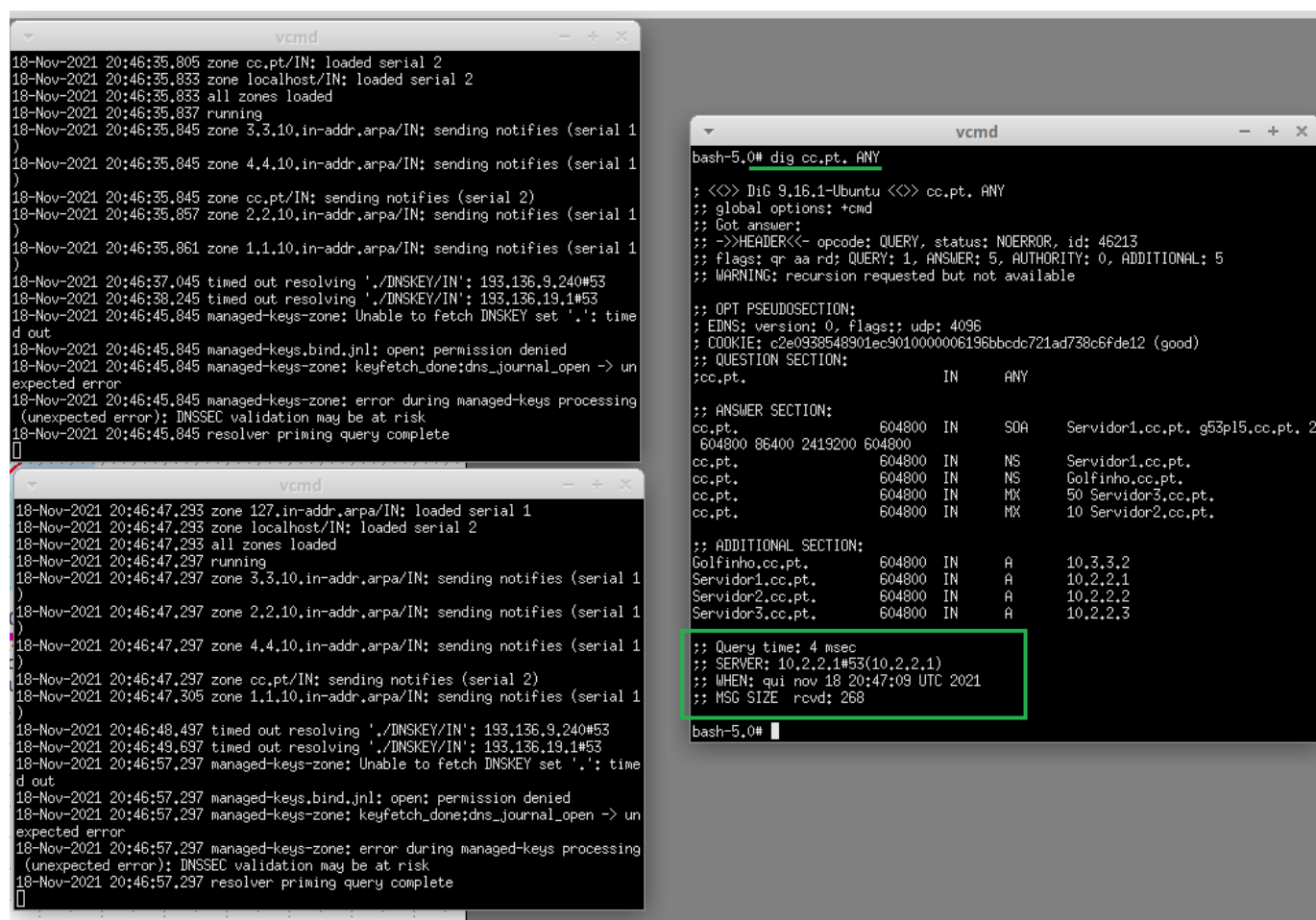
12. Query SOA para o endereço “uminho.pt.”

² <https://www.ionos.com/digitalguide/hosting/technical-matters/soa-record/>

- *serial* - este valor é incrementado com cada alteração aos dados do servidor. Permite, assim, aos servidores secundários “saber” se estão ou não atualizados.
- *refresh* - tempo, em segundos, que indica quando deve um *slave* pedir informação atualizada ao *master* (neste caso, 4 horas).
- *retry - timeout* para um novo pedido de *refresh*, no caso deste falhar (neste caso, 2 horas).
- *expire* - durante quanto tempo um *slave* pode continuar em atividade com uma base de dados desatualizada (neste caso, 14 dias).
- *minimum - time to live* dos dados em *cache* de um cliente, até ser necessário interrogar novamente o servidor (neste caso, 5 minutos).

Parte II

Nesta secção, apresentam-se as demonstrações necessárias aos testes que nos foram exigidos, fazendo uso da topologia de rede fornecida. De notar que esta foi alterada de modo a que os *nameservers* fossem de encontro ao contexto da topologia, isto é, o *Servidor1* e o *Golfinho*. Para tal, em cada nodo que representa um cliente, alterou-se o *script* de configuração do ficheiro *resolv.conf* adequadamente, como nos foi instruído. Os testes foram executados no *Portatil2*, mas seriam igualmente válidos em qualquer outro nodo cliente.



The image shows two terminal windows. The left window, titled 'vcmd', displays a series of log messages from the DNS resolver, including zone loading, sending notifications, and a resolver priming query complete message. The right window, also titled 'vcmd', shows the output of a 'dig cc.pt. ANY' command. The output includes the query details, the question section, the answer section with records for Servidor1, Servidor2, and Servidor3, and the additional section with IP addresses for Golfinho and the three servers. The query time is 4 msec and the server is 10.2.2.1#53(10.2.2.1).

```
18-Nov-2021 20:46:35.805 zone cc.pt/IN: loaded serial 2
18-Nov-2021 20:46:35.833 zone localhost/IN: loaded serial 2
18-Nov-2021 20:46:35.833 all zones loaded
18-Nov-2021 20:46:35.837 running
18-Nov-2021 20:46:35.845 zone 3.3.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:35.845 zone 4.4.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:35.845 zone cc.pt/IN: sending notifies (serial 2)
18-Nov-2021 20:46:35.857 zone 2.2.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:35.861 zone 1.1.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:37.045 timed out resolving './DNSKEY/IN': 193.136.9.240#53
18-Nov-2021 20:46:38.245 timed out resolving './DNSKEY/IN': 193.136.19.1#53
18-Nov-2021 20:46:45.845 managed-keys-zone: Unable to fetch DNSKEY set '': time d out
18-Nov-2021 20:46:45.845 managed-keys.bind.jnl: open: permission denied
18-Nov-2021 20:46:45.845 managed-keys-zone: keyfetch_done:dns_journal_open -> unexpected error
18-Nov-2021 20:46:45.845 managed-keys-zone: error during managed-keys processing (unexpected error): DNSSEC validation may be at risk
18-Nov-2021 20:46:45.845 resolver priming query complete

18-Nov-2021 20:46:47.293 zone 127.in-addr.arpa/IN: loaded serial 1
18-Nov-2021 20:46:47.293 zone localhost/IN: loaded serial 2
18-Nov-2021 20:46:47.293 all zones loaded
18-Nov-2021 20:46:47.297 zone 3.3.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:47.297 zone 2.2.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:47.297 zone 4.4.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:47.297 zone cc.pt/IN: sending notifies (serial 2)
18-Nov-2021 20:46:47.305 zone 1.1.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:48.497 timed out resolving './DNSKEY/IN': 193.136.9.240#53
18-Nov-2021 20:46:49.697 timed out resolving './DNSKEY/IN': 193.136.19.1#53
18-Nov-2021 20:46:57.297 managed-keys-zone: Unable to fetch DNSKEY set '': time d out
18-Nov-2021 20:46:57.297 managed-keys.bind.jnl: open: permission denied
18-Nov-2021 20:46:57.297 managed-keys-zone: keyfetch_done:dns_journal_open -> unexpected error
18-Nov-2021 20:46:57.297 managed-keys-zone: error during managed-keys processing (unexpected error): DNSSEC validation may be at risk
18-Nov-2021 20:46:57.297 resolver priming query complete

bash-5.0# dig cc.pt. ANY

; <<> DiG 9.16.1-Ubuntu <<> cc.pt. ANY
;; global options: +cmd
;; Got answer:
;; ->HEADER<- opcode: QUERY, status: NOERROR, id: 46213
;; flags: qr aa rd: QUERY: 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 5
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags: udp: 4096
; COOKIE: c2e0938548901ec9010000006196bbcdc721ad738c6fde12 (good)
;; QUESTION SECTION:
;cc.pt.                                IN      ANY

;; ANSWER SECTION:
cc.pt.                604800  IN      SOA     Servidor1.cc.pt. g53p15.cc.pt. 2
604800 86400 2419200 604800
cc.pt.                604800  IN      NS      Servidor1.cc.pt.
cc.pt.                604800  IN      NS      Golfinho.cc.pt.
cc.pt.                604800  IN      MX      50 Servidor3.cc.pt.
cc.pt.                604800  IN      MX      10 Servidor2.cc.pt.

;; ADDITIONAL SECTION:
Golfinho.cc.pt.      604800  IN      A       10.3.3.2
Servidor1.cc.pt.     604800  IN      A       10.2.2.1
Servidor2.cc.pt.     604800  IN      A       10.2.2.2
Servidor3.cc.pt.     604800  IN      A       10.2.2.3

;; Query time: 4 msec
;; SERVER: 10.2.2.1#53(10.2.2.1)
;; WHEN: qui nov 18 20:47:09 UTC 2021
;; MSG SIZE rcvd: 268

bash-5.0#
```

13. Dig para o domínio “cc.pt.” com ambos os servidores a correr

```
vcmd
18-Nov-2021 20:46:35,805 zone cc.pt/IN: loaded serial 2
18-Nov-2021 20:46:35,833 zone localhost/IN: loaded serial 2
18-Nov-2021 20:46:35,833 all zones loaded
18-Nov-2021 20:46:35,837 running
18-Nov-2021 20:46:35,845 zone 3.3.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:35,845 zone 4.4.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:35,845 zone cc.pt/IN: sending notifies (serial 2)
18-Nov-2021 20:46:35,857 zone 2.2.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:35,861 zone 1.1.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:37,045 timed out resolving './DNSKEY/IN': 193.136.9.240#53
18-Nov-2021 20:46:38,245 timed out resolving './DNSKEY/IN': 193.136.19.1#53
18-Nov-2021 20:46:45,845 managed-keys-zone: Unable to fetch DNSKEY set '.': time
d out
18-Nov-2021 20:46:45,845 managed-keys.bind.jnl: open: permission denied
18-Nov-2021 20:46:45,845 managed-keys-zone: keyfetch_done:dns_journal_open -> un
expected error
18-Nov-2021 20:46:45,845 managed-keys-zone: error during managed-keys processing
(unexpected error): DNSSEC validation may be at risk
18-Nov-2021 20:46:45,845 resolver priming query complete
)

vcmd
18-Nov-2021 20:46:47,293 zone 127.in-addr.arpa/IN: loaded serial 1
18-Nov-2021 20:46:47,293 zone localhost/IN: loaded serial 2
18-Nov-2021 20:46:47,293 all zones loaded
18-Nov-2021 20:46:47,297 running
18-Nov-2021 20:46:47,297 zone 3.3.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone 2.2.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone 4.4.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone cc.pt/IN: sending notifies (serial 2)
18-Nov-2021 20:46:47,305 zone 1.1.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:48,497 timed out resolving './DNSKEY/IN': 193.136.9.240#53
18-Nov-2021 20:46:49,697 timed out resolving './DNSKEY/IN': 193.136.19.1#53
18-Nov-2021 20:46:57,297 managed-keys-zone: Unable to fetch DNSKEY set '.': time
d out
18-Nov-2021 20:46:57,297 managed-keys.bind.jnl: open: permission denied
18-Nov-2021 20:46:57,297 managed-keys-zone: keyfetch_done:dns_journal_open -> un
expected error
18-Nov-2021 20:46:57,297 managed-keys-zone: error during managed-keys processing
(unexpected error): DNSSEC validation may be at risk
18-Nov-2021 20:46:57,297 resolver priming query complete
)

bash-5.0#
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bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0# ping www.cc.pt. -c 10
PING Servidor2.cc.pt (10.2.2.2) 56(84) bytes of data.
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=1 ttl=61 time=1.46 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=2 ttl=61 time=0.487 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=3 ttl=61 time=0.490 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=4 ttl=61 time=0.518 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=5 ttl=61 time=0.460 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=6 ttl=61 time=0.526 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=7 ttl=61 time=0.486 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=8 ttl=61 time=0.525 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=9 ttl=61 time=0.452 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=10 ttl=61 time=0.457 ms

--- Servidor2.cc.pt ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9185ms
rtt min/avg/max/mdev = 0.452/0.586/1.461/0.292 ms
bash-5.0#
```

14. Ping para “www.cc.pt.” com ambos os servidores a correr

```

vcmd
)
18-Nov-2021 20:46:35,845 zone cc.pt/IN: sending notifies (serial 2)
18-Nov-2021 20:46:35,857 zone 2.2.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:35,861 zone 1.1.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:37,045 timed out resolving './DNSKEY/IN': 193.136.9.240#53
18-Nov-2021 20:46:38,245 timed out resolving './DNSKEY/IN': 193.136.19.1#53
18-Nov-2021 20:46:45,845 managed-keys-zone: Unable to fetch DNSKEY set '.': time
d out
18-Nov-2021 20:46:45,845 managed-keys.bind.jnl: open: permission denied
18-Nov-2021 20:46:45,845 managed-keys-zone: keyfetch_done:dns_journal_open -> un
expected error
18-Nov-2021 20:46:45,845 managed-keys-zone: error during managed-keys processing
(unexpected error): DNSSEC validation may be at risk
18-Nov-2021 20:46:45,845 resolver priming query complete
^C18-Nov-2021 20:52:18,113 no longer listening on 127.0.0.1#53
18-Nov-2021 20:52:18,113 no longer listening on 10.2.2.1#53
18-Nov-2021 20:52:18,113 no longer listening on ::1#53
18-Nov-2021 20:52:18,113 no longer listening on 2001:2::1#53
18-Nov-2021 20:52:18,113 no longer listening on fe80::200:ff:feaa:14#55#53
18-Nov-2021 20:52:18,113 shutting down
18-Nov-2021 20:52:18,141 exiting
root@Servidor1:/tmp/pycore.38717/Servidor1.conf#

vcmd
18-Nov-2021 20:46:47,293 zone 127.in-addr.arpa/IN: loaded serial 1
18-Nov-2021 20:46:47,293 zone localhost/IN: loaded serial 2
18-Nov-2021 20:46:47,293 all zones loaded
18-Nov-2021 20:46:47,297 running
18-Nov-2021 20:46:47,297 zone 3.3.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone 2.2.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone 4.4.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone cc.pt/IN: sending notifies (serial 2)
18-Nov-2021 20:46:47,305 zone 1.1.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:48,497 timed out resolving './DNSKEY/IN': 193.136.9.240#53
18-Nov-2021 20:46:49,697 timed out resolving './DNSKEY/IN': 193.136.19.1#53
18-Nov-2021 20:46:57,297 managed-keys-zone: Unable to fetch DNSKEY set '.': time
d out
18-Nov-2021 20:46:57,297 managed-keys.bind.jnl: open: permission denied
18-Nov-2021 20:46:57,297 managed-keys-zone: keyfetch_done:dns_journal_open -> un
expected error
18-Nov-2021 20:46:57,297 managed-keys-zone: error during managed-keys processing
(unexpected error): DNSSEC validation may be at risk
18-Nov-2021 20:46:57,297 resolver priming query complete
)

```

```

vcmd
;; Connection to 10.2.2.1#53(10.2.2.1) for cc.pt. failed: connection refused.

; <<>> DiG 9.16.1-Ubuntu <<>> cc.pt. ANY
;; global options: +cmd
;; Got answer:
;; ->HEADER<- opcode: QUERY, status: NOERROR, id: 25078
;; flags: qr aa rd: QUERY, 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 5
;; WARNING: recursion requested but not available

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
; COOKIE: c63235776ff00051010000006196bd08a44da80888129af5 (good)
;; QUESTION SECTION:
;cc.pt.                                IN      ANY

;; ANSWER SECTION:
cc.pt.      604800 IN      NS      Golfinho.cc.pt.
cc.pt.      604800 IN      NS      Servidor1.cc.pt.
cc.pt.      604800 IN      MX      50 Servidor3.cc.pt.
cc.pt.      604800 IN      MX      10 Servidor2.cc.pt.
cc.pt.      604800 IN      SOA     Servidor1.cc.pt. g53p15.cc.pt. 2
604800 86400 2419200 604800

;; ADDITIONAL SECTION:
Golfinho.cc.pt. 604800 IN      A      10.3.3.2
Servidor1.cc.pt. 604800 IN      A      10.2.2.1
Servidor2.cc.pt. 604800 IN      A      10.2.2.2
Servidor3.cc.pt. 604800 IN      A      10.2.2.3

;; Query time: 0 msec
;; SERVER: 10.3.3.2#53(10.3.3.2)
;; WHEN: qui nov 18 20:52:24 UTC 2021
;; MSG SIZE rcvd: 268

bash-5.0#

```

15. Dig para o domínio “cc.pt.” com apenas o servidor secundário a correr

```
vcmd
)
18-Nov-2021 20:46:35,845 zone cc.pt/IN: sending notifies (serial 2)
18-Nov-2021 20:46:35,857 zone 2.2.10.in-addr.arpa/IN: sending notifies (serial 1)
18-Nov-2021 20:46:35,861 zone 1.1.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:37,045 timed out resolving './DNSKEY/IN': 193.136.9.240#53
18-Nov-2021 20:46:38,245 timed out resolving './DNSKEY/IN': 193.136.19.1#53
18-Nov-2021 20:46:45,845 managed-keys-zone: Unable to fetch DNSKEY set '.': time
d out
18-Nov-2021 20:46:45,845 managed-keys.bind.jnl: open: permission denied
18-Nov-2021 20:46:45,845 managed-keys-zone: keyfetch_done:dns_journal_open -> un
expected error
18-Nov-2021 20:46:45,845 managed-keys-zone: error during managed-keys processing
(unexpected error): DNSSEC validation may be at risk
18-Nov-2021 20:46:45,845 resolver priming query complete
^C18-Nov-2021 20:52:18,113 no longer listening on 127.0.0.1#53
18-Nov-2021 20:52:18,113 no longer listening on 10.2.2.1#53
18-Nov-2021 20:52:18,113 no longer listening on ::1#53
18-Nov-2021 20:52:18,113 no longer listening on 2001:2::1#53
18-Nov-2021 20:52:18,113 no longer listening on fe80::200:ff:feaa:14:55#53
18-Nov-2021 20:52:18,113 shutting down
18-Nov-2021 20:52:18,141 exiting
root@Servidor1:/tmp/pycore.38717/Servidor1.conf#

vcmd
18-Nov-2021 20:46:47,293 zone 127.in-addr.arpa/IN: loaded serial 1
18-Nov-2021 20:46:47,293 zone localhost/IN: loaded serial 2
18-Nov-2021 20:46:47,293 all zones loaded
18-Nov-2021 20:46:47,297 running
18-Nov-2021 20:46:47,297 zone 3.3.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone 2.2.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone 4.4.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:47,297 zone cc.pt/IN: sending notifies (serial 2)
18-Nov-2021 20:46:47,305 zone 1.1.10.in-addr.arpa/IN: sending notifies (serial 1)
)
18-Nov-2021 20:46:48,497 timed out resolving './DNSKEY/IN': 193.136.9.240#53
18-Nov-2021 20:46:49,697 timed out resolving './DNSKEY/IN': 193.136.19.1#53
18-Nov-2021 20:46:57,297 managed-keys-zone: Unable to fetch DNSKEY set '.': time
d out
18-Nov-2021 20:46:57,297 managed-keys.bind.jnl: open: permission denied
18-Nov-2021 20:46:57,297 managed-keys-zone: keyfetch_done:dns_journal_open -> un
expected error
18-Nov-2021 20:46:57,297 managed-keys-zone: error during managed-keys processing
(unexpected error): DNSSEC validation may be at risk
18-Nov-2021 20:46:57,297 resolver priming query complete
)
```

```
vcmd
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
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bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0#
bash-5.0# ping www.cc.pt. -c 10
PING Servidor2.cc.pt (10.2.2.2) 56(84) bytes of data.
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=1 ttl=61 time=0.610 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=2 ttl=61 time=0.489 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=3 ttl=61 time=0.585 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=4 ttl=61 time=0.839 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=5 ttl=61 time=0.501 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=6 ttl=61 time=0.614 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=7 ttl=61 time=0.640 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=8 ttl=61 time=0.667 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=9 ttl=61 time=1.04 ms
64 bytes from Servidor2.cc.pt (10.2.2.2): icmp_seq=10 ttl=61 time=1.23 ms

--- Servidor2.cc.pt ping statistics ---
10 packets transmitted, 10 received, 0% packet loss, time 9120ms
rtt min/avg/max/mdev = 0.489/0.721/1.232/0.229 ms
bash-5.0#
```

16. Ping para “www.cc.pt.” apenas o servidor secundário a correr

Parte III

Conclusão

O serviço de resolução de nomes (DNS) é essencial para o normal funcionamento da *world wide web*. Demonstra-se como sendo um serviço complexo e minucioso, pois requer uma série de configurações de modo a garantir a sua total operabilidade. Dado por concluído, este trabalho permite-nos agora compreender os conceitos de *nameserver*, *host*, domínio, servidores primários e secundários, TLD (*top level domains*), entre outros, bem como visualizar a árvore de resolução de nomes.