IETF DNS Privacy

A short introduction and update on DPRIVE

Warren Kumari

What’s the problem?

What’s the problem?

I hate doing expense reports…

What’s the problem?

I hate doing expense reports…

so I procrastinate…

What’s the problem?

I hate doing expense reports…

so I procrastinate…

… and tidy up my desk

What’s the problem?

I hate doing expense reports…

so I procrastinate…

… and tidy up my desk

… and clean all the crumbs out of my keyboard

What’s the problem?

I hate doing expense reports…

so I procrastinate…

… and tidy up my desk

… and clean all the crumbs out of my keyboard

… and do the laundry

What’s the problem?

I hate doing expense reports…

so I procrastinate…

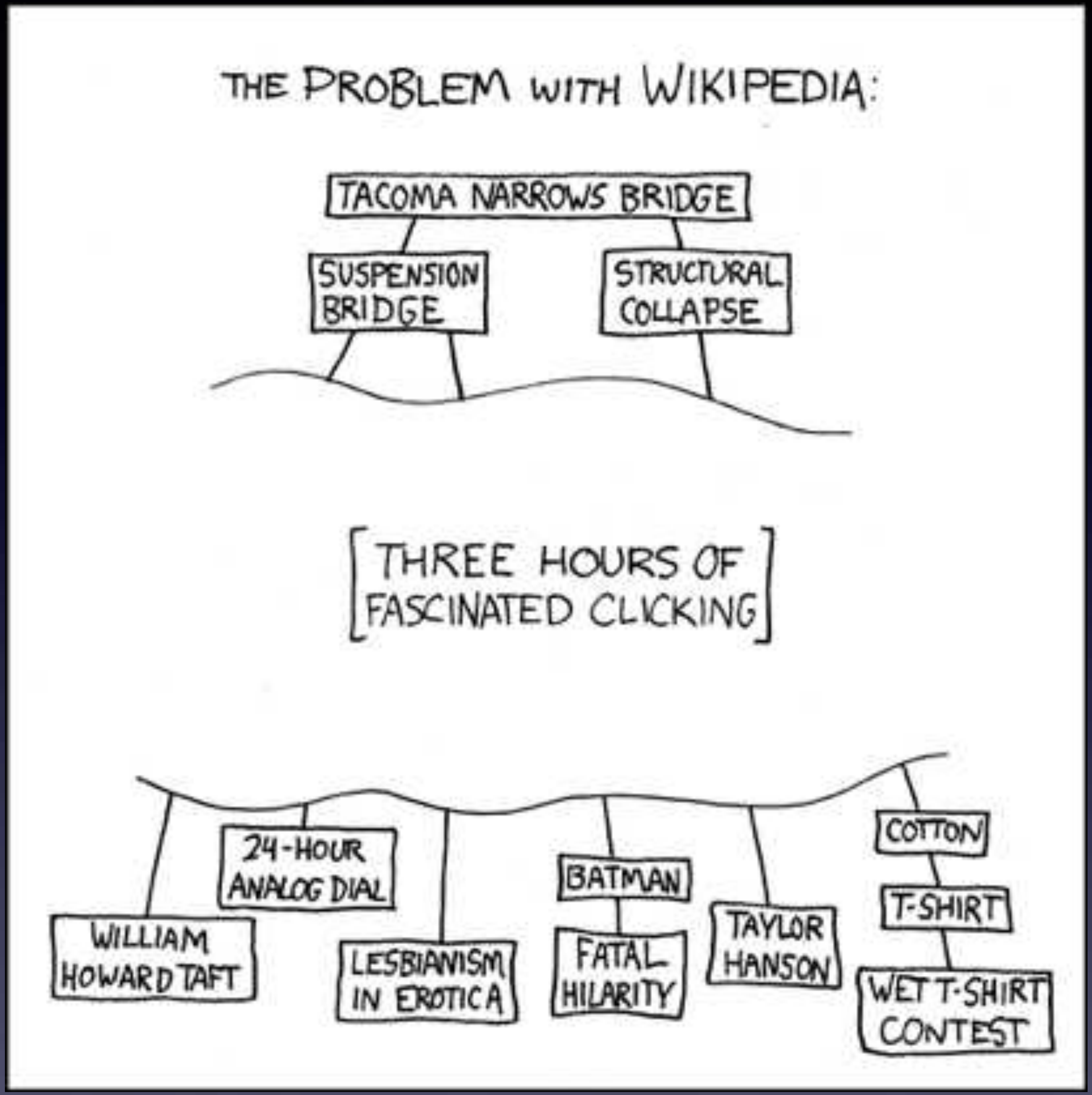
… and tidy up my desk

… and clean all the crumbs out of my keyboard

… and do the laundry

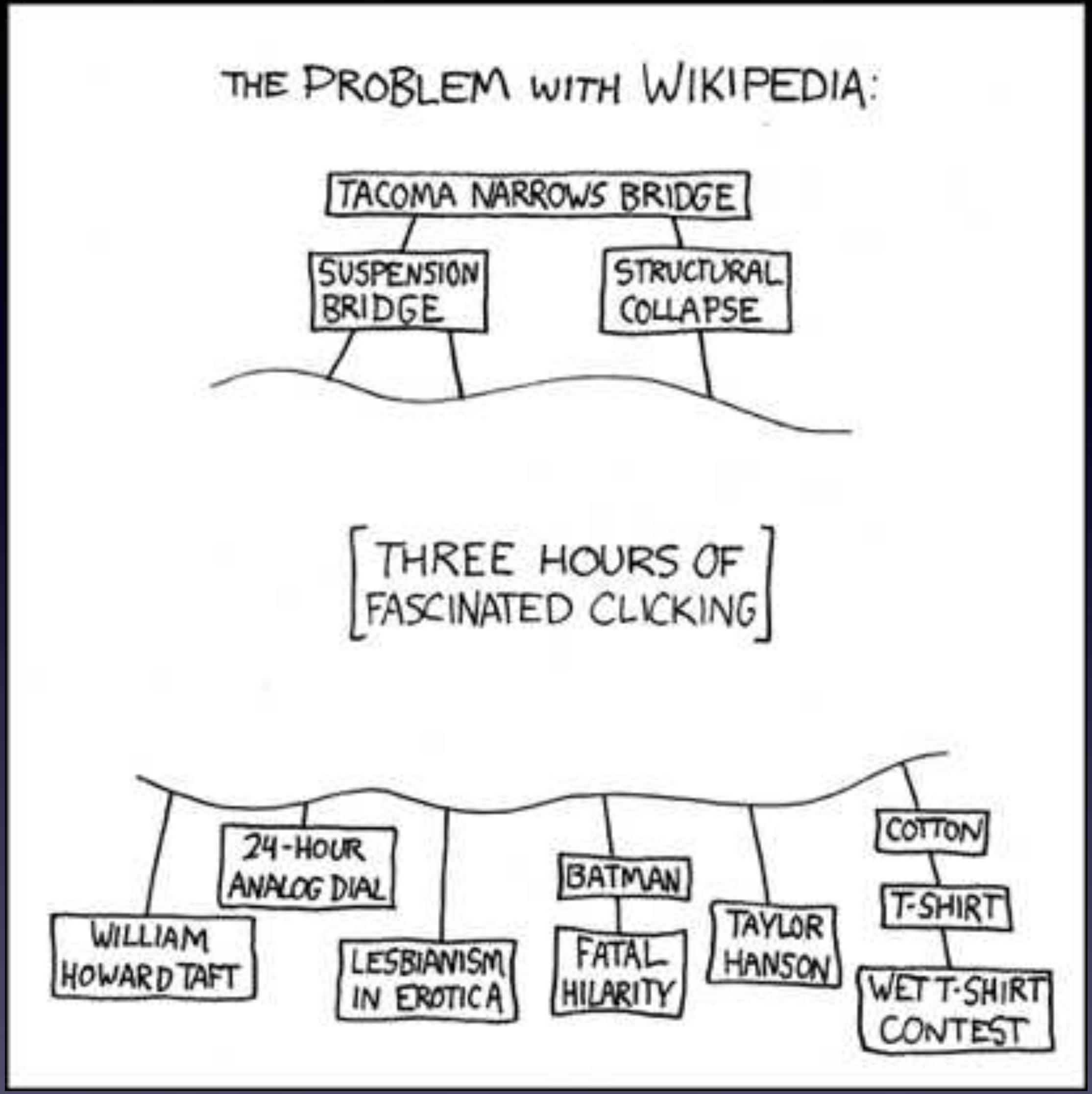
… and then start reading Wikipedia….

What’s the problem? (cont)



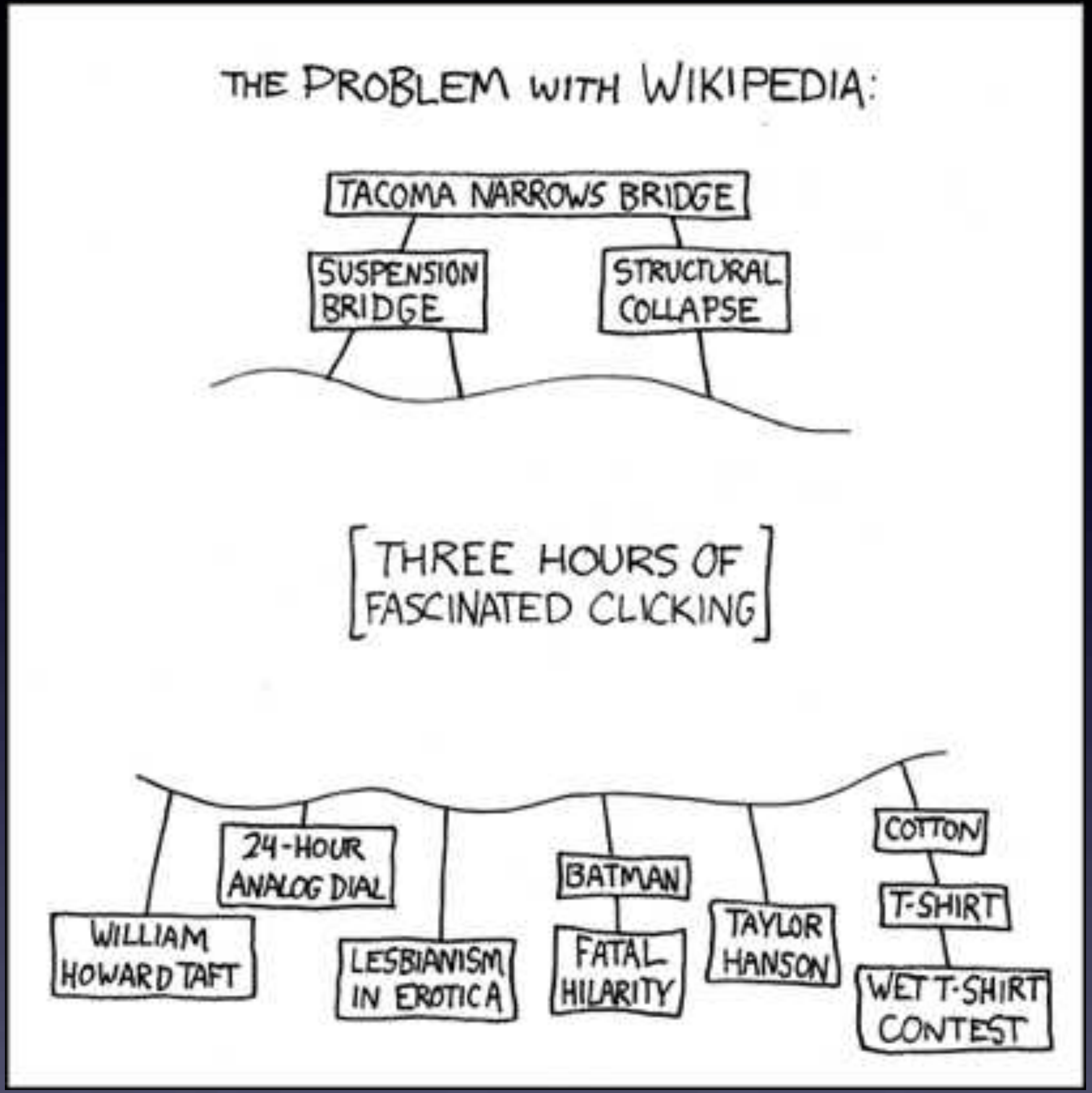
Attribution: xkcd is licensed by Randall Munroe under a Creative Commons Attribution-NonCommercial 2.5 License - XKCD from http://imgs.xkcd.com/comics/the_problem_with_wikipedia.png

What's the problem? (cont)



"99 Luftballons"

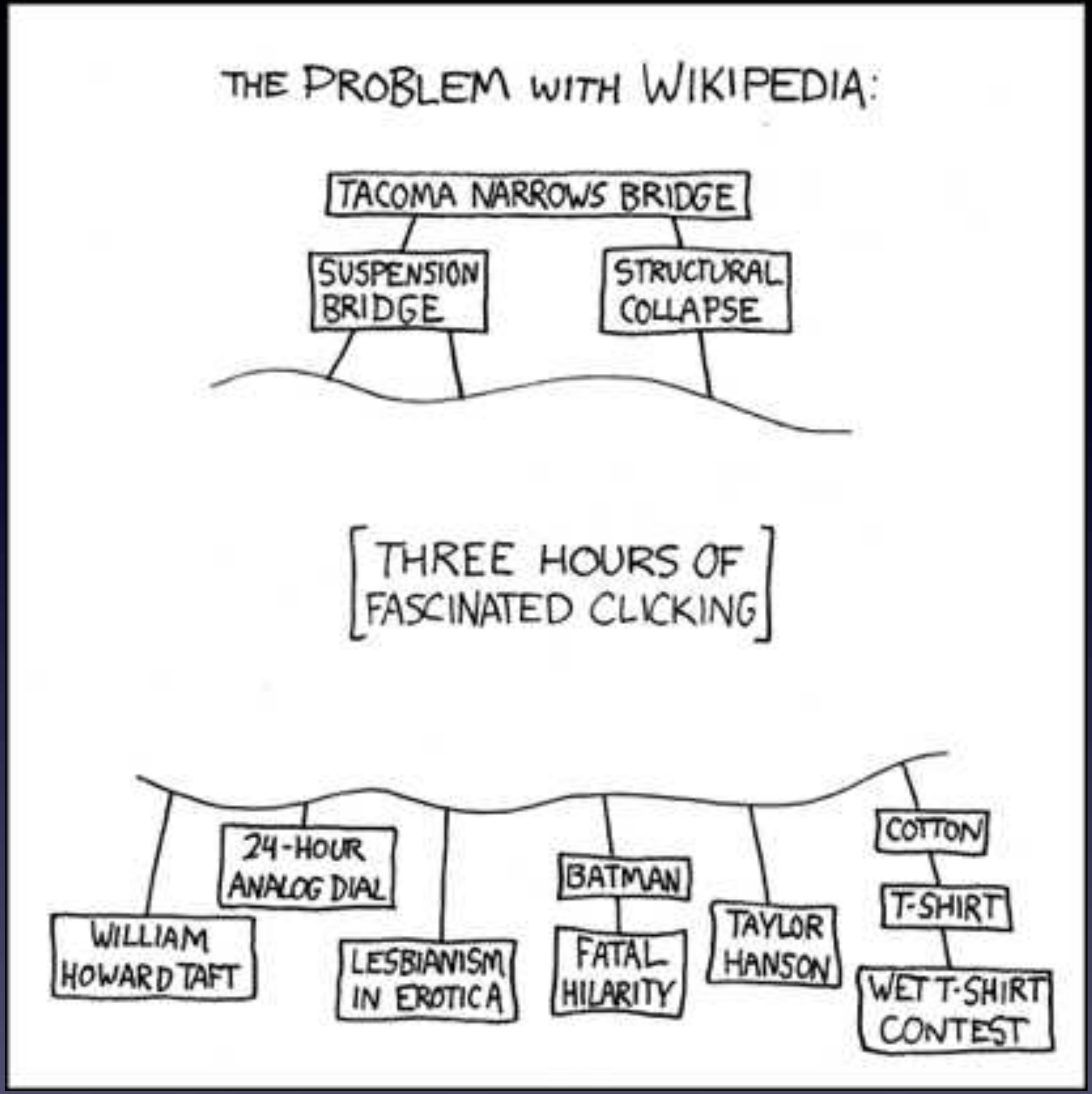
What's the problem? (cont)



"99 Luftballons" → "99 Red Balloons"

Attribution: xkcd is licensed by Randall Munroe under a Creative Commons Attribution-NonCommercial 2.5 License - XKCD from http://imgs.xkcd.com/comics/the_problem_with_wikipedia.png

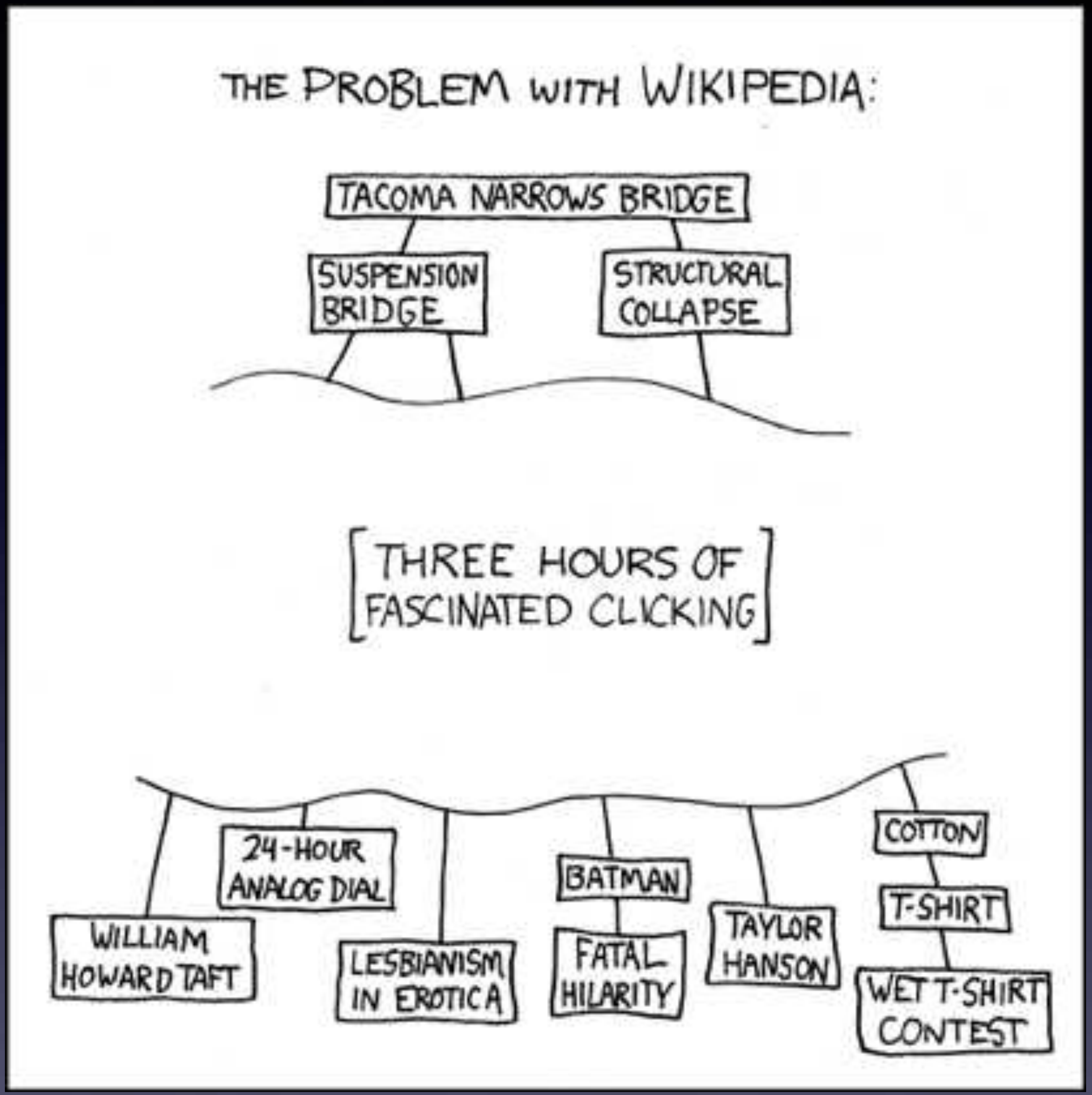
What’s the problem? (cont)



“99 Luftballons”→ “99 Red Balloons”→ Nuclear accidents

Attribution: xkcd is licensed by Randall Munroe under a Creative Commons Attribution-NonCommercial 2.5 License - XKCD from http://imgs.xkcd.com/comics/the_problem_with_wikipedia.png

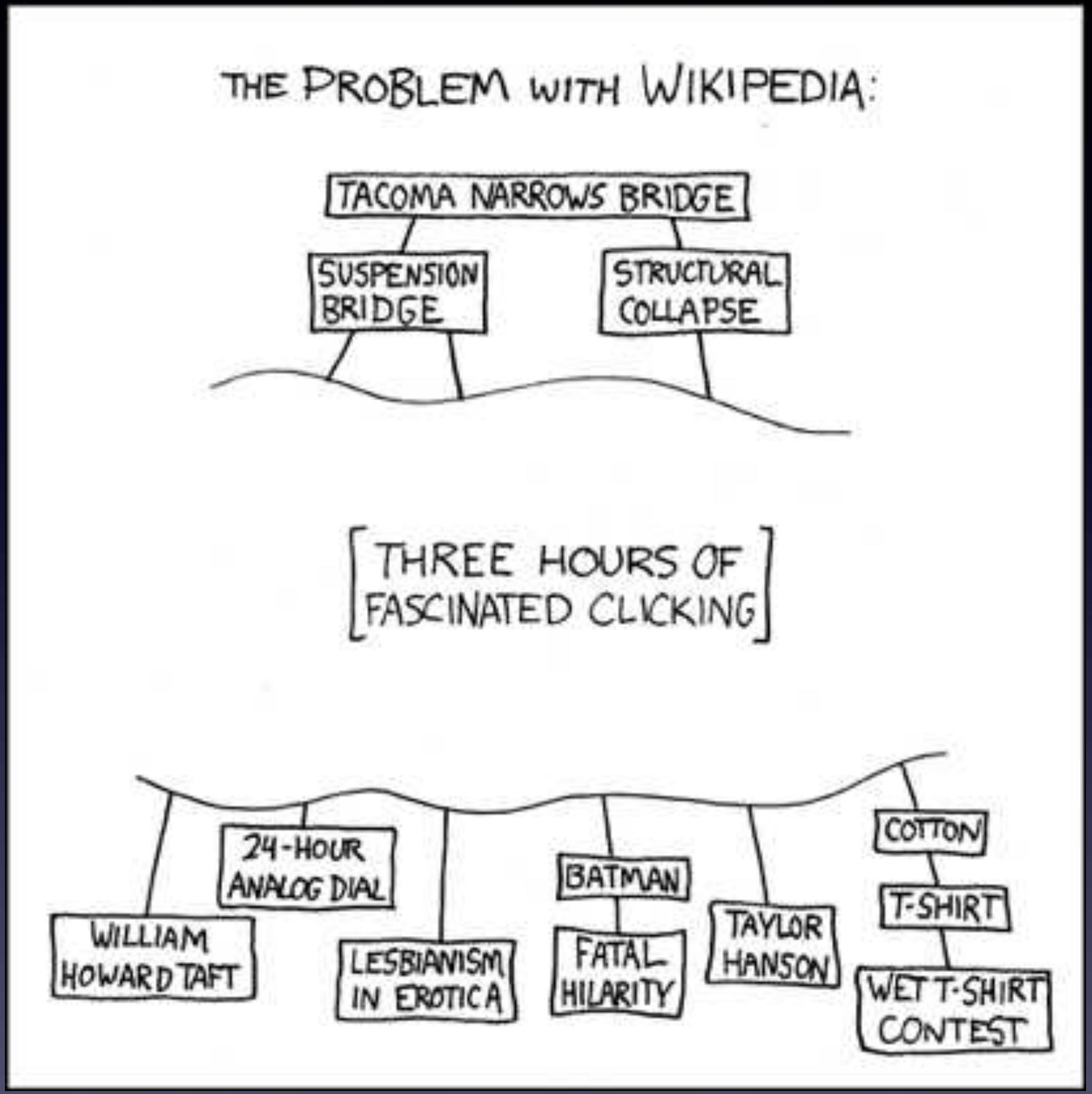
What’s the problem? (cont)



“99 Luftballons”→ “99 Red Balloons”→ Nuclear accidents → [Three hours of fascinated clicking]

Attribution: xkcd is licensed by Randall Munroe under a Creative Commons Attribution-NonCommercial 2.5 License - XKCD from http://imgs.xkcd.com/comics/the_problem_with_wikipedia.png

What’s the problem? (cont)



“99 Luftballons”→ “99 Red Balloons”→ Nuclear accidents → [Three hours of fascinated clicking] → websites on the efficiency of centrifugal enrichment of uranium-235

Attribution: xkcd is licensed by Randall Munroe under a Creative Commons Attribution-NonCommercial 2.5 License - XKCD from http://imgs.xkcd.com/comics/the_problem_with_wikipedia.png

So what?

So what?

All of the URLs I went to were https:// , so the content is protected, no-one is likely to get the wrong idea…

So what?

All of the URLs I went to were https:// , so the content is protected, no-one is likely to get the wrong idea…

…but many of the domain names that my machine looked up were, um, suspicious, especially if taken out of context.

So what?

All of the URLs I went to were https:// , so the content is protected, no-one is likely to get the wrong idea…

…but many of the domain names that my machine looked up were, um, suspicious, especially if taken out of context.

... and it has become clear that governments and pervasive monitors are using actively exploiting metadata for targeting.

So what?

All of the URLs I went to were https:// , so the content is protected, no-one is likely to get the wrong idea…

…but many of the domain names that my machine looked up were, um, suspicious, especially if taken out of context.

... and it has become clear that governments and pervasive monitors are using actively exploiting metadata for targeting.

Am I really concerned about this particular case? Nah, I'm not that paranoid, but it makes a good example :-)

RFC 7258 - Pervasive Monitoring Is an Attack

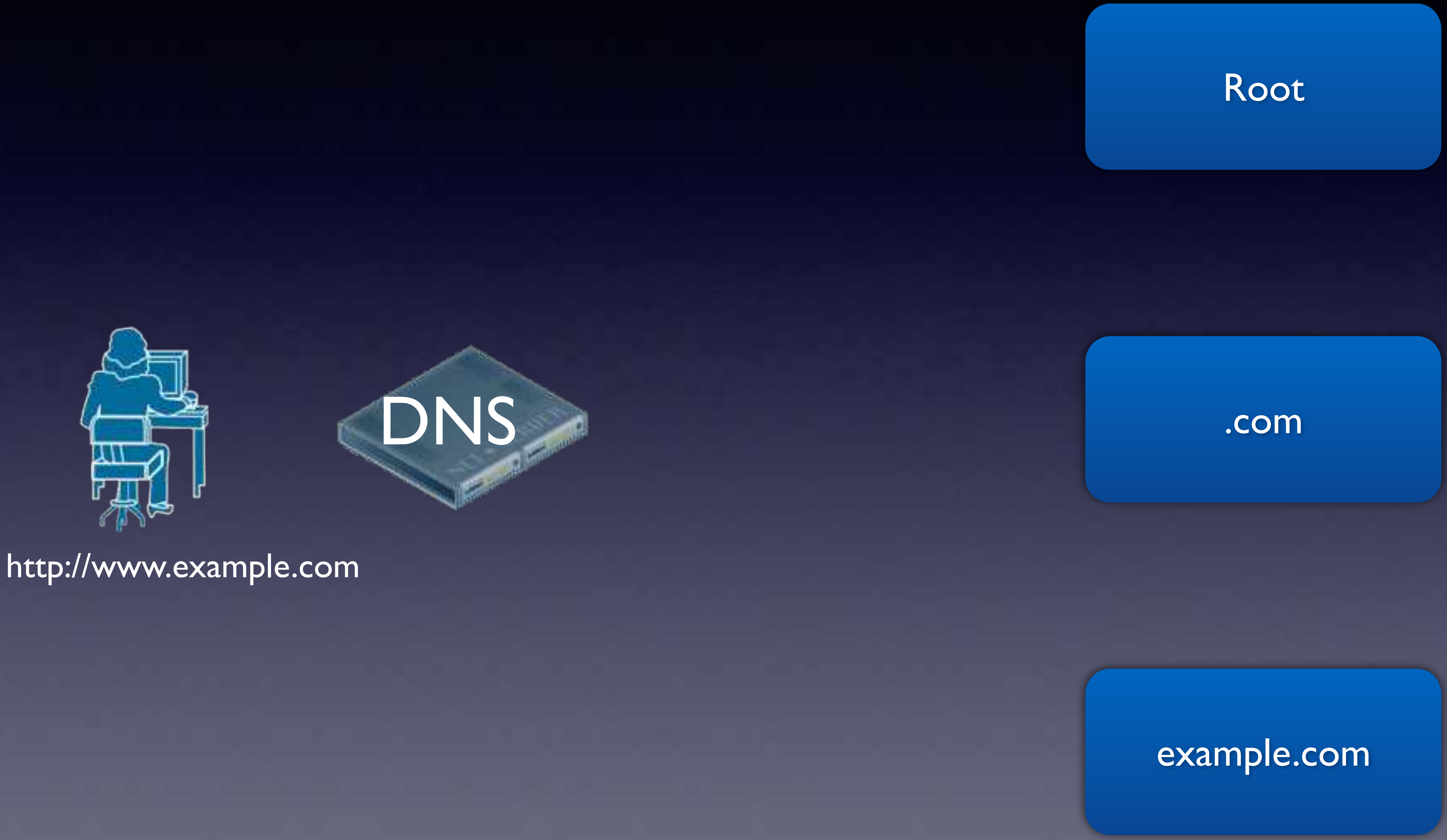
The IETF community's technical assessment is that PM is an attack on the privacy of Internet users and organisations. The IETF community has expressed strong agreement that PM is an attack that needs to be mitigated where possible, via the design of protocols that make PM significantly more expensive or infeasible.

QNAME Minimization

draft-ietf-dnsop-qname-minimisation[*]

[*]:Submitted to IESG for Publication

How DNS works



DNS

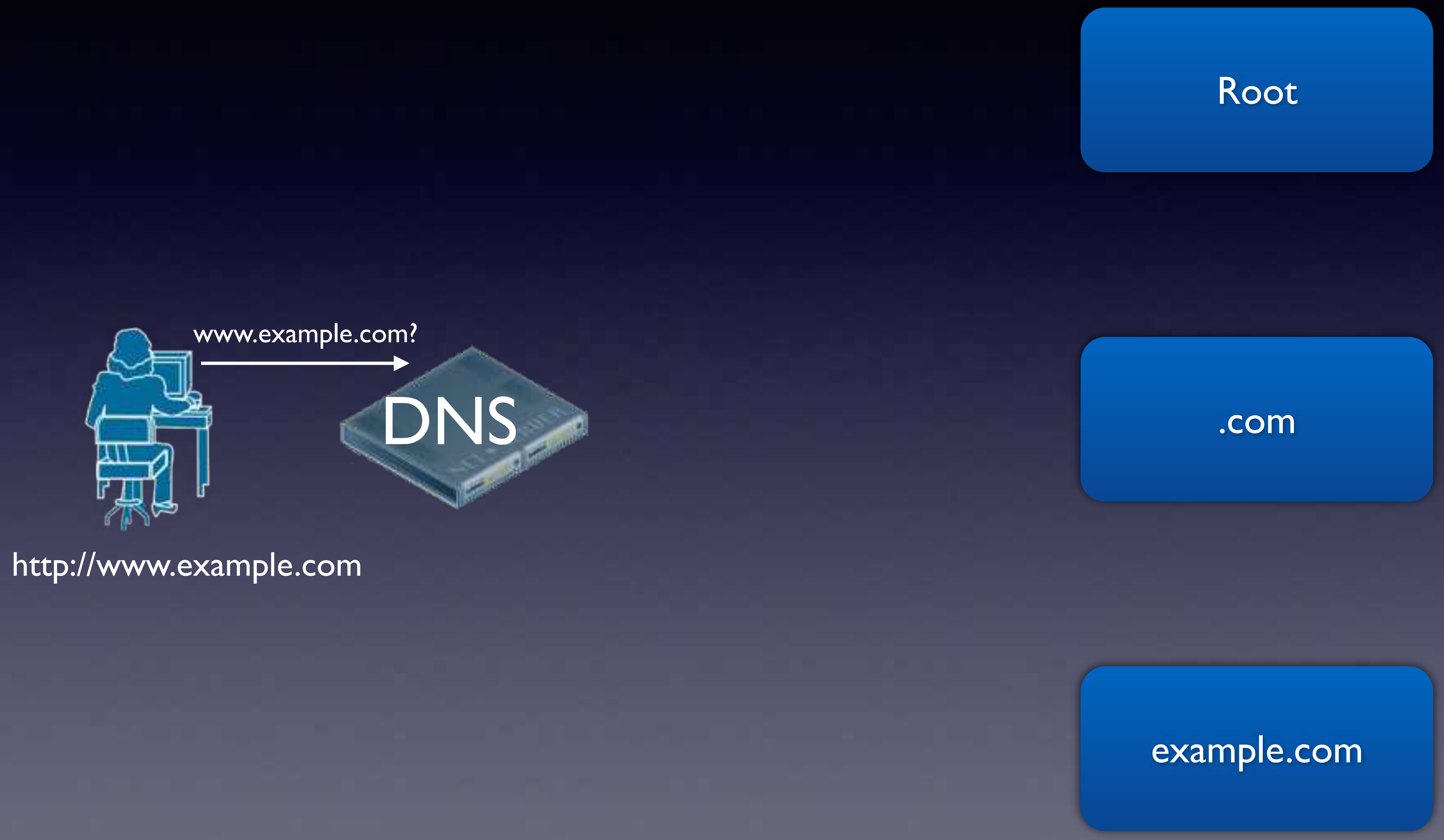
http://www.example.com

Root

.com

example.com

How DNS works



www.example.com?

DNS

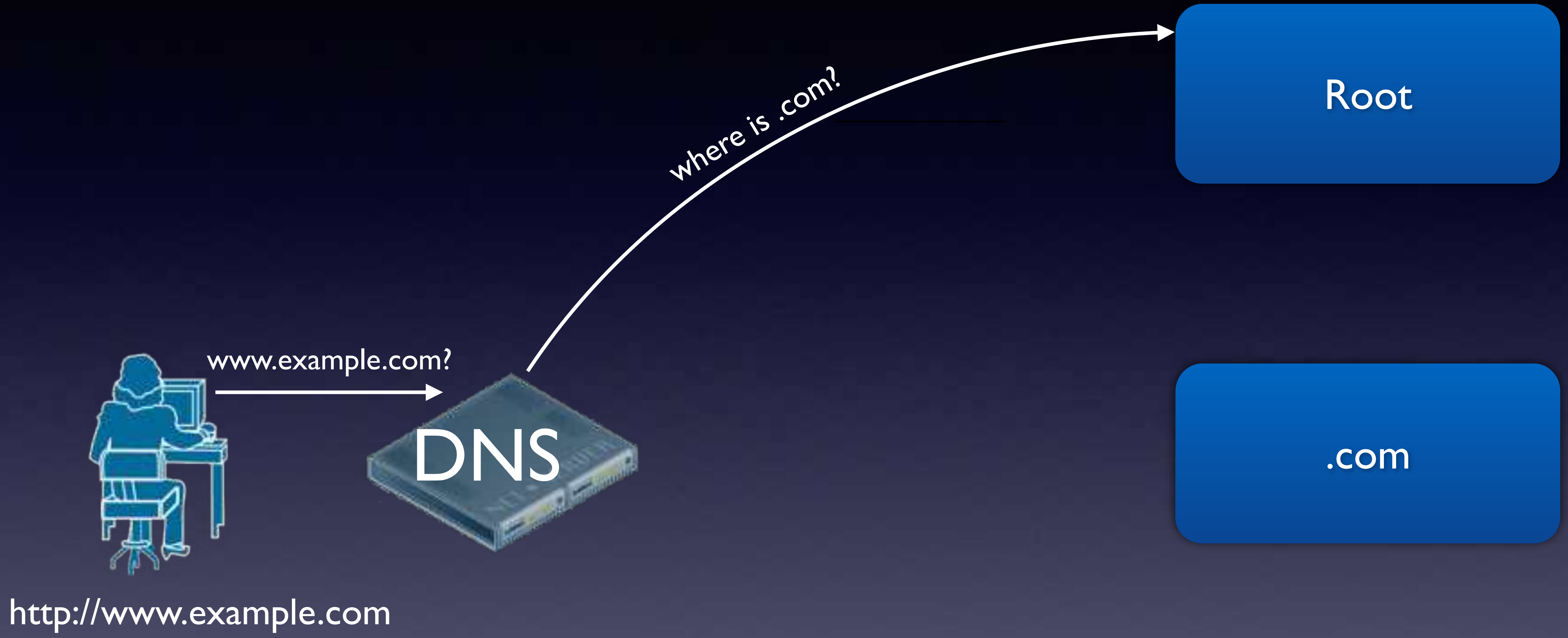
http://www.example.com

Root

.com

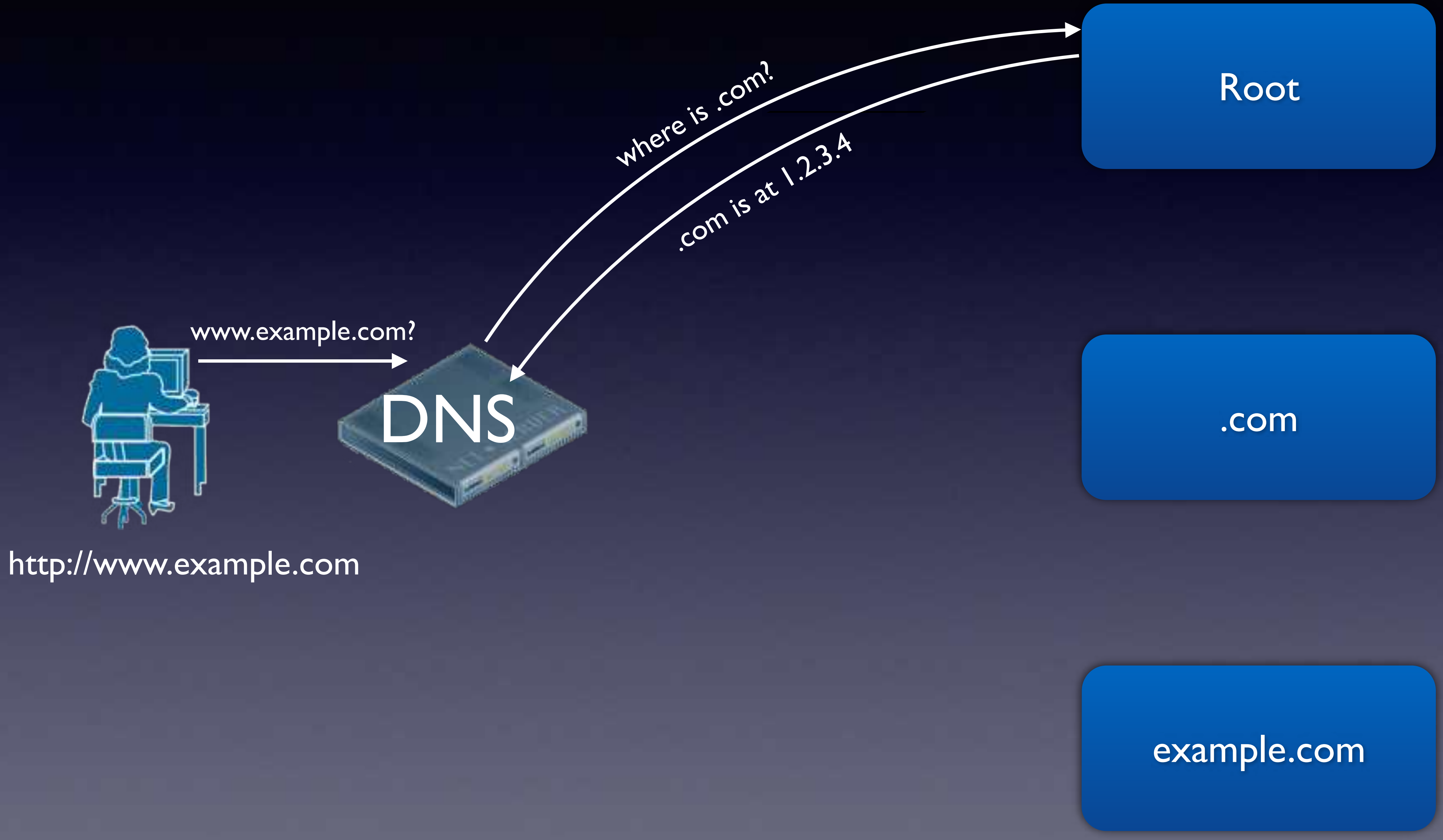
example.com

How DNS works

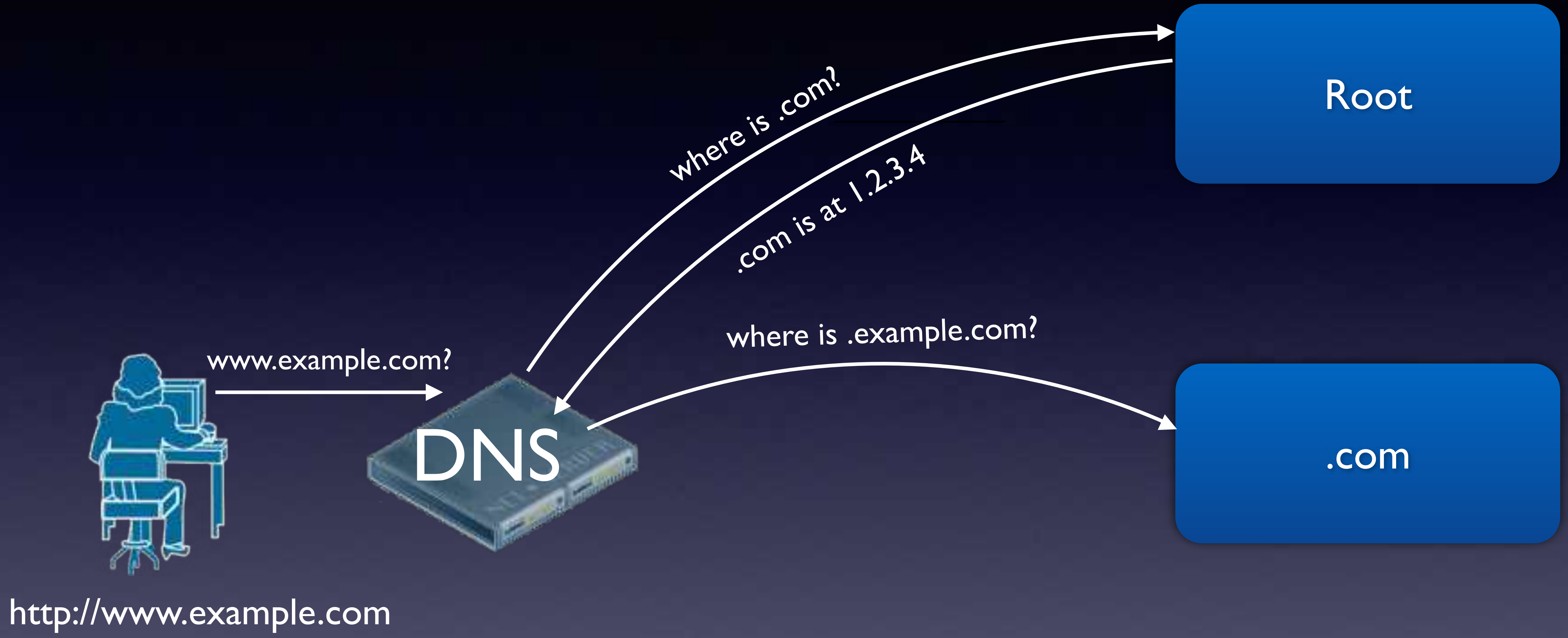


example.com

How DNS works

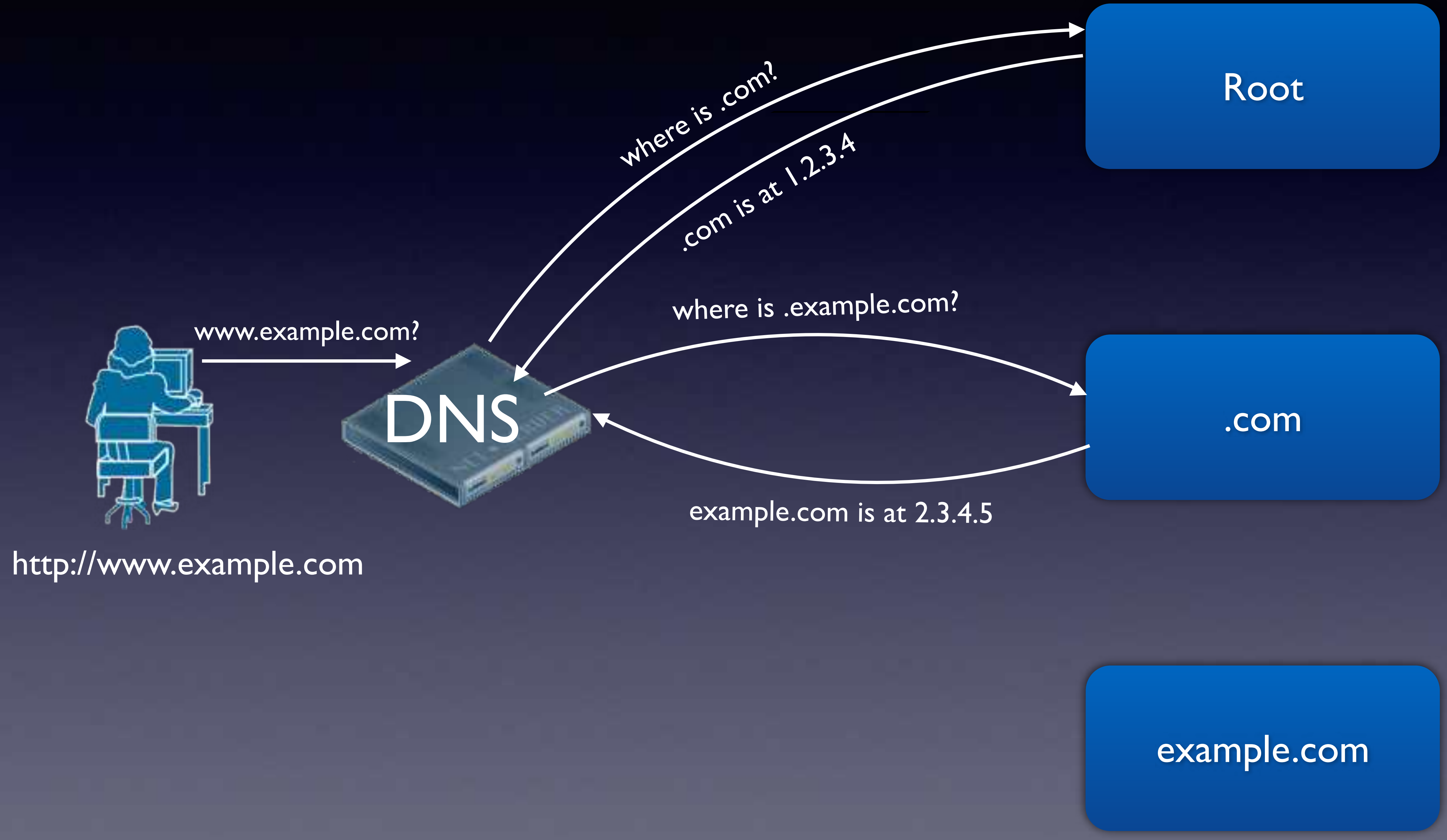


How DNS works

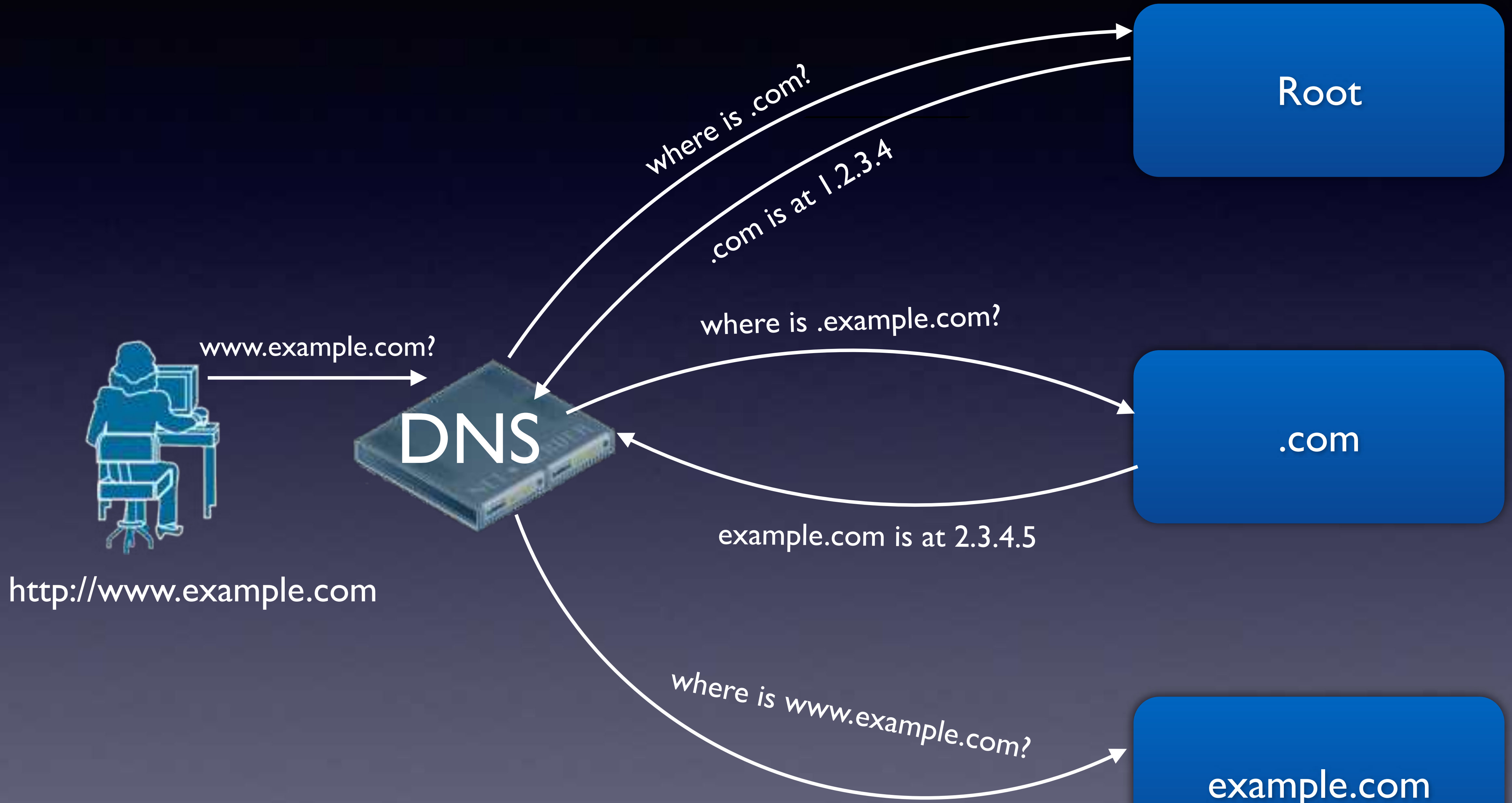


example.com

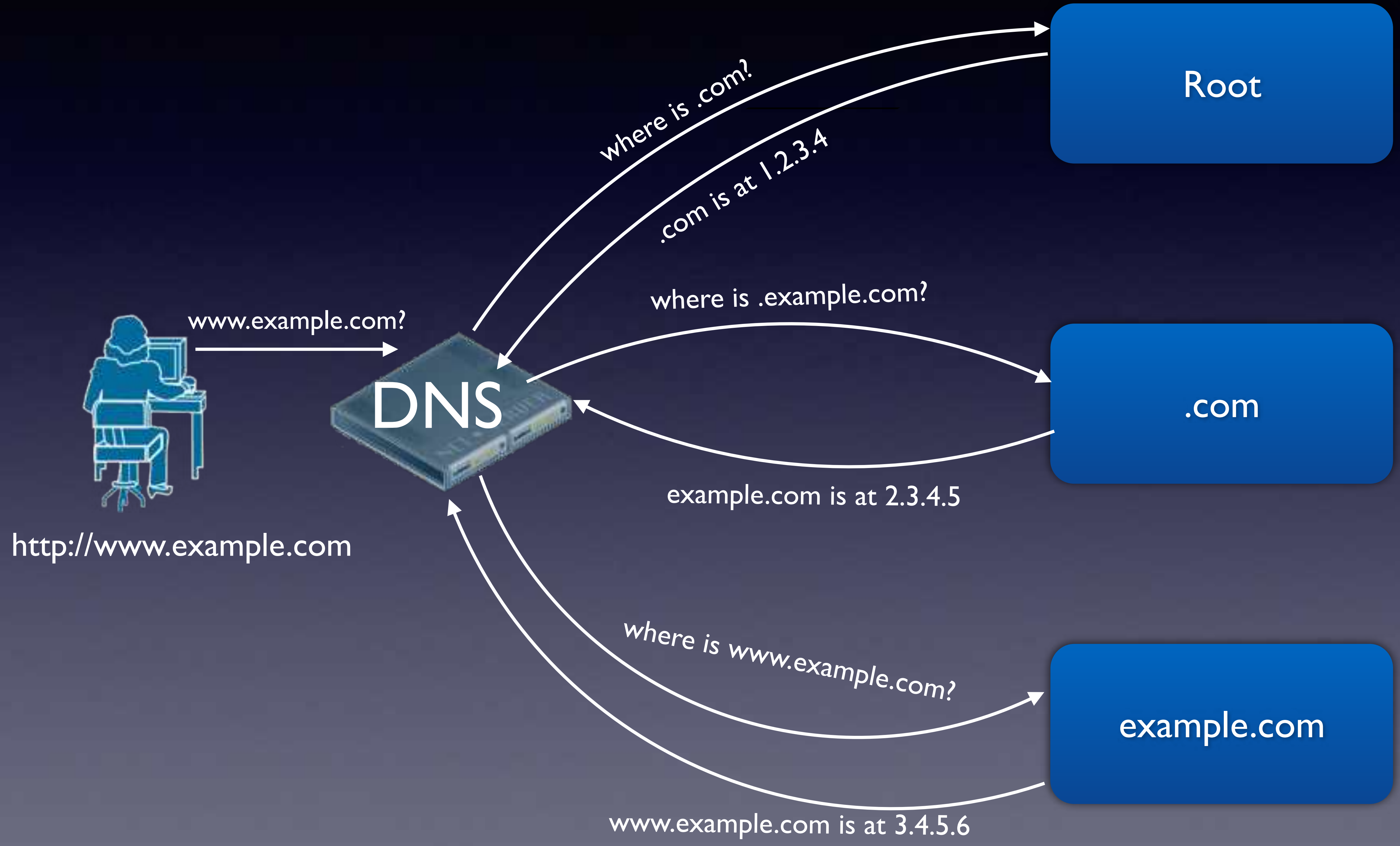
How DNS works



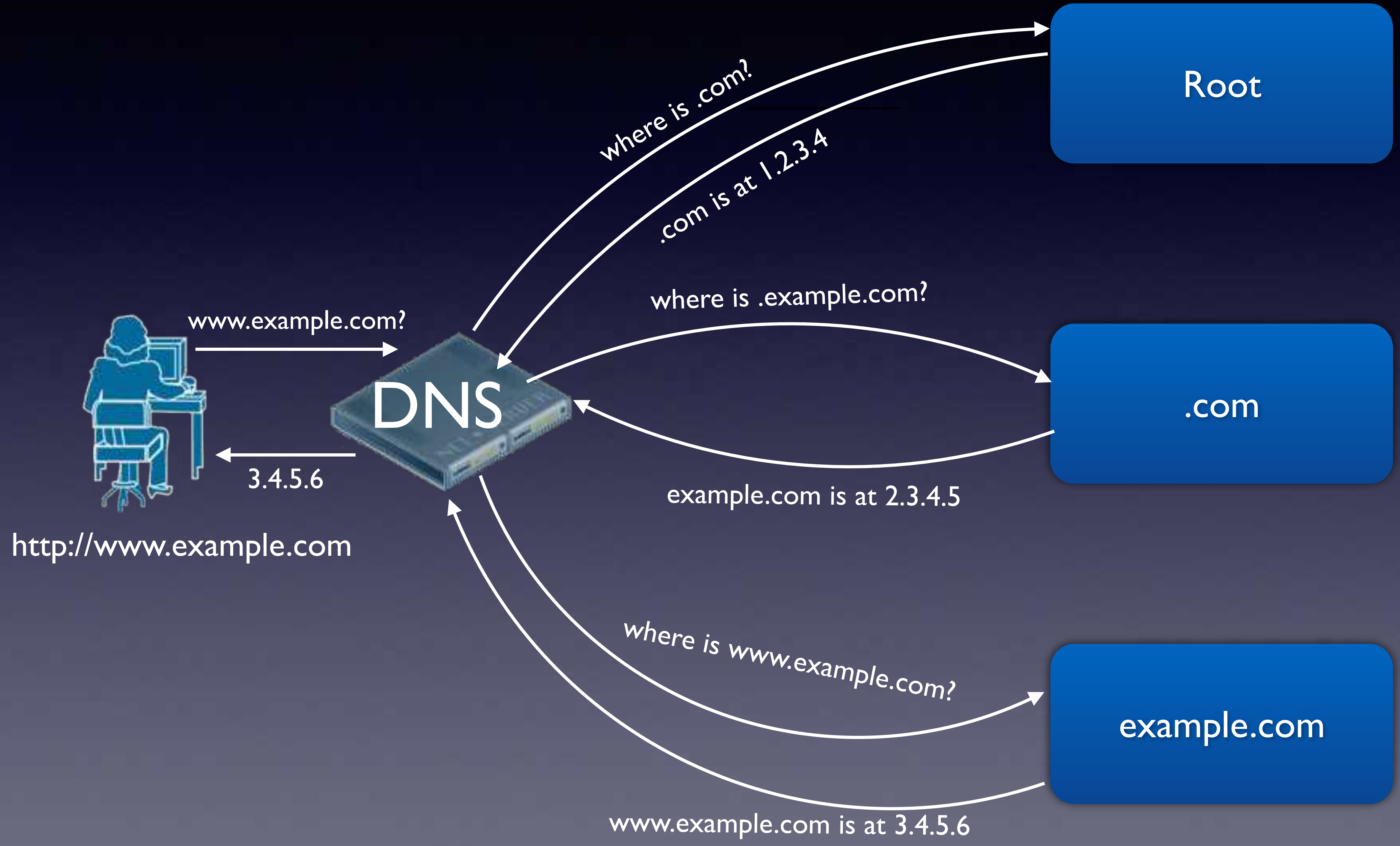
How DNS works



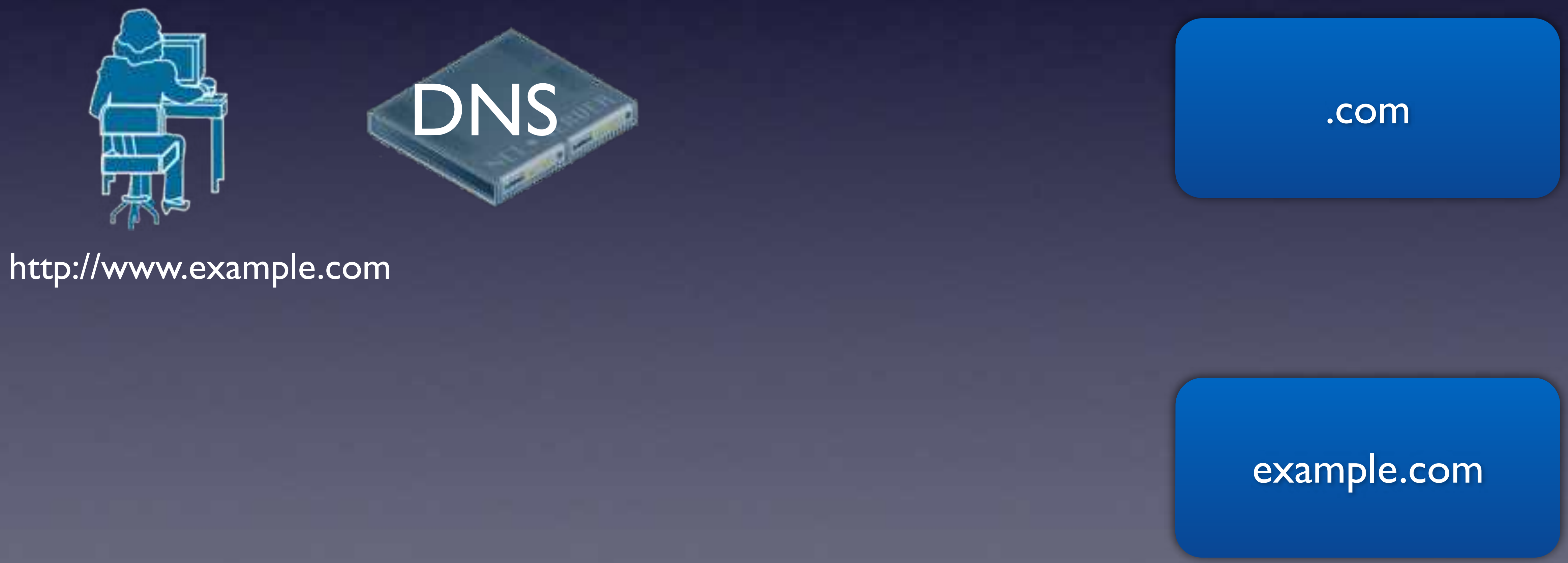
How DNS works



How DNS works



How DNS *actually* works



DNS

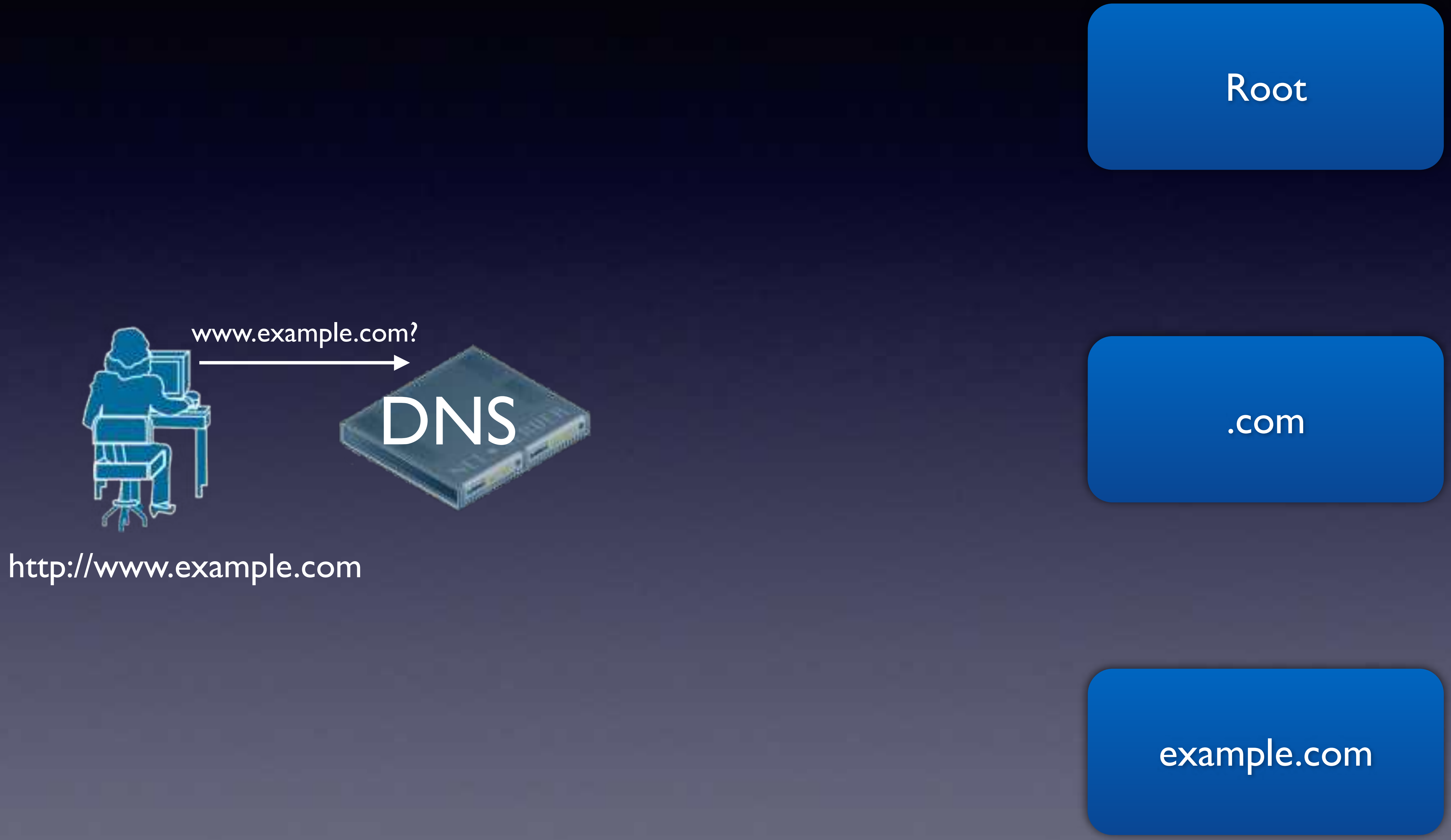
http://www.example.com

Root

.com

example.com

How DNS *actually* works



www.example.com?

DNS

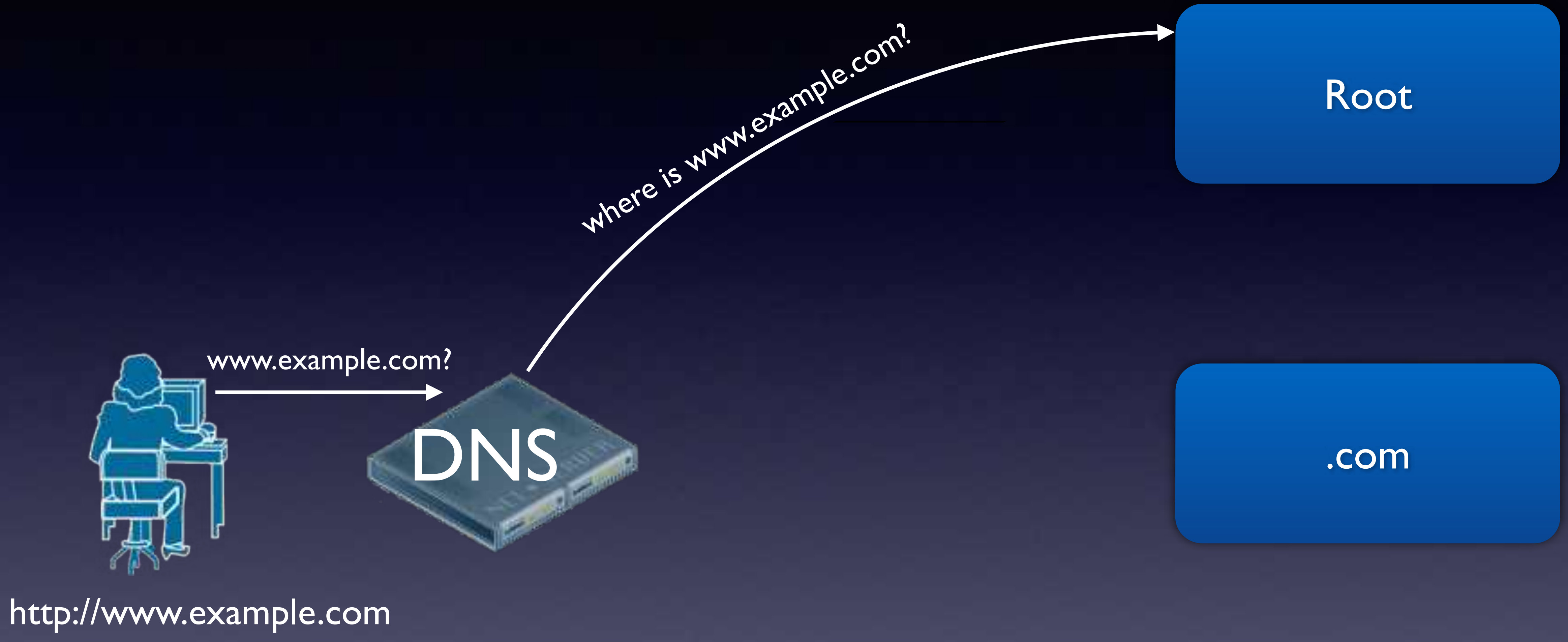
http://www.example.com

Root

.com

example.com

How DNS *actually* works



www.example.com?

where is www.example.com?

Root

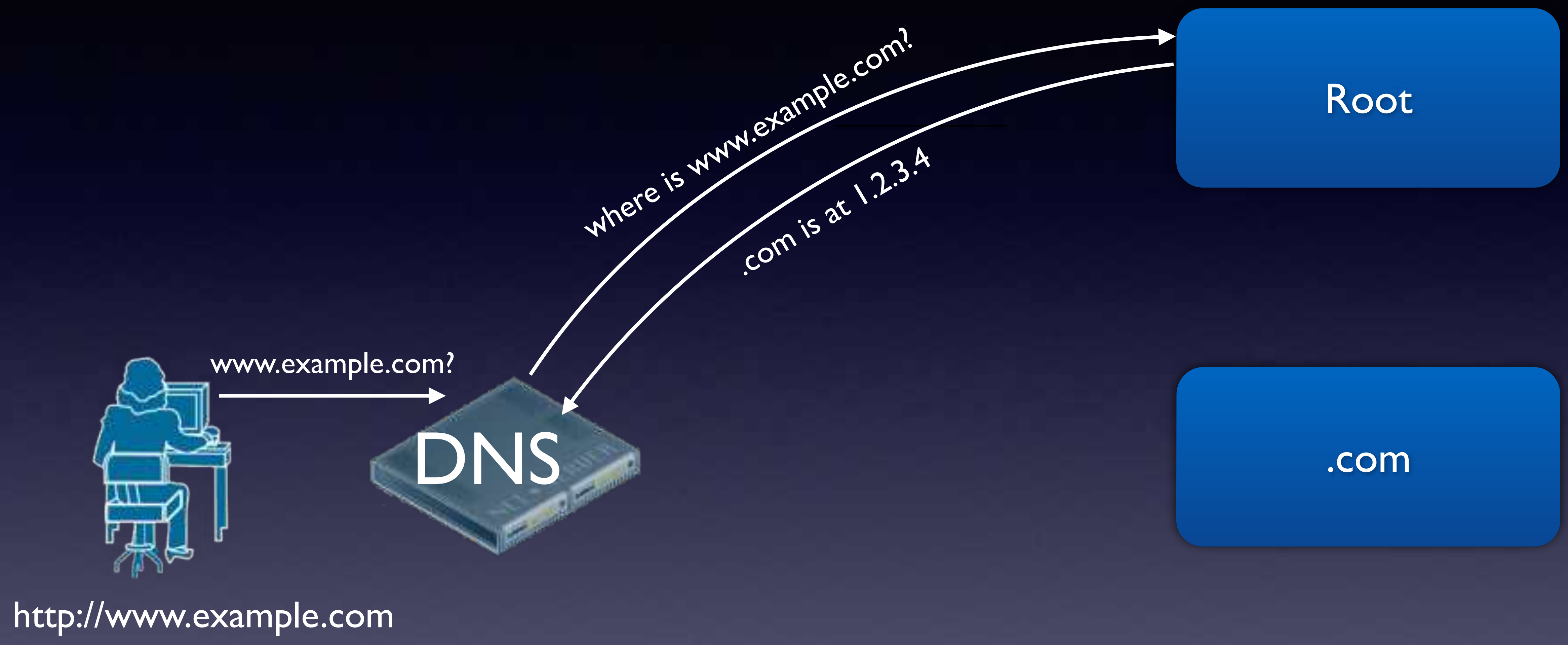
DNS

.com

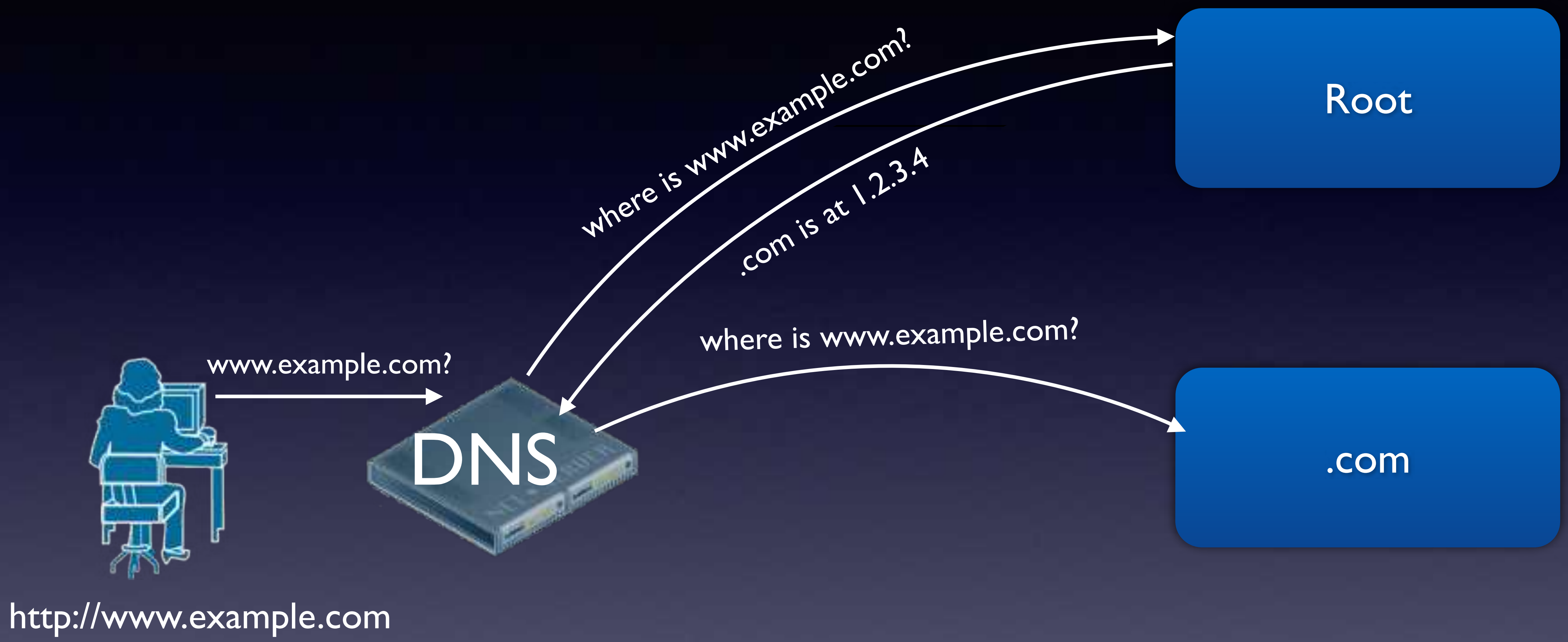
http://www.example.com

example.com

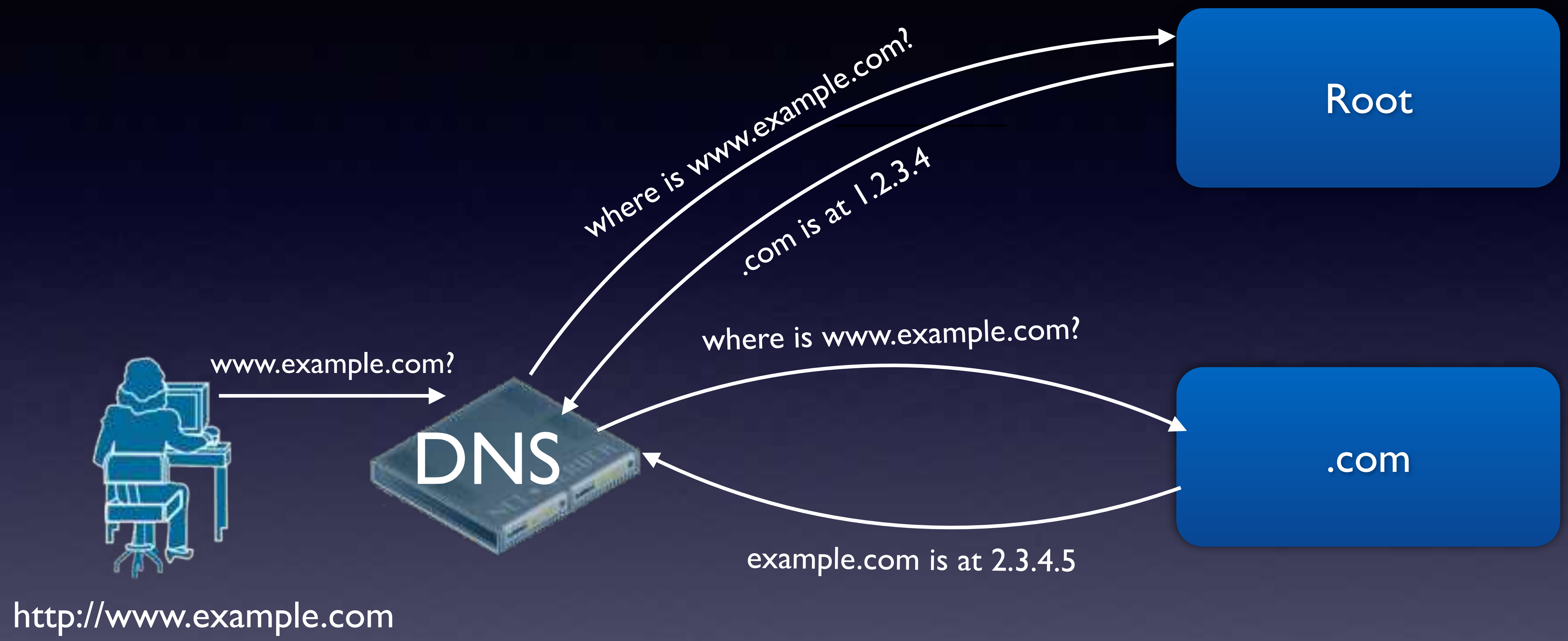
How DNS *actually* works



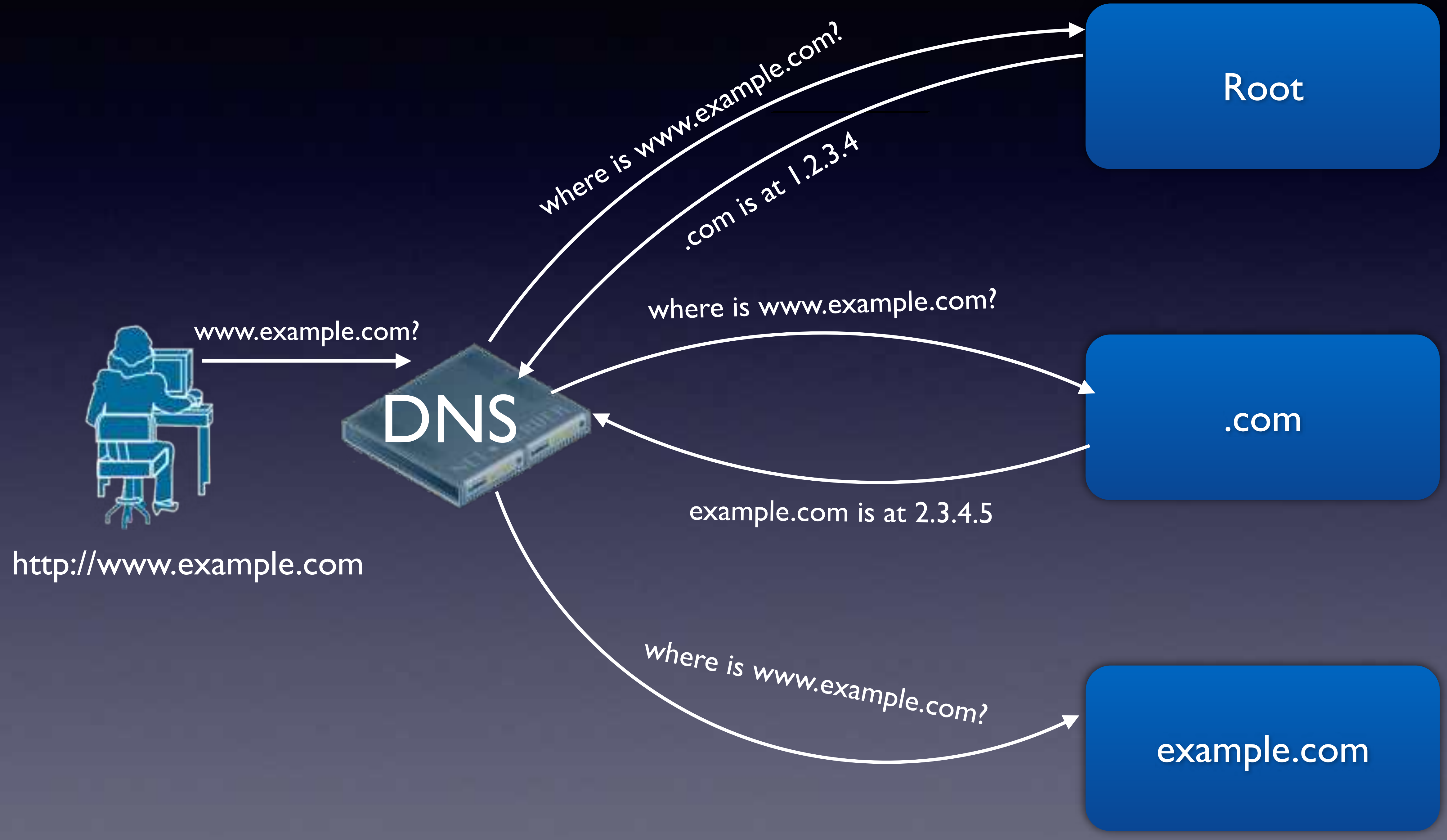
How DNS *actually* works



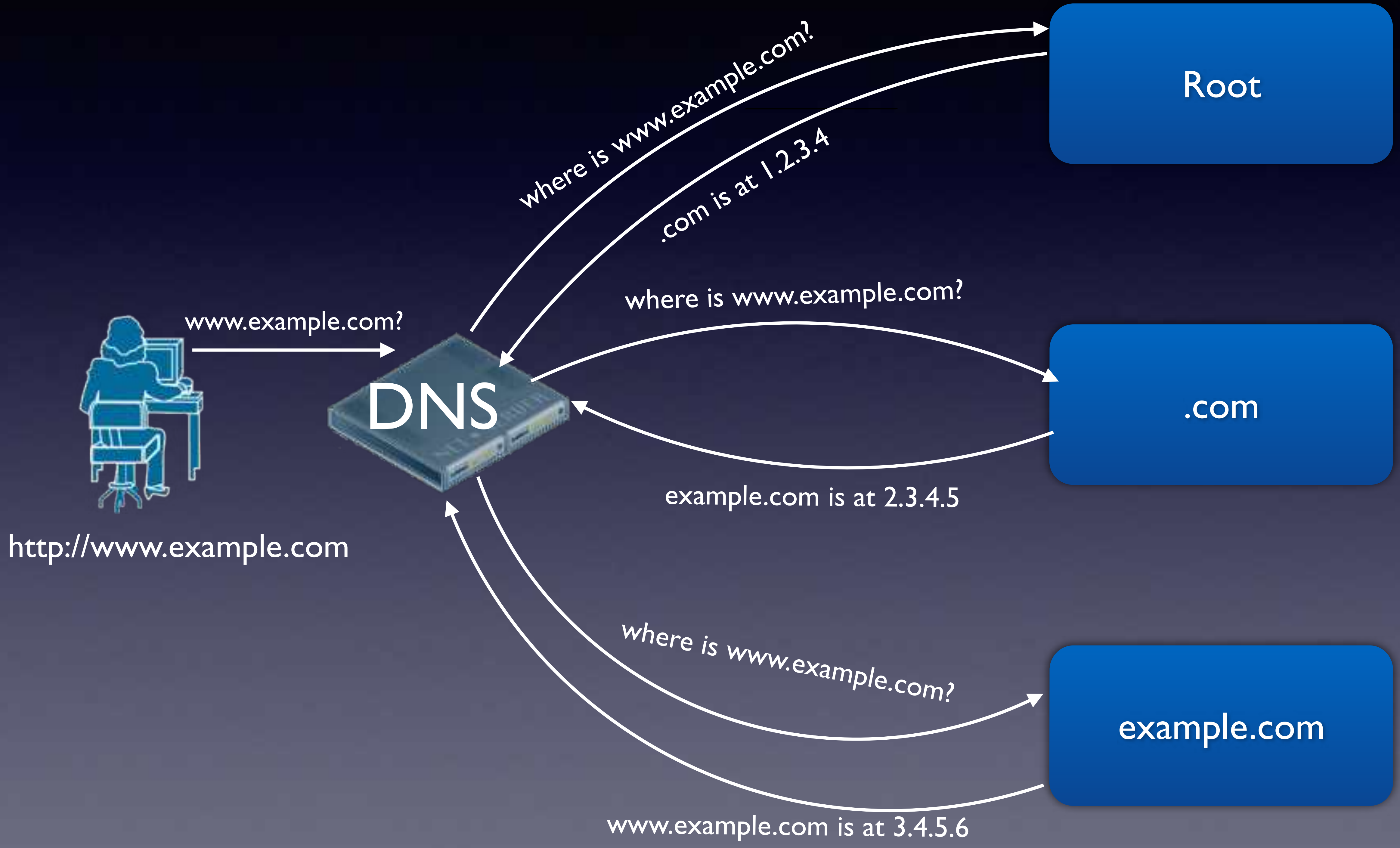
How DNS *actually* works



How DNS *actually* works

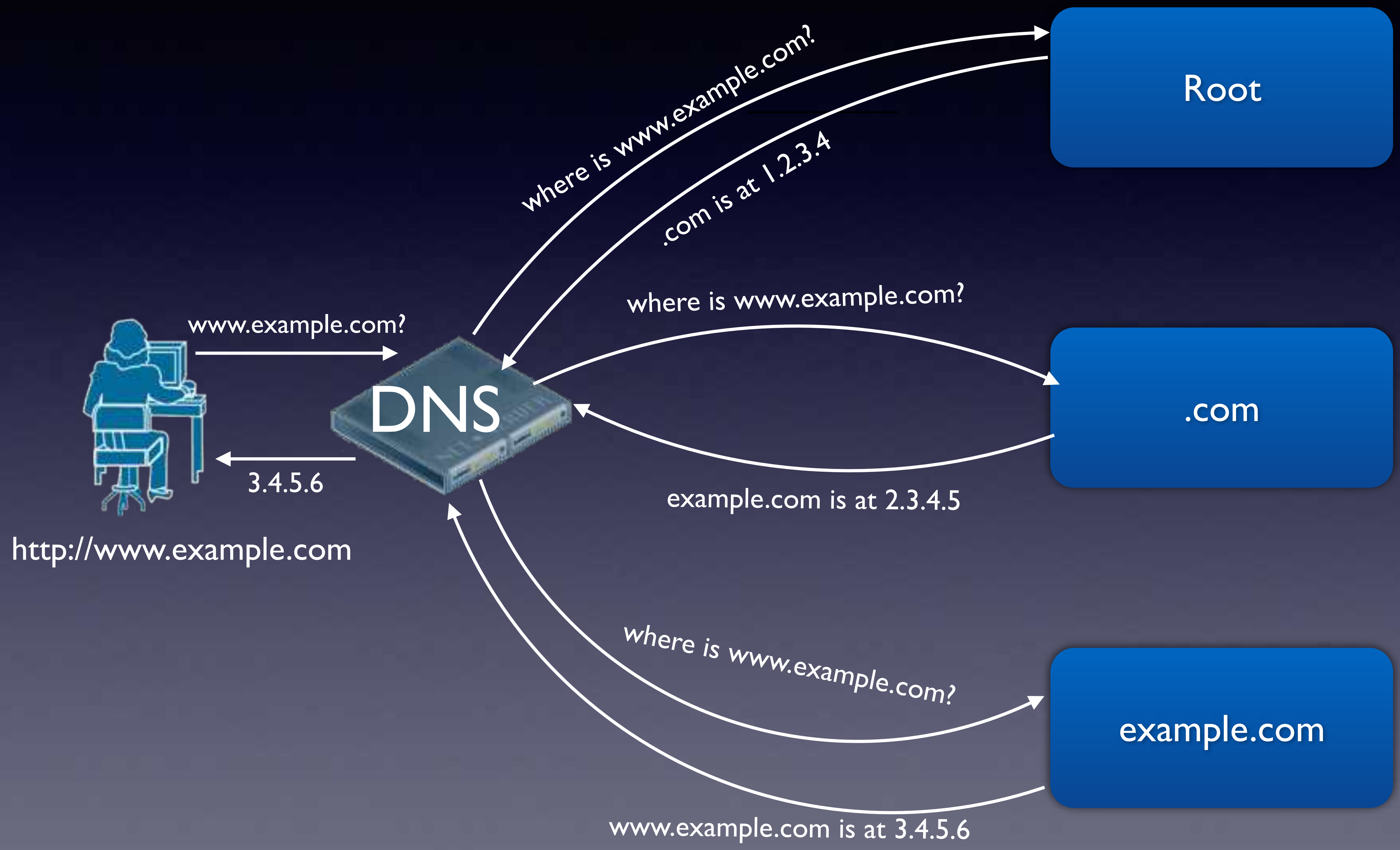

Root
where is www.example.com?
.com is at 1.2.3.4
where is www.example.com?
www.example.com?
DNS
.com
example.com is at 2.3.4.5
http://www.example.com
where is www.example.com?
example.com

How DNS *actually* works

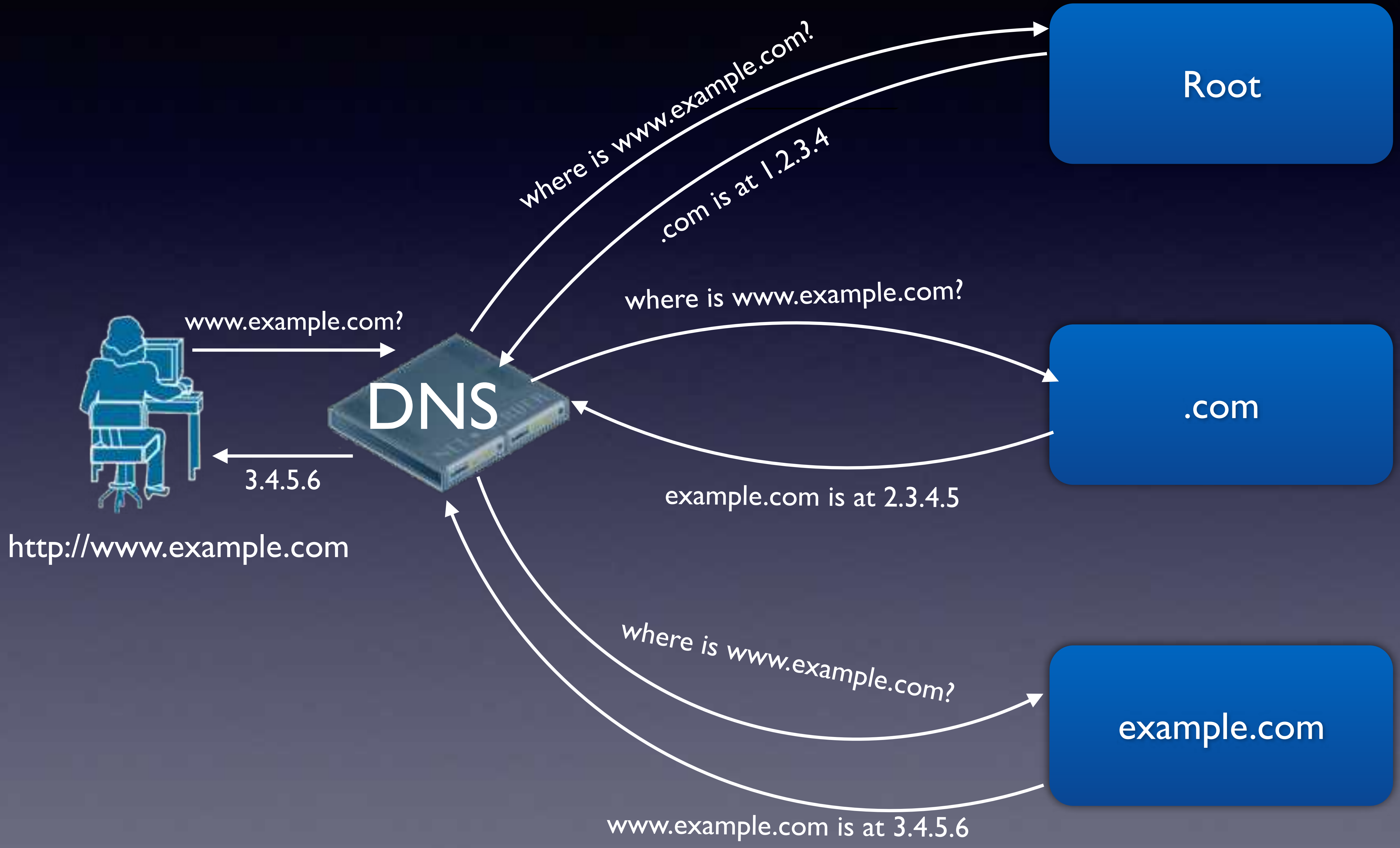


www.example.com?
DNS
http://www.example.com
where is www.example.com?
.com is at 1.2.3.4
Root
where is www.example.com?
.com
example.com is at 2.3.4.5
where is www.example.com?
example.com
www.example.com is at 3.4.5.6

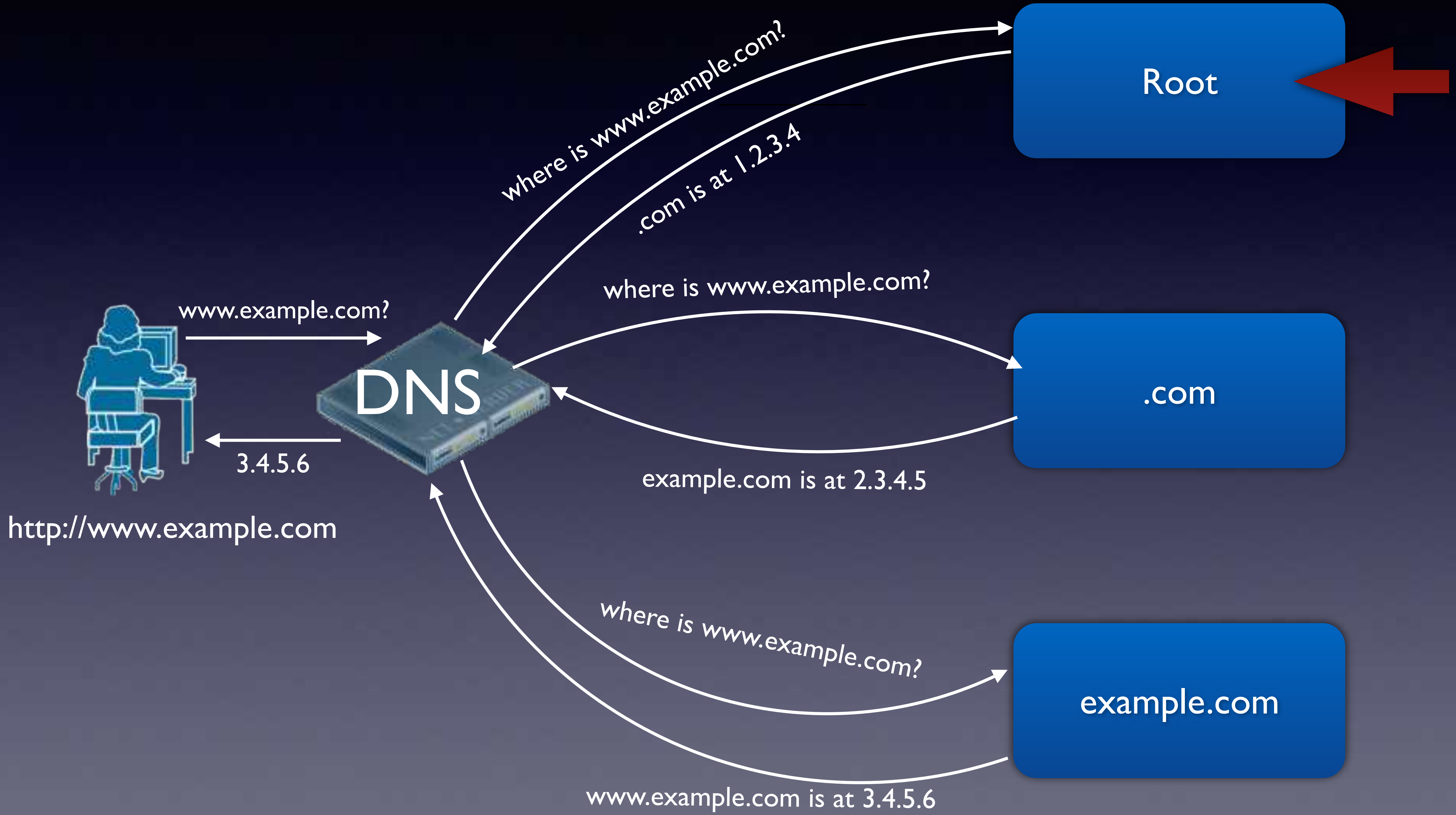
How DNS *actually* works


Root
where is www.example.com?
.com is at 1.2.3.4
where is www.example.com?
.com
www.example.com?
DNS
3.4.5.6
http://www.example.com
example.com is at 2.3.4.5
where is www.example.com?
example.com
www.example.com is at 3.4.5.6

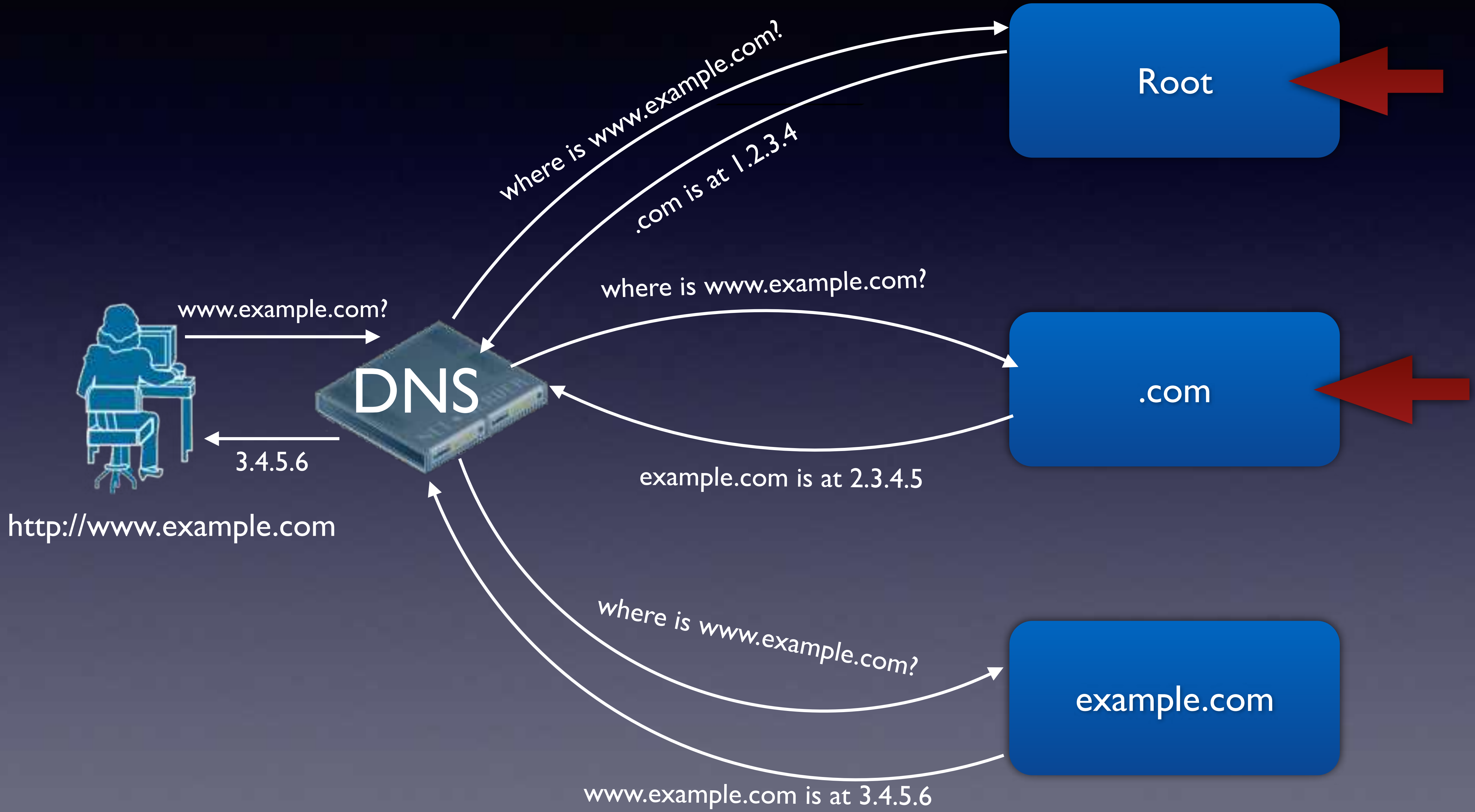
QNAME attack surface


Root
where is www.example.com?
.com is at 1.2.3.4
www.example.com?
DNS
3.4.5.6
http://www.example.com
where is www.example.com?
.com
example.com is at 2.3.4.5
where is www.example.com?
example.com
www.example.com is at 3.4.5.6

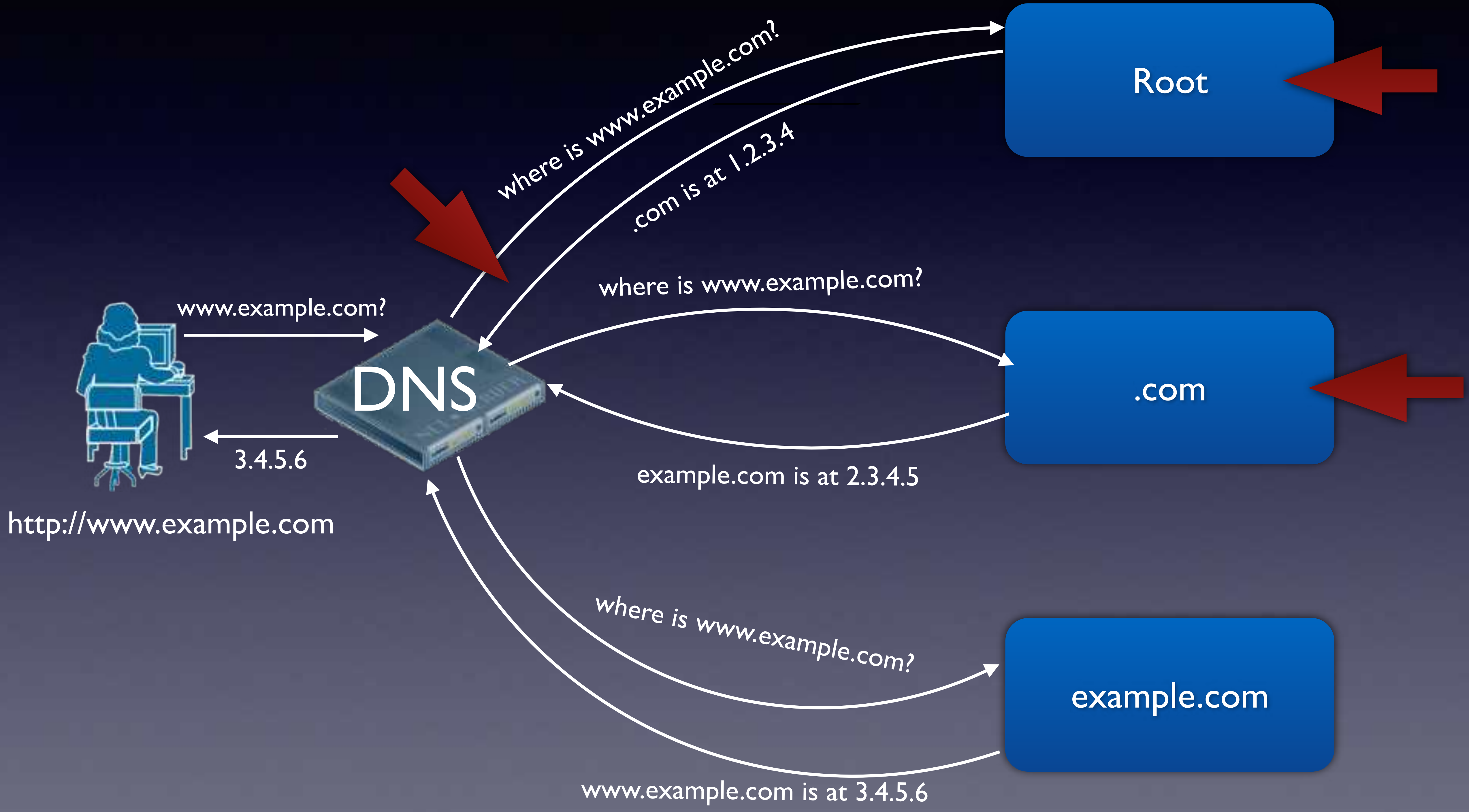
QNAME attack surface


Root
where is www.example.com?
.com is at 1.2.3.4
www.example.com?
DNS
3.4.5.6
http://www.example.com
where is www.example.com?
.com
example.com is at 2.3.4.5
where is www.example.com?
example.com
www.example.com is at 3.4.5.6

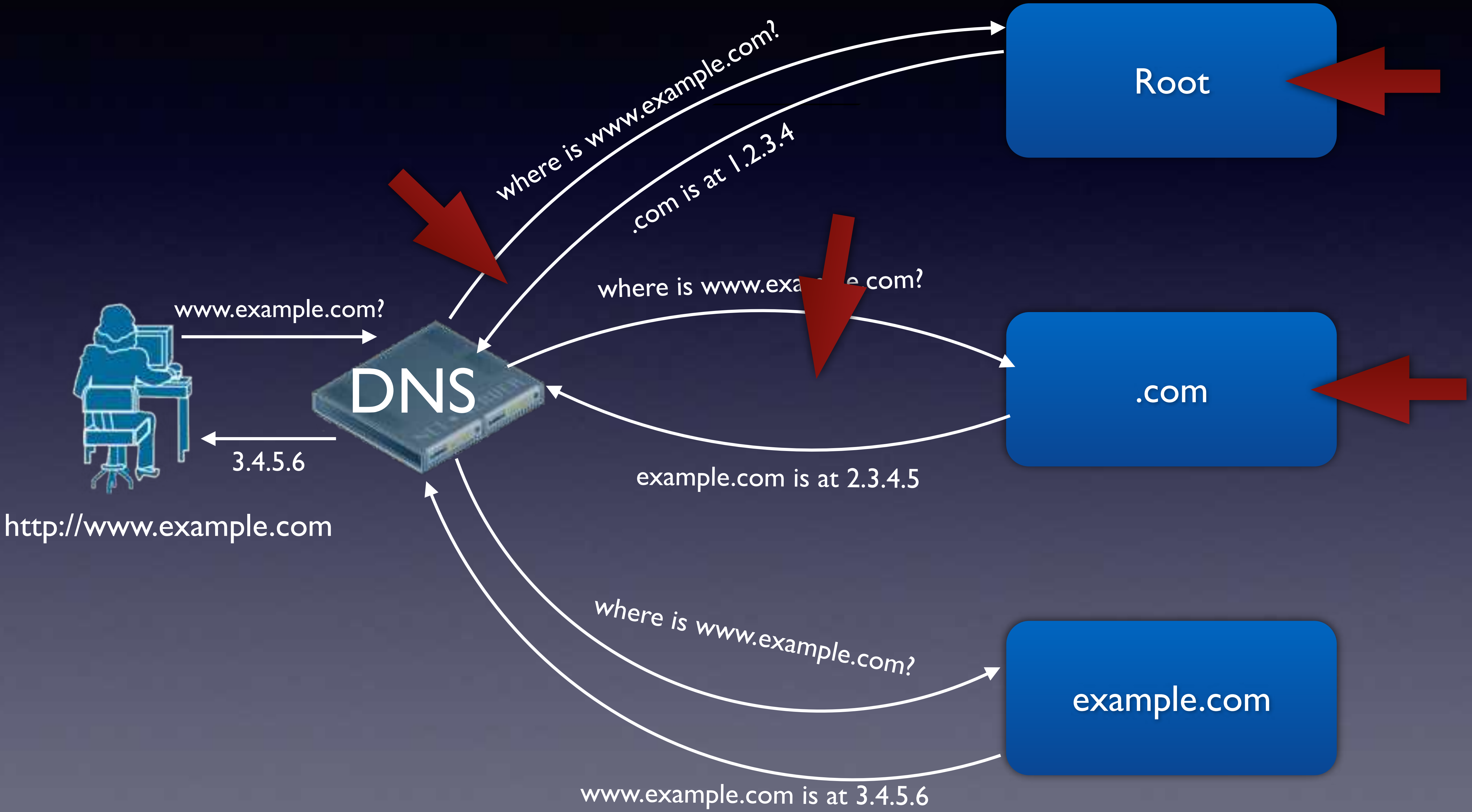
QNAME attack surface


Root
where is www.example.com?
.com is at 1.2.3.4
www.example.com?
where is www.example.com?
DNS
.com
3.4.5.6
example.com is at 2.3.4.5
http://www.example.com
where is www.example.com?
example.com
www.example.com is at 3.4.5.6

QNAME attack surface


Root
where is www.example.com?
.com is at 1.2.3.4
www.example.com?
DNS
3.4.5.6
http://www.example.com
where is www.example.com?
.com
example.com is at 2.3.4.5
where is www.example.com?
example.com
www.example.com is at 3.4.5.6

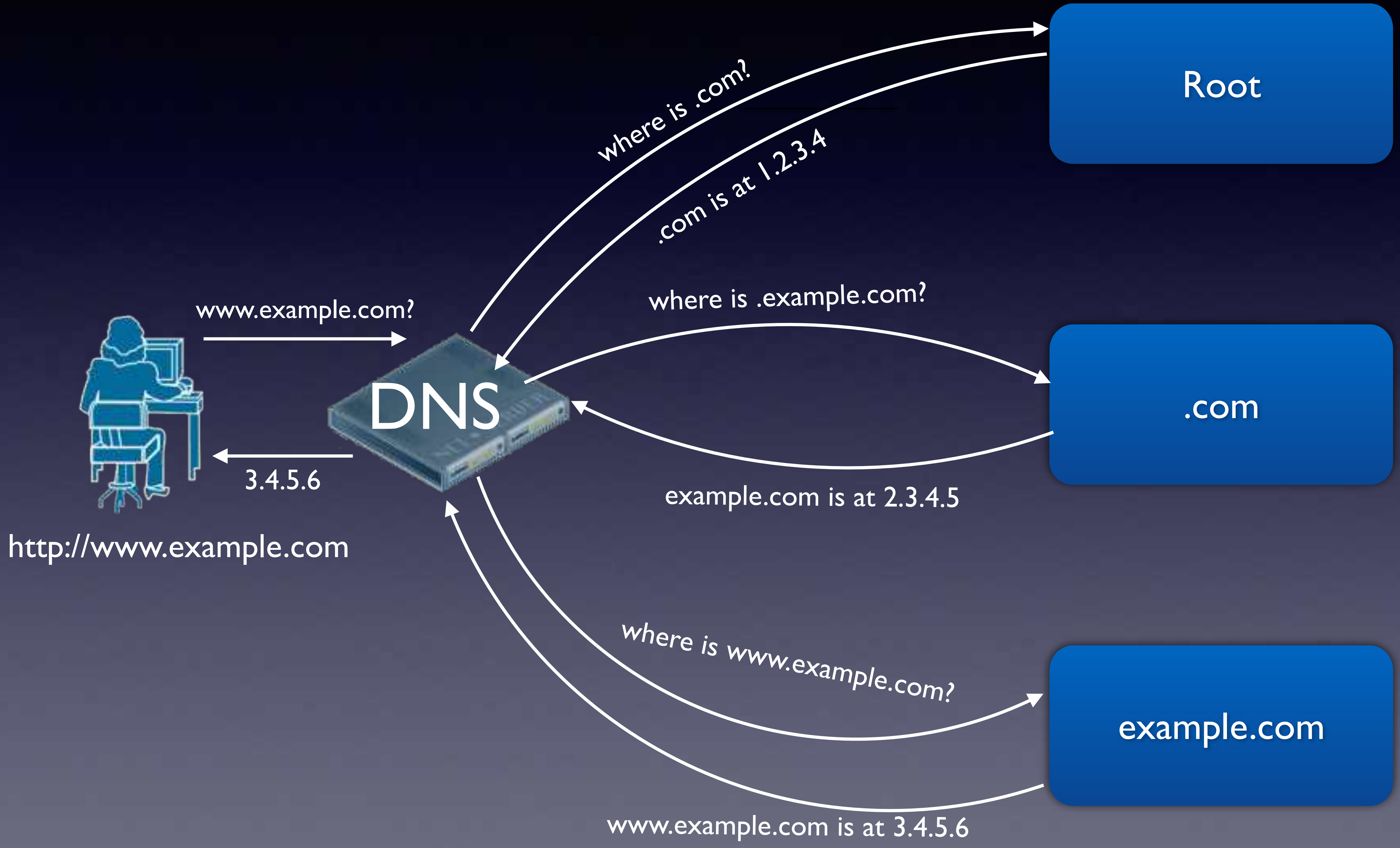
QNAME attack surface



QNAME Minimization

- Really short summary is that it makes the behavior be how people describe it…
    - Only include .com when querying the root, only include example.com when querying .com, etc.
    - Basically send the very minimum info needed to resolve the name.

DPRIVE


Root

.com

example.com

DNS

where is .com?

.com is at 1.2.3.4

where is .example.com?

example.com is at 2.3.4.5

where is www.example.com?

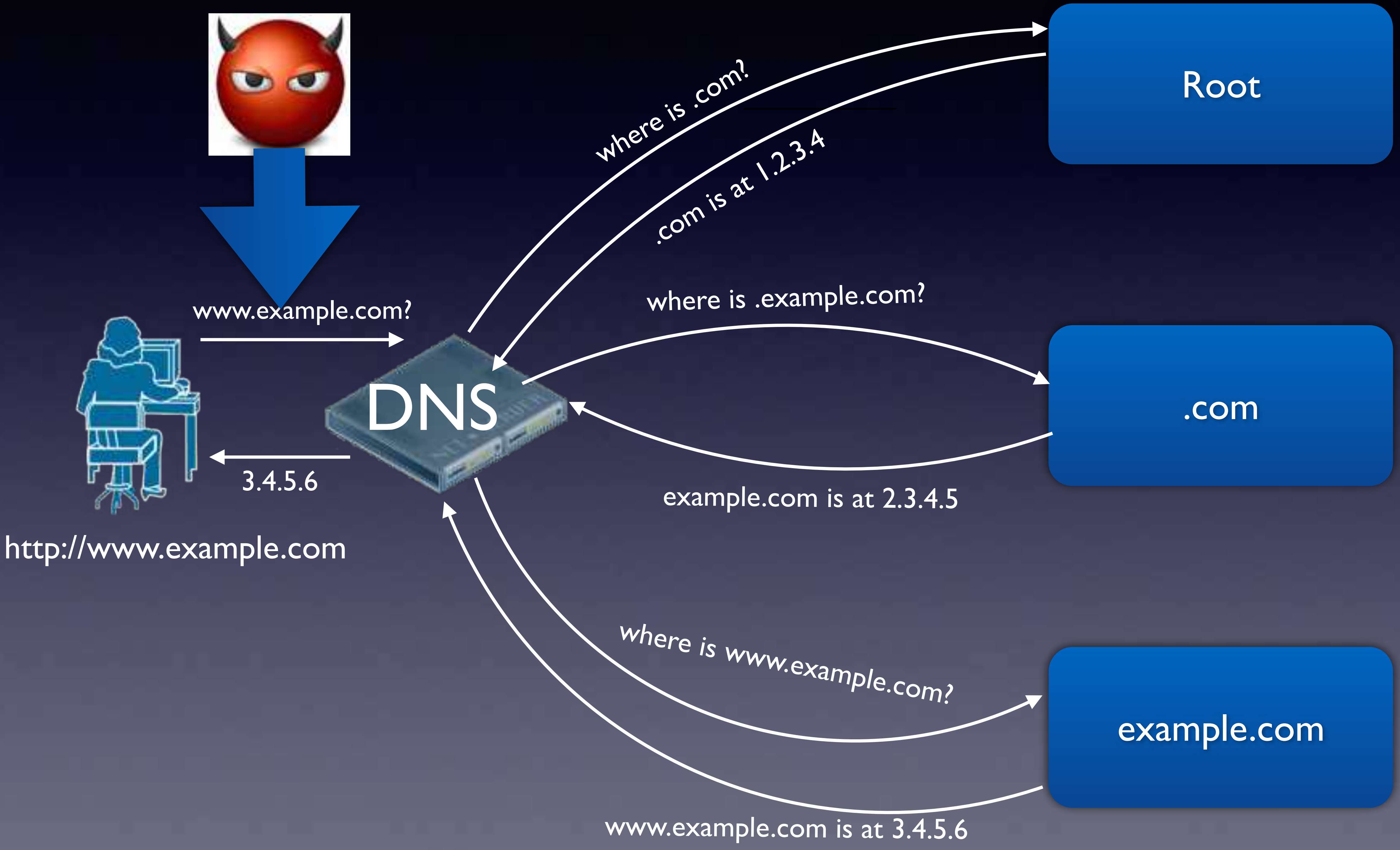
www.example.com is at 3.4.5.6

www.example.com?

3.4.5.6

http://www.example.com

DPRIVE


Root
.com
example.com
DNS
www.example.com?
3.4.5.6
http://www.example.com
where is .com?
.com is at 1.2.3.4
where is .example.com?
example.com is at 2.3.4.5
where is www.example.com?
www.example.com is at 3.4.5.6

DPRIVE WG

- This takes DNS privacy even further
    - Encrypts the DNS messages themselves
    - Addresses much more active attacks
    - Complements QNAME minimization

No Privacy

```
15:48:29 IP 204.42.252.2.26838 > 199.19.53.1.53:
A? www.aa.org. ar: . OPT UDPsize=4096 OK
0x0000:45000043a40a00004011125ecc2afc02  E..C….@..^.*..
0x0010:c713350168d60035002fc48293110000  ..5.h.5./......
0x0020:00010000000000010377777702616103  ..........www.aa.
0x0030:6f726700000100010000291000000080  org.......).....
0x0040:0000                              ...

15:48:29 IP 199.19.53.1.53 > 204.42.252.2.26838:
q: A? www.aa.org. 0/6/1 ns: aa.org. NS ns2.rackspace.com.,
aa.org. NS ns.rackspace.com.
0x0000:45000260414a000038117b01c7133501  E..`AJ..8.{...5.
0x0010:cc2afc02003568d6024c230093118000  .*…5h..L#…..
0x0020:00010000000600010377777702616103  ..........www.aa.
0x0030:6f72670000010001c010000200010001  org.............
```

With DPRIVE

```
15:59:51 IP 204.42.252.2.42607 > 185.49.141.38.1021
0x0000:4500015bc9b0400040066167cc2afc02  E..[..@.@.ag.*..
0x0010:b9318d26a66f03fdda34fe90e31ee965  .1.&.o…4.....e
0x0020:801800e50fd300000101080a783c373e  ............x<7>
0x0030:d637f745160301012201000011e0303d6  .7.E...."......
0x0040:62f0d139ed30428d51e9802bfc89376e  b..9.0B.Q..+..7n
0x0050:09ddacbe0a20d6a5af716a70f9d6ea00  .........qjp....
0x0060:0088c030c02cc028c024c014c00a00a3  ...0.,.(.$......
0x0070:009f006b006a00390038008880087c032  ...k.j.9.8.....2
0x0080:c02ec02ac026c00fc005009d003d0035  ...*.&.......=5
0x0090:0084c012c0080016013c00dc003000a  ................
0x00a0:c02fc02bc027c023c013c00900a2009e  ./.+.'.#........
```

... and now...