Recursive Servers

The Resolution Process

- Stub resolvers, recursive name servers and authoritative name servers cooperate to look up DNS data in the name space

- A DNS query always comprises three parameters:
  - Domain name, class, type
    - E.g., *www.example.com*, IN, A

- Two kinds of queries:
  - Stub resolvers send ***recursive*** queries
    - “I need the complete answer or an error.”
  - Recursive name servers send ***non-recursive*** or ***iterative*** queries
    - “I can do some of the lookup work myself and will accept a ***referral***.”

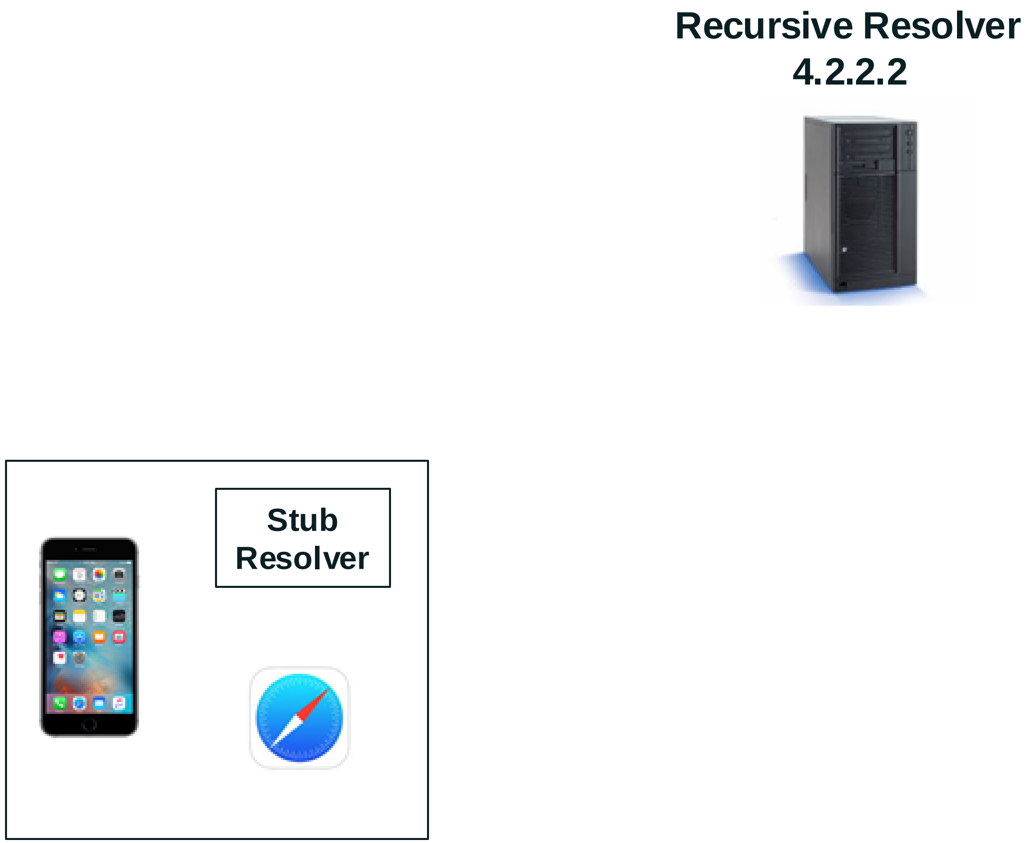
The Resolution Process

But first…

- How do you start the resolution process if there is no local data (you are a resolver and you have just booted up)?
  - Empty cache, and/or
  - Not authoritative for any zones
- No choice but to start at the root zone
  - The ***root name servers*** are the servers authoritative for the root zone
- But how does a resolver find the NS, A, and AAAA records for the root name servers?
  - They must be configured (in fact, most of DNS software come preloaded with an up to date version of the file called ***hint file***)
  - No way to discover them
- The ***root hints file*** contains the names and IP addresses of the root name servers
  - https://www.iana.org/domains/root/files

Resolution Process

The phone's stub resolver is configured to send queries to the recursive resolver with IP address 4.2.2.2



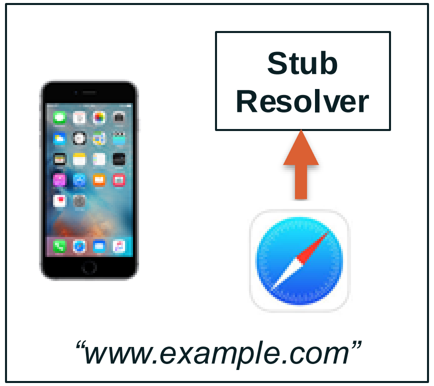
Recursive Resolver
4.2.2.2

Stub Resolver

Resolution Process

A user types *www.example.com* into Safari, which then calls the stub resolver function to resolve the name

Recursive Resolver
4.2.2.2

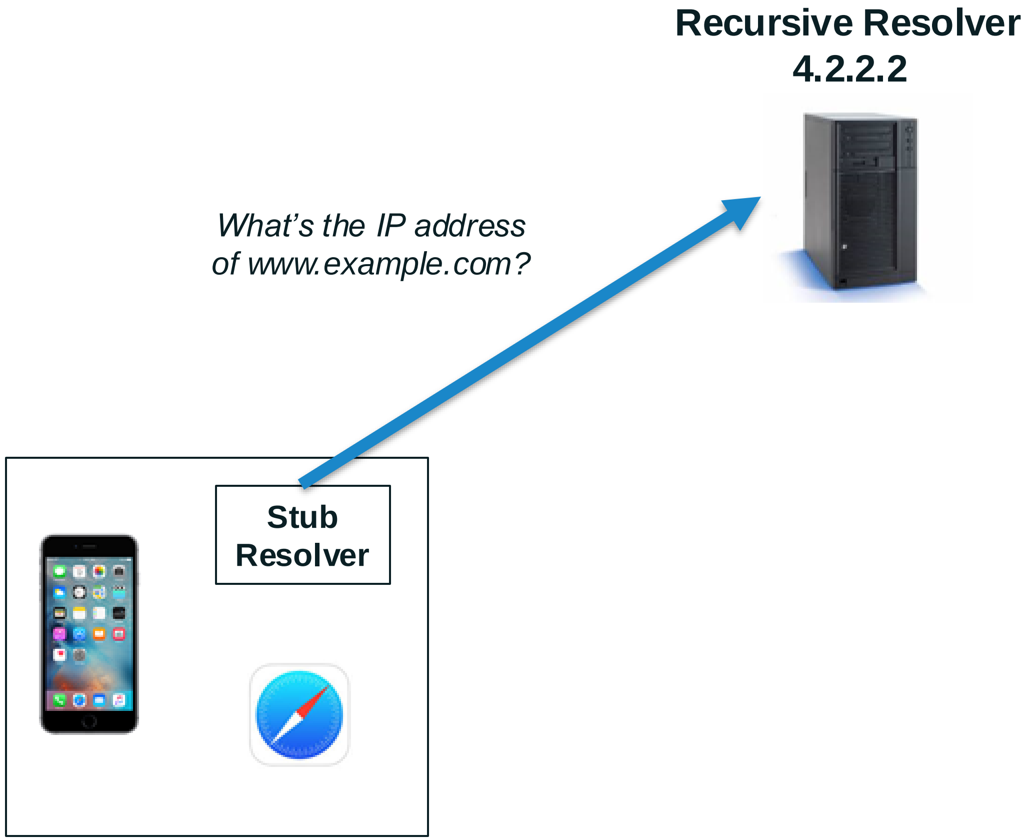


Stub Resolver

"www.example.com"

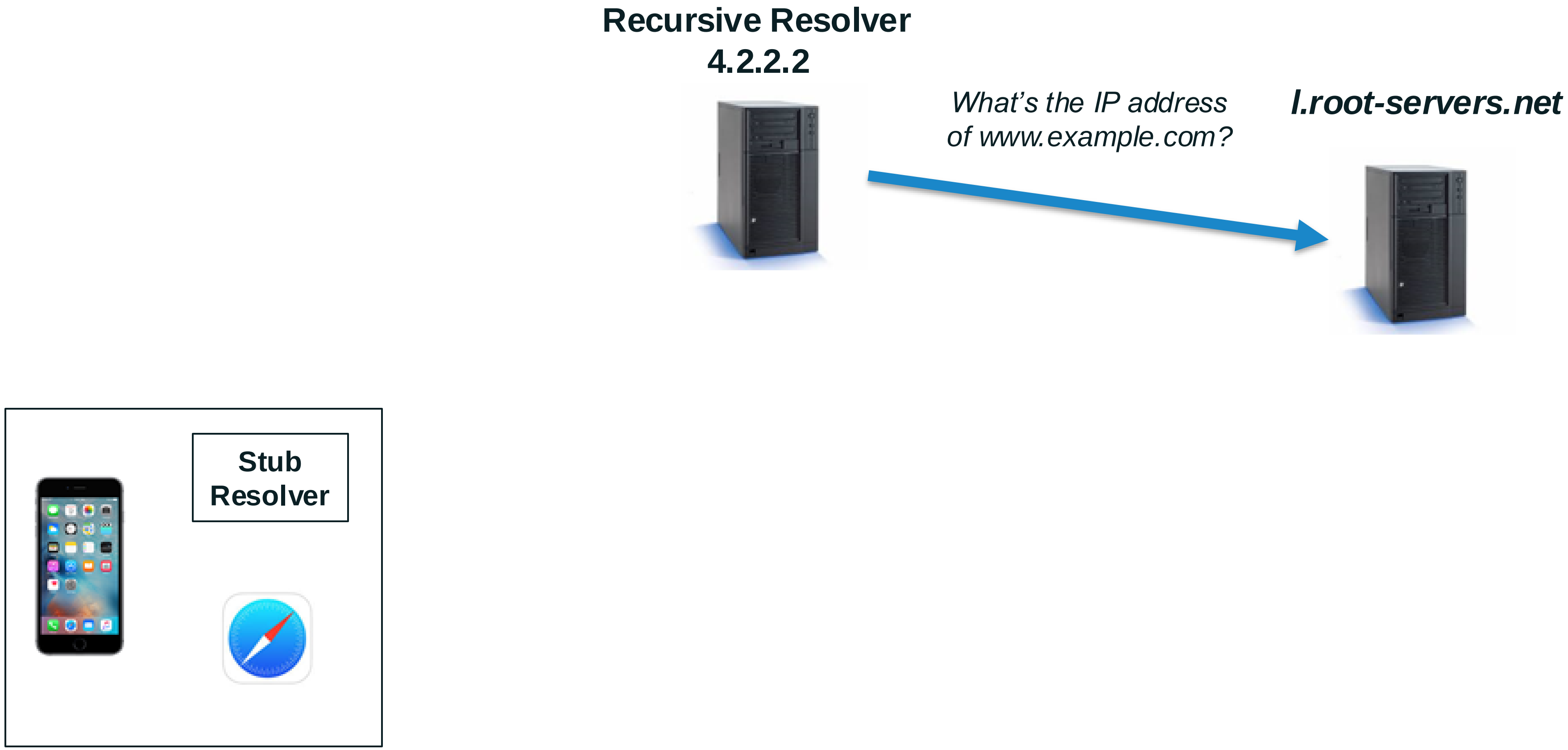
Resolution Process

The phone’s stub resolver sends a query for *www.example.com*, IN, A to 4.2.2.2



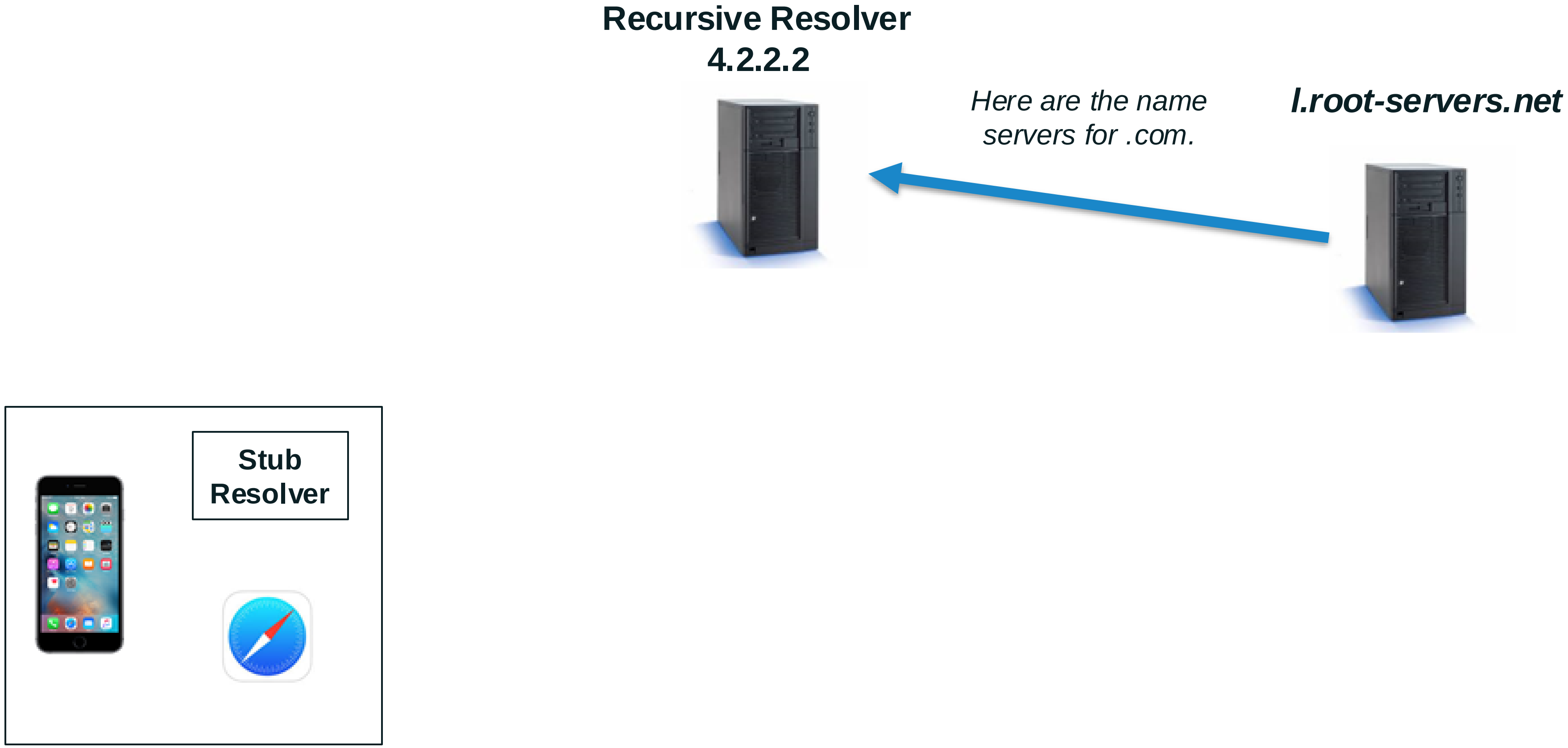
Resolution Process

Recursive resolver 4.2.2.2 has no data cached for *www.example.com*, so it queries a root server



Resolution Process

Root server returns a referral to *.com*



Recursive Resolver
4.2.2.2

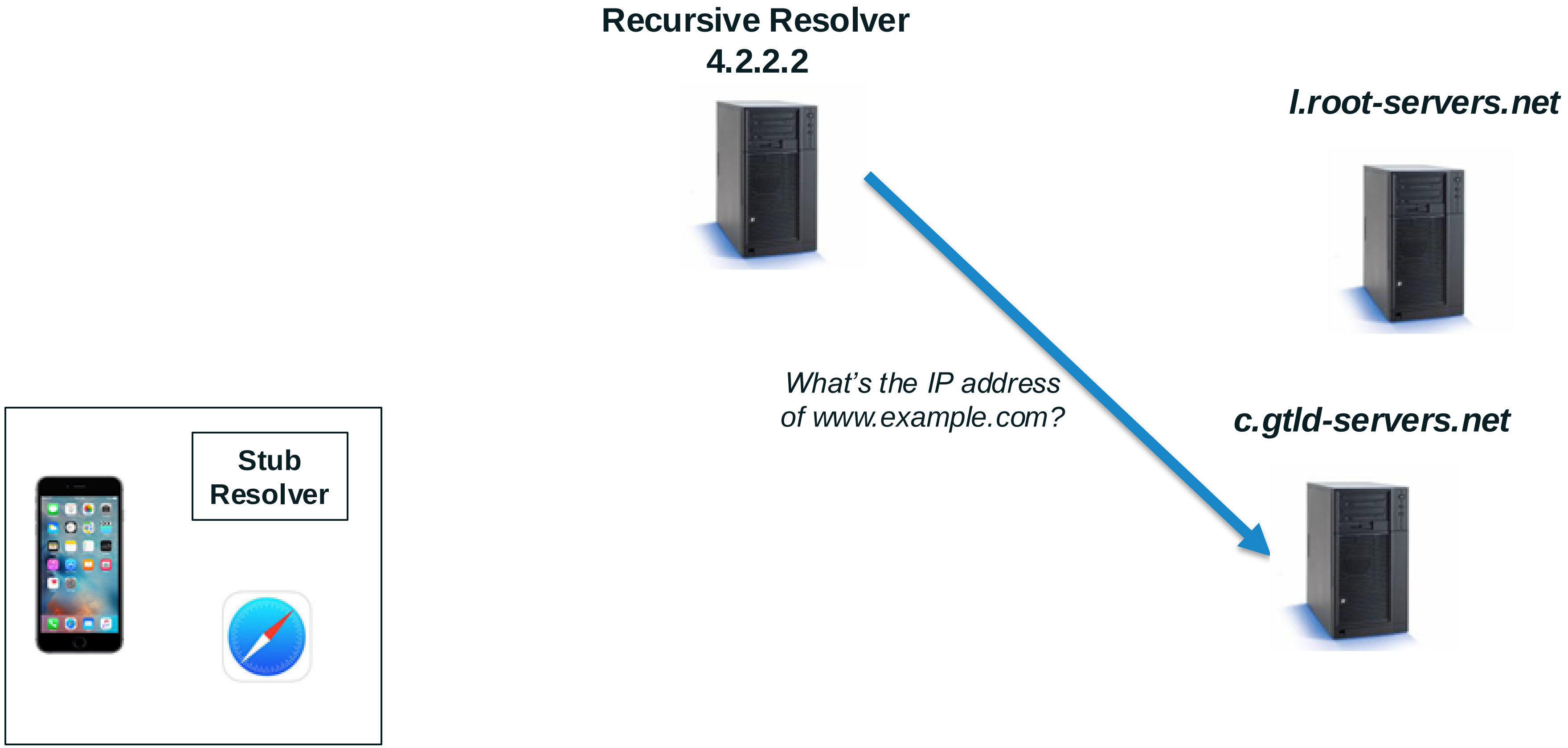
Here are the name servers for .com.

l.root-servers.net

Stub Resolver

Resolution Process

Recursive resolver queries a *.com* server



Recursive Resolver
4.2.2.2

l.root-servers.net

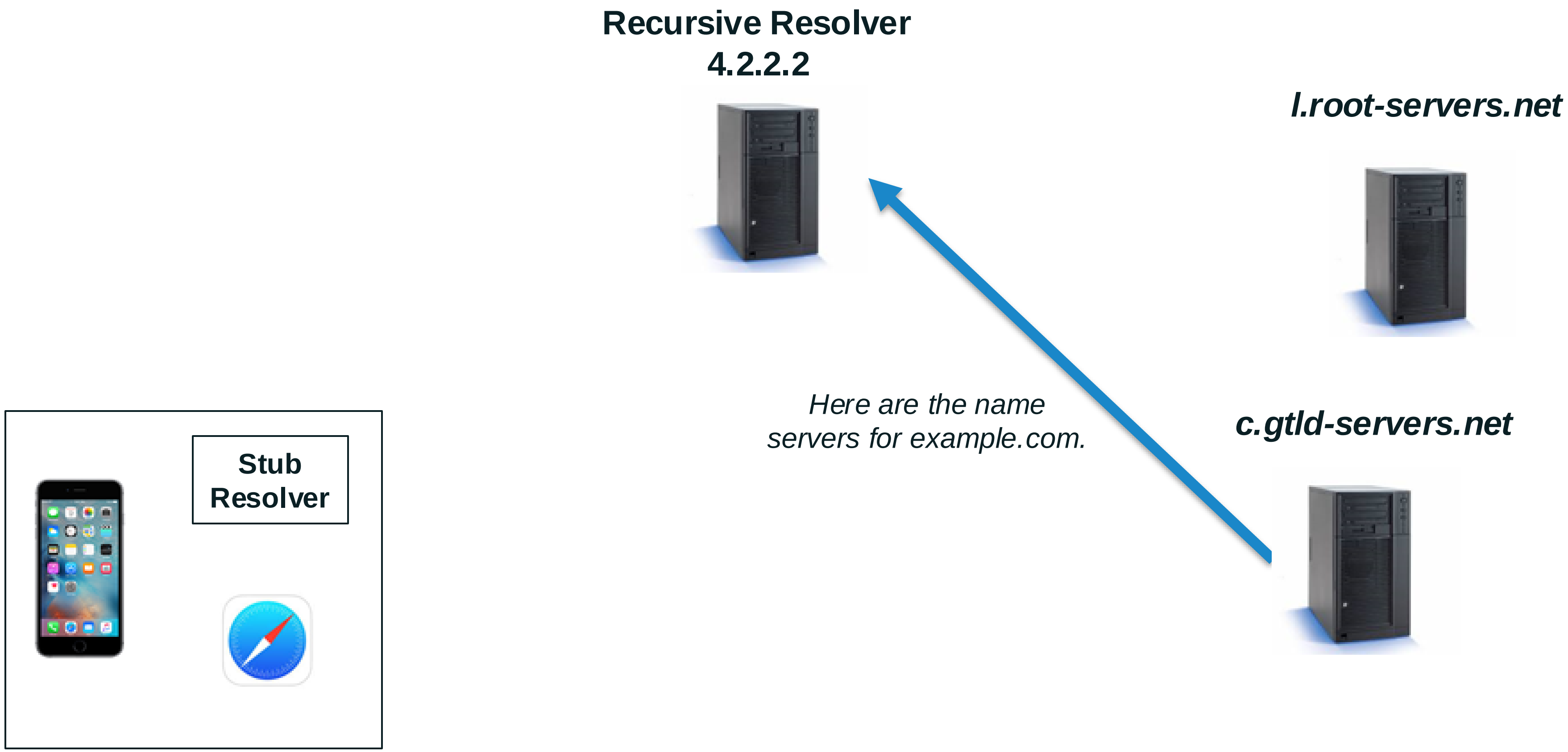
What's the IP address of www.example.com?

c.gtld-servers.net

Stub Resolver

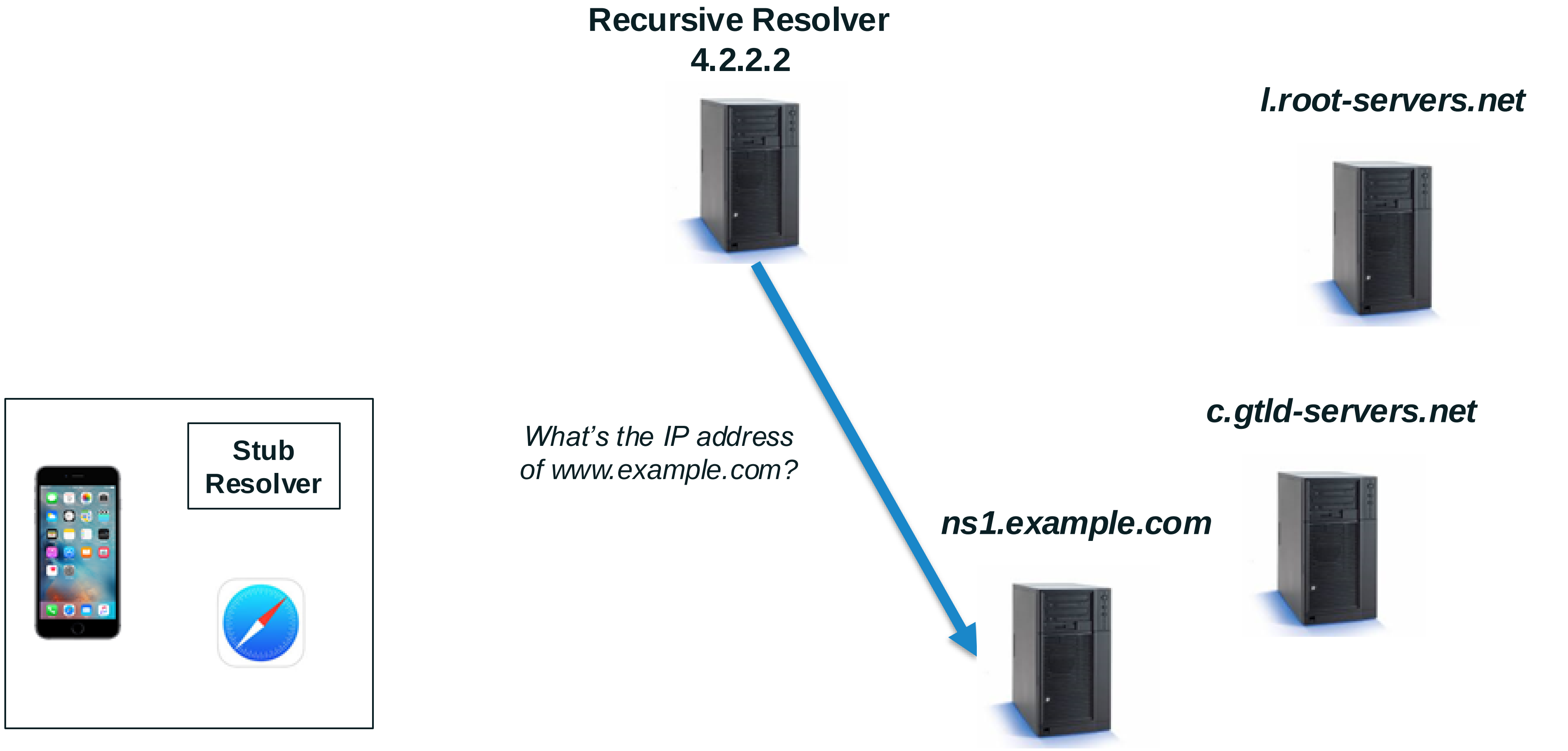
Resolution Process

.com server returns a referral to *example.com*



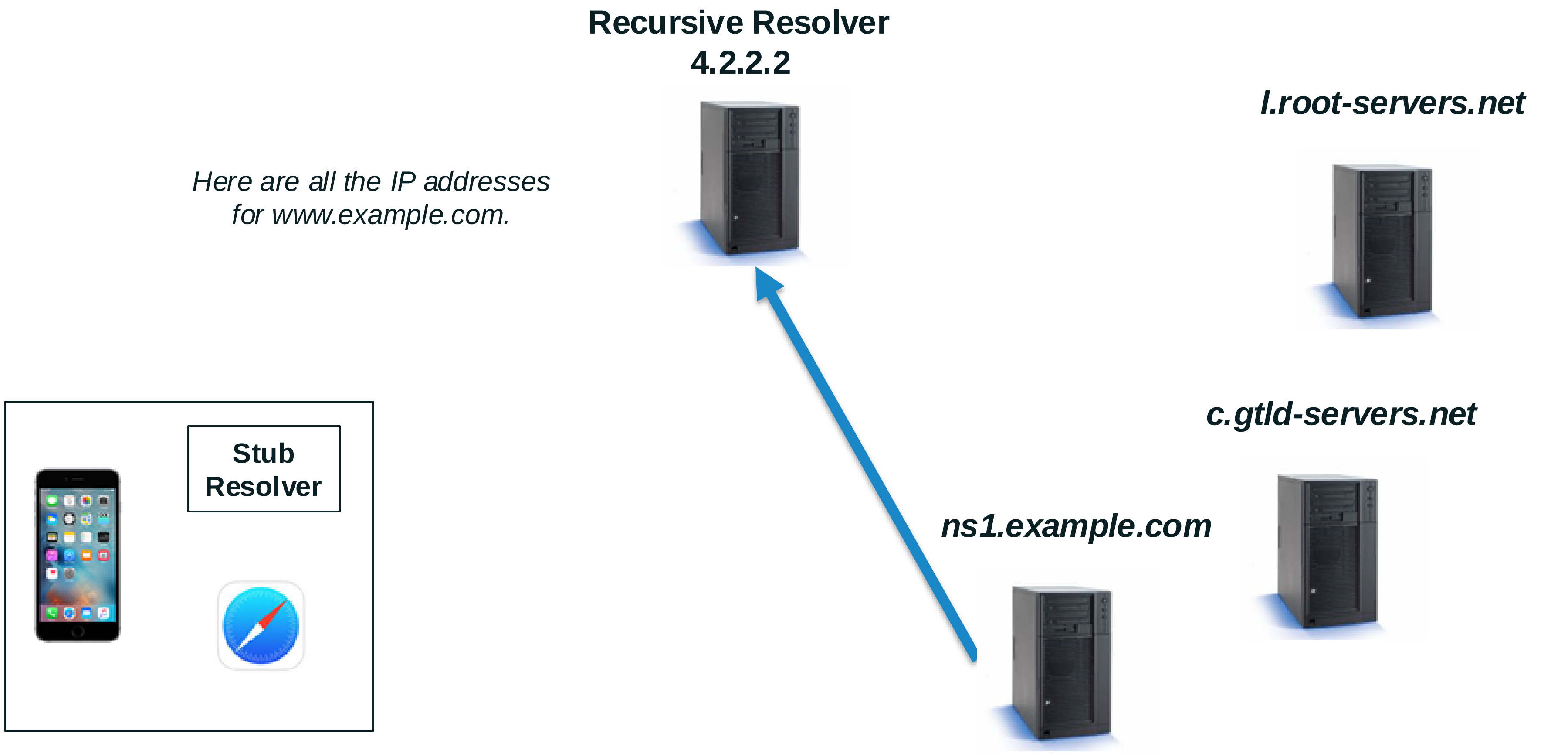
Resolution Process

Recursive resolver queries an *example.com* server



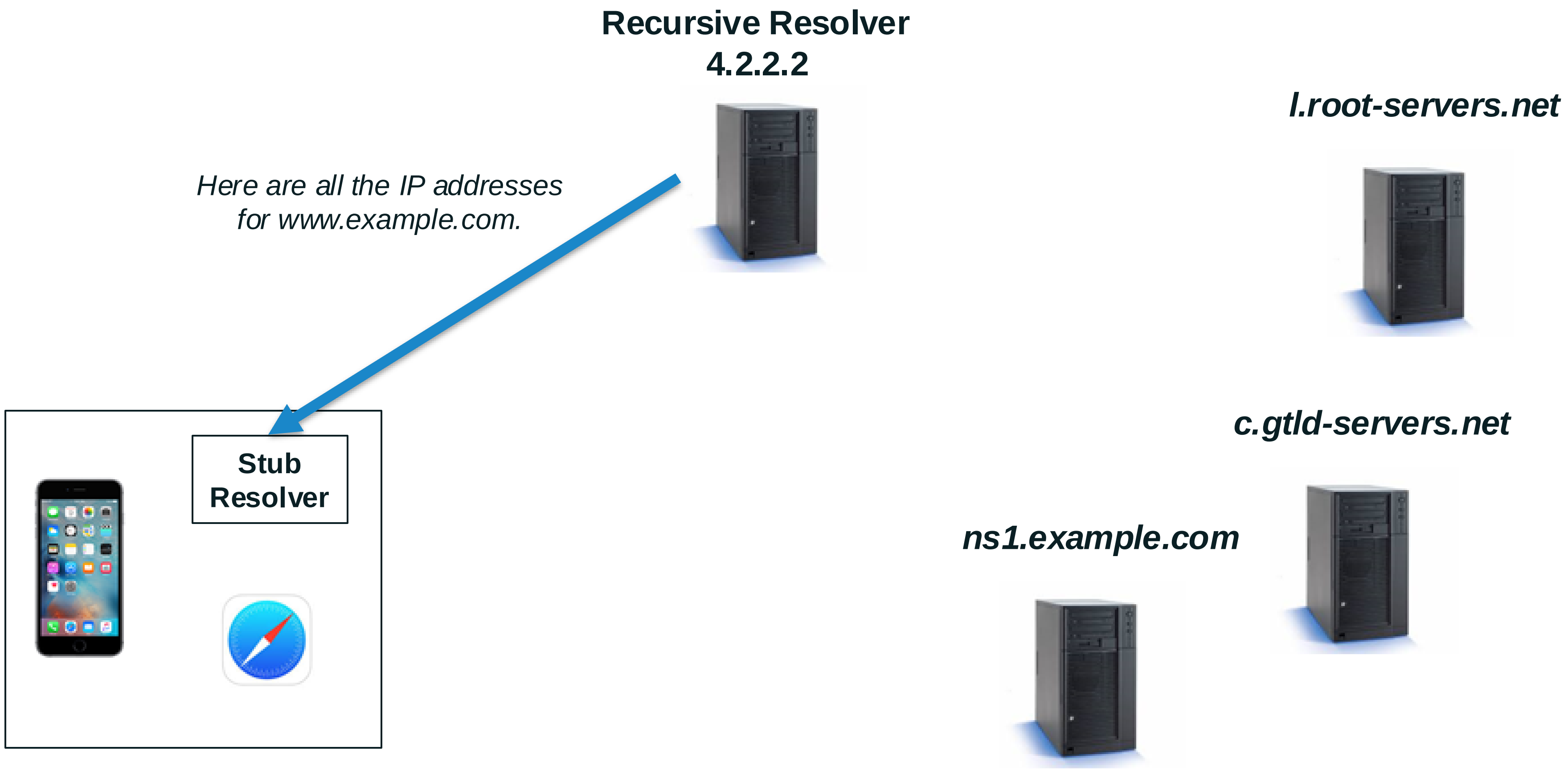
Resolution Process

example.com server returns the answer to the query because it is the authoritative for example.com



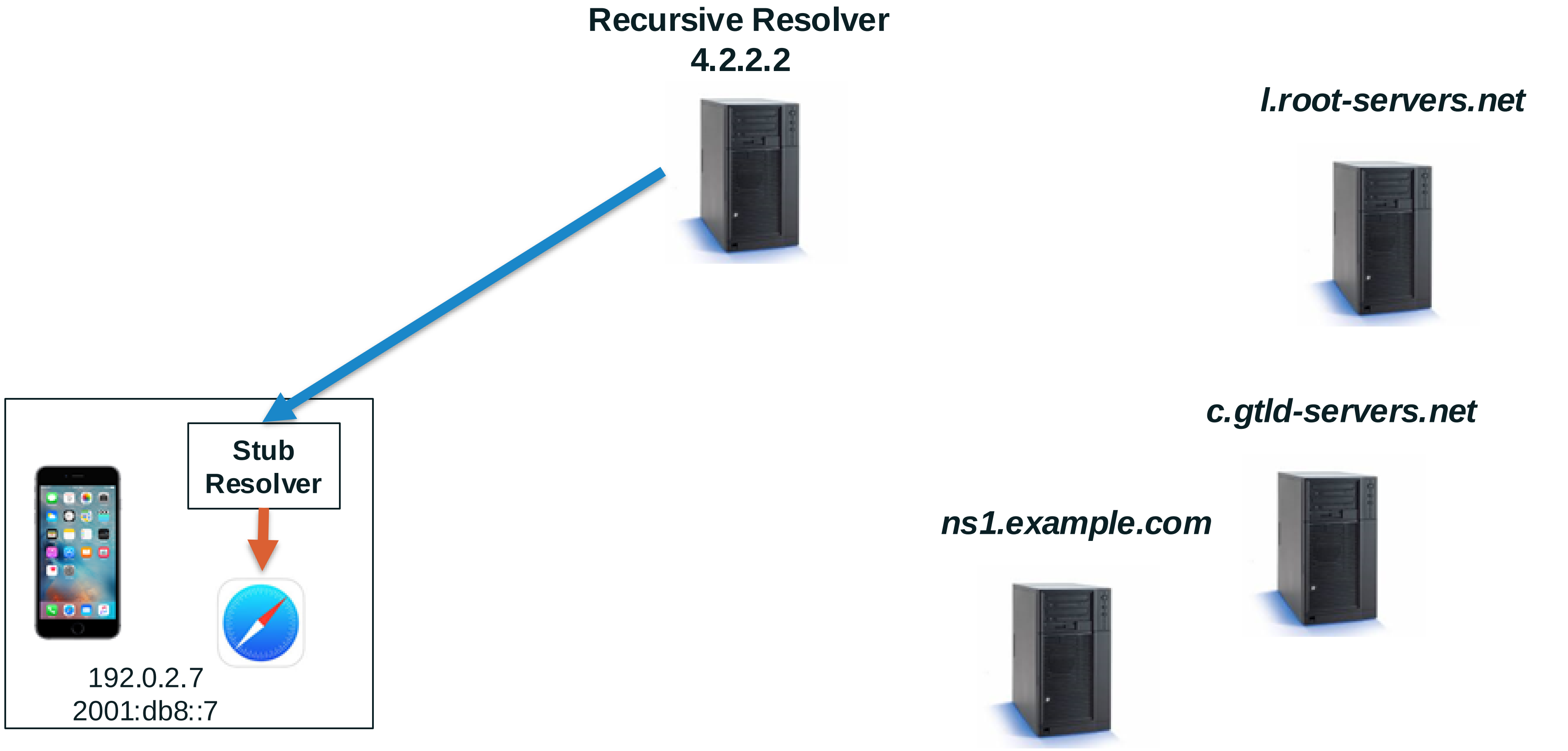
Resolution Process

Recursive resolver returns the answer to the query to the stub resolver



Resolution Process

Stub resolver returns the IP addresses to Safari



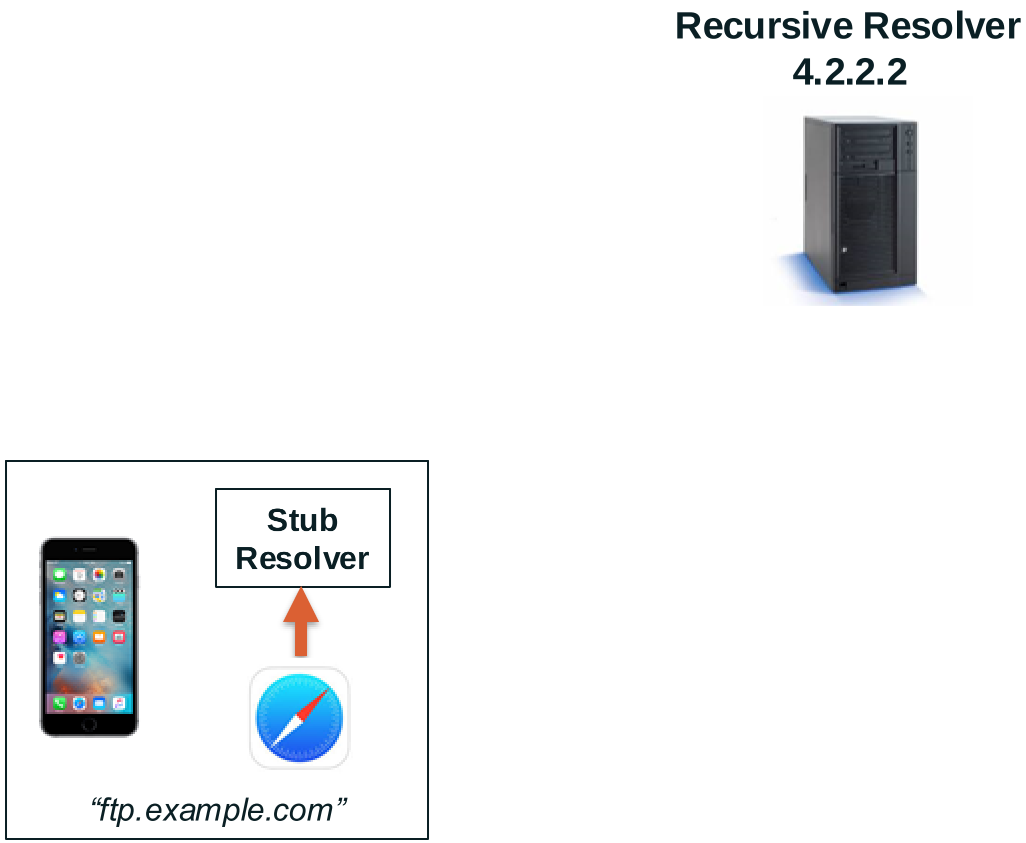
Resolution Process

- After the previous query, the recursive resolver at 4.2.2.2 now knows:
  - Names and IP addresses of the .com servers
  - Names and IP addresses of the example.com servers
  - IP addresses for www.example.com
- It caches all that data so that it can answer future queries quickly, without repeating the entire resolution process.

Let’s look at another query immediately following the first query . . .

Resolution Process

A user types *ftp.example.com* into Safari, and it calls the stub resolver function to resolve the name



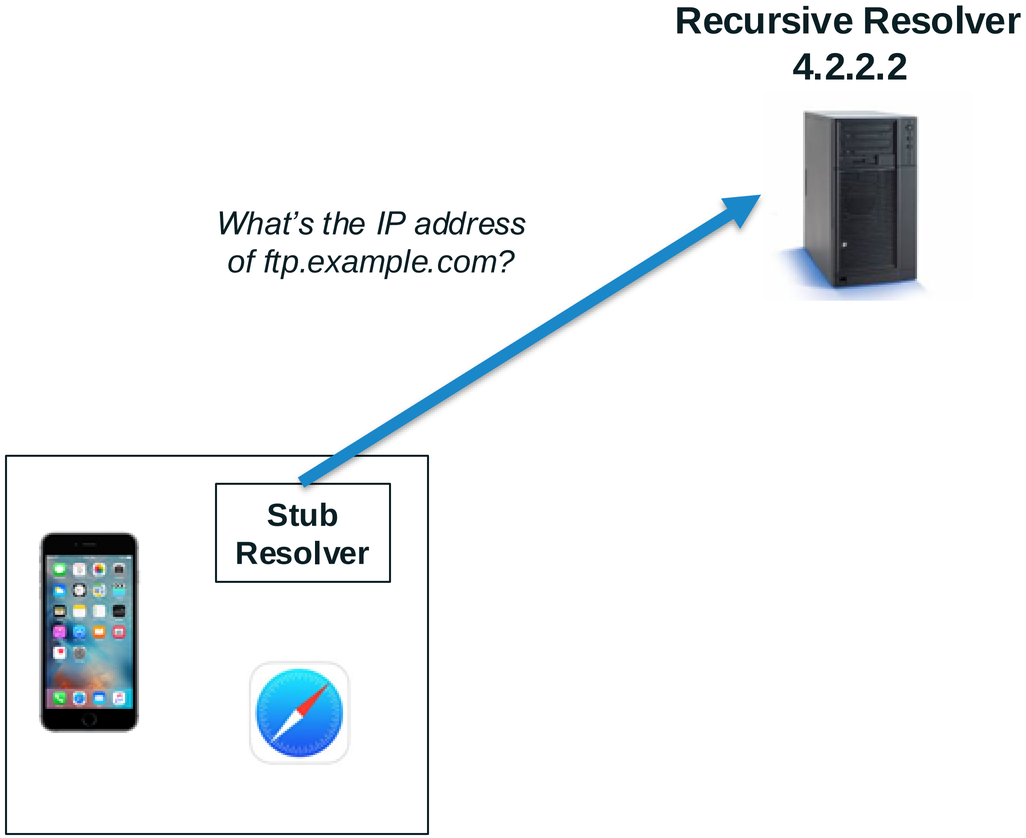
Recursive Resolver
4.2.2.2

Stub Resolver

“ftp.example.com”

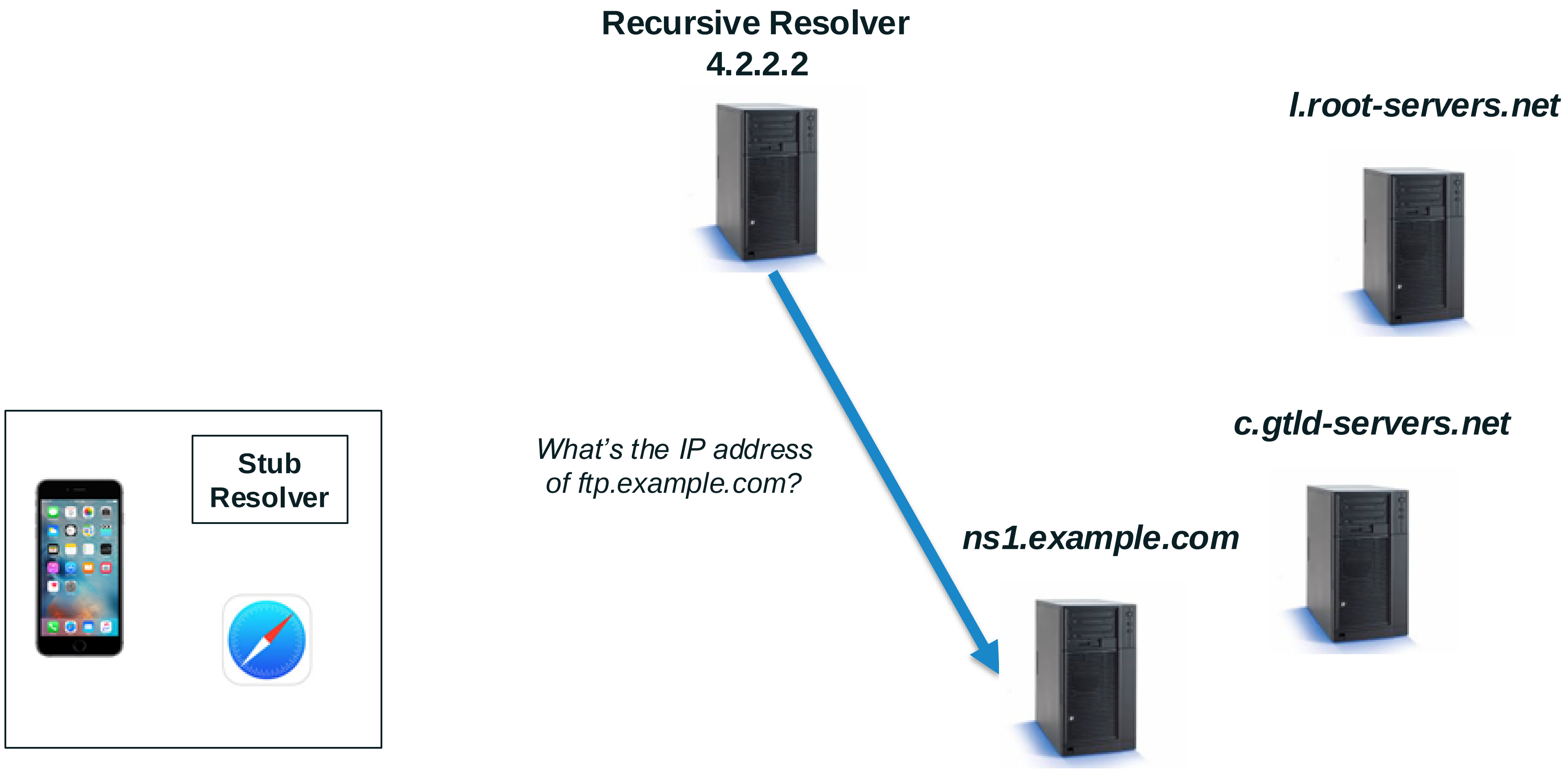
Resolution Process

The phone's stub resolver sends a query for *ftp.example.com*/IN/A to 4.2.2.2



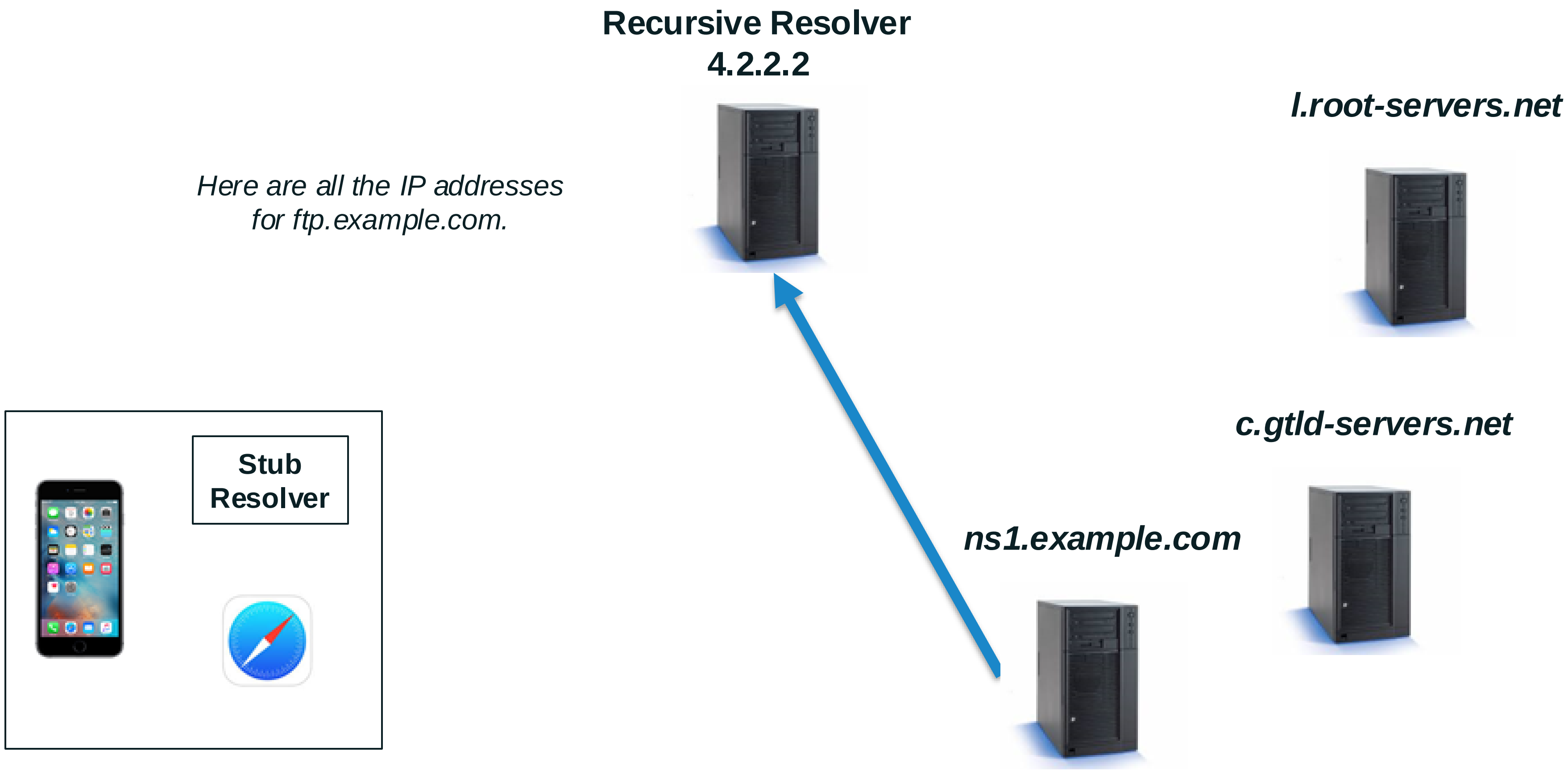
Resolution Process

Recursive resolver goes directly to example.com servers because it has that data in its cache



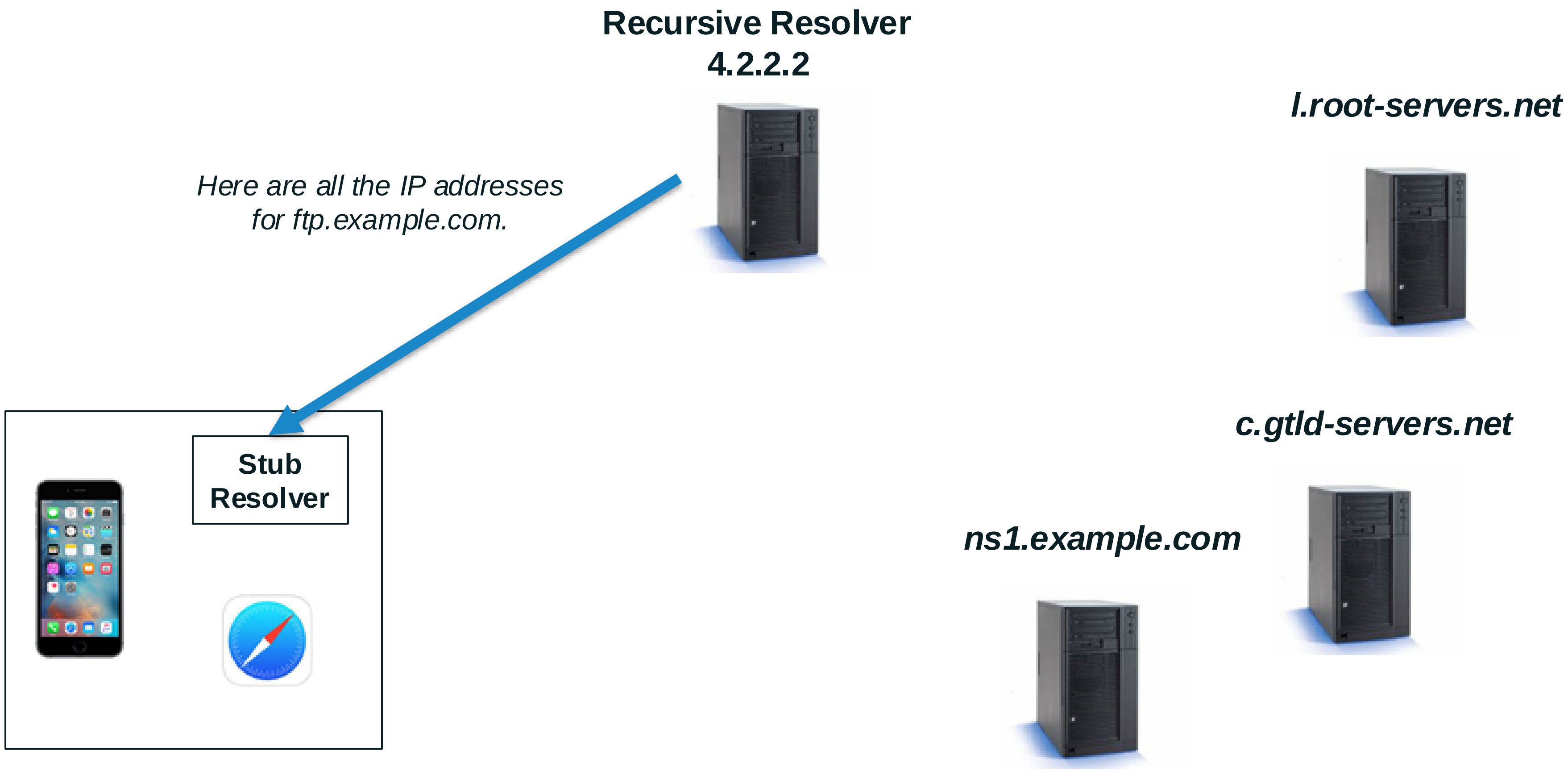
Resolution Process

example.com server returns the answer to the query



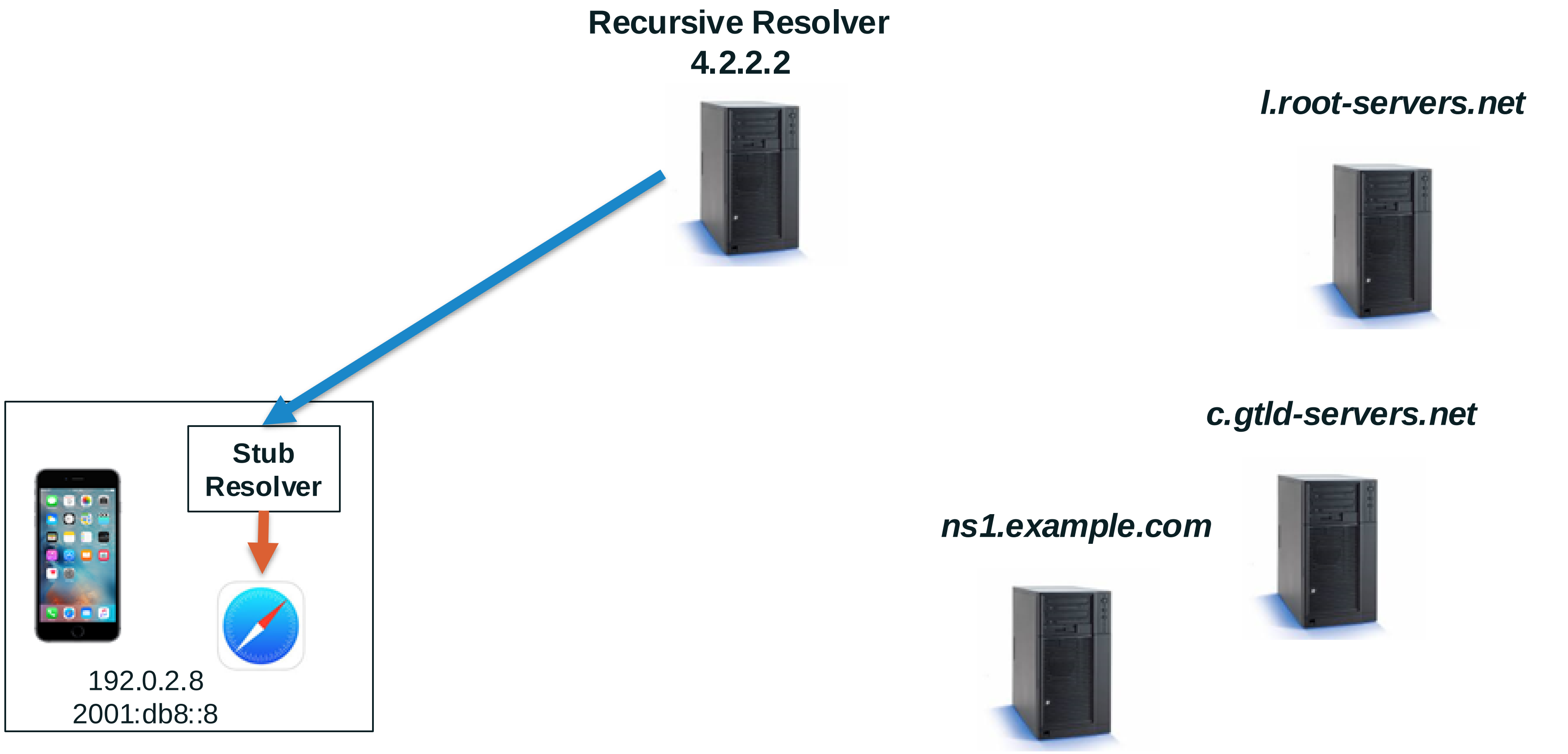
Resolution Process

Recursive resolver returns the answer to the query to the stub resolver



Resolution Process

Stub resolver returns the IP addresses to Safari



Questions?

Engage with ICANN – Thank You and Questions

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