Computer Networks

Lab Assignment 1 Report

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Explanation of the Code Implementation

There are four main classes, **DNSServer**, **DNS Handler**, **CacheManager** and **ReplyGenerator**. I will explain each class. Since it's difficult to explain tasks in order, I will explain all of my code and make notes of what code and explanation is for what task, which won't be in order. **Please note that I implemented all tasks**. In code section in this report, I deleted all of original comments not to make the report too long, but I still put my own comments.

Note that if u wanna check the task i implemented, you can use Ctrl+F and find (Task 1.1, Task 2.1, etc).

Before explanation of each class, let me explain **get_local_ip()** function first.

Automatically Detect Outbound Interface IP

1.
```python
def get_local_ip():
    try:
        # connect to a public DNS server for outbound interface
        s = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
        s.connect(('8.8.8.8', 53)) #Google DNS
        ip = s.getsockname()[0]  #get the local IP that would be used
        s.close()
        return ip
    except Exception:
        return '0.0.0.0'  # fallback address
```

In get_local_ip() method, I make a dumpy UDP connection to a public DNS server(here google DNS) to make our OS select the outbound interface and return local IPv4 address, if fail, return 0.0.0.0 which is fallback address. **(Task 1.1)**

DNSServer Class Explanation

```python
class DNSServer:

    def __init__(self, source_ip, source_port, ip='0.0.0.0', port=5533, num_workers=20):
        self.source_ip = source_ip #ip for outgoing DNS queries
        self.source_port = source_port #Port for outgoing DNS queries
        self.ip = ip  # ip to listen on for incoming DNS queries
        self.port = port # port to listen on for incoming DNS queries(5533)

        # create UDP socket and bind to listening address
        self.socket = socket.socket(socket.AF_INET, socket.SOCK_DGRAM)
        self.socket.bind((self.ip, self.port))
```

```
12
13          # create queues for producer-consumer pattern
14          self.request_queue = Queue()  #queue for incoming requests
15          self.response_queue = Queue()  #queue for outgoing responses
16
17          # initialize cache manager with auto-save for every 30 writes
18          self.cache_manager = CacheManager(auto_save_count=30)
19
20          # create worker threads
21          self.workers = []
22          self.running = threading.Event()  #event flag to control server
    lifecycle
23          self.running.set()  #set the flag to indicate server should run
24
25          #create and start worker threads
26          for i in range(num_workers):
27              worker = DNSHandler(self.source_ip, self.source_port,
    self.cache_manager,
28                                  self.request_queue, self.response_queue, i)
29              worker.daemon = True  #daemon threads will exit when main thread
    exits
30              self.workers.append(worker)
31
32          # create receiver thread(producer)
33          self.receive_thread = threading.Thread(target=self._receive_loop)
34          self.receive_thread.daemon = True
35
36          # create sender thread(consumer)
37          self.send_thread = threading.Thread(target=self._send_loop)
38          self.send_thread.daemon = True
39
40      def start(self):
41          # start all worker threads
42          for worker in self.workers:
43              worker.start()
44
45          # start receiver and sender threads
46          self.receive_thread.start()
47          self.send_thread.start()
48
49          print(f"Server started on {self.ip}:{self.port}")
50          print(f"Outbound communication IP: {self.source_ip}")
51          print(f"Cache auto-save enabled (every 10 writes)")
52          print("⏹Press Ctrl+C to stop server and save cache")
53
54          # main thread loop<keeps server running until stopped>
55          while self.running.is_set():
56              time.sleep(1)
57
58      def stop(self):
59          print("Stopping server...")
60          self.running.clear() #clear running flag to stop all threads
61          self.cache_manager.force_save() #force final cache save
62          self.socket.close()  #close the server socket
63          print("Server stopped successfully")
64
```

```
    def _receive_loop(self):
        while self.running.is_set():
            try:
                # wait for incoming DNS queries (blocking call)
                data, addr = self.socket.recvfrom(1024)
                # put received data and client address into request queue
                self.request_queue.put((data, addr))
            except OSError:
                break #break if socket is closed
            except Exception:
                pass #ignore other exceptions and continue

    def _send_loop(self):
        while self.running.is_set():
            try:
                #get response data and client address from response queue
                addr, data = self.response_queue.get(timeout=1)
                #send DNS response back to client
                self.socket.sendto(data, addr)
            except Empty:
                continue #no responses in queue
            except OSError:
                break # break if socket is closed
            except Exception:
                pass # ignore other exceptions and continue
```

The DNSServer manages server's operational lifecycle via a multithreaded architecture, which is designed for high concurrency and non-blocking I/O. My implementation initializes a UDP socket bound to '0.0.0.0:5533' to listen on all interfaces. I created two thread-safe queues, request_queue for incoming packets and response_queue for outgoing responses by decoupling I/O operations. Then, I instantiated 30 DNSHandler worker threads. Each was configured as a daemon to terminate with the main process and each dedicated receiver and sender threads for network operations. The receiver thread uses **recvfrom()** to capture queries and enqueue them and the sender dequeues and transmits responses via **sendto()**. In the **start()** method, I launch all threads and maintain a monitoring loop with a **threading.Event**. Then, I implemented a **stop()** method, which saves the cache and closes the socket. Therefore, this producer-consumer model supports non-blocking operation which is **Task 3.1 concurrency**. **(Task 1.2 and Task 3.1)**

DNSHandler Class

Core DNS Resolution Process

```
    def handle(self, message):
        """Handle a single DNS query, incorporating filtering and
redirection logic."""
        try:
            # parse incoming DNS message
            income_record = DNSRecord.parse(message)
            # extract domain name and query type from question section
            domain_name = str(income_record.q.qname).rstrip('.')
            qtype_str = QTYPE[income_record.q.qtype]

            #check if domain should be redirected
```

```
            if domain_name.lower() in self.redirect_map:
                redirect_ip = self.redirect_map[domain_name.lower()]
                # generate redirect response with forged IP
                return ReplyGenerator.replyForRedirect(income_record,
redirect_ip)


            #check if domain should be blocked
            if domain_name.lower() in self.blocklist:
                # generate blocked response
                return ReplyGenerator.replyForBlocked(income_record)


            #check cache first
            cached = self.cache_manager.readCache(domain_name, qtype_str)
            if cached:
                cached.header.id = income_record.header.id #match
transaction ID
                return cached  # return cached response

            # cache miss - perform iterative DNS query
            rr_list = self.query(domain_name, income_record.q.qtype)
            if rr_list:
                # generate successful response with resource records
                response = ReplyGenerator.myReply(income_record, rr_list)
                # cache the successful response
                self.cache_manager.writeCache(domain_name, qtype_str,
response)
                return response
            else:
                # generate NXDOMAIN response for non existent domains
                response_record =
ReplyGenerator.replyForNotFound(income_record)
                # cache the negative response
                self.cache_manager.writeCache(domain_name, qtype_str,
response_record)
                return response_record

        except Exception as e:
            print(f"Error handling query: {e}")
            # return NXDOMAIN for any processing errors
            return ReplyGenerator.replyForNotFound(DNSRecord.parse(message))
```

In the **DNSHandler.handle()** method, I begin by parsing the incoming UDP packet with **dnslib** in order to extract the domain and query type. The domain is normalized by removing trailing dots. Then, I checked the **redirect_map** and **blocklist** first to return custom responses in order to avoid unnecessary network queries. For standard queries, I query the cache using **readCache()** first and on a hit, I update the response's transaction ID to match the client's and return it immediately. But on a cache miss, I call **query()** to perform iteratively by collecting resource records (RRs). If RRs are returned, I use **ReplyGenerator.myReply()** to make a response with QR=1, AA=0, RA=0 by adding all RRs to the answer section, then cache it via **writeCache()**. For failures, I generate an NXDOMAIN response with **replyForNotFound()** and cache it negatively.

Finding Root Server IP

```
def queryRoot(self, source_ip, source_port):
    """
    --- Task 1.4 Robust Dynamic Discovery of Root Server IP ---

    Dynamically and reliably discover the IP address of a currently available root DNS server.

    :param source_ip: (str) Source IP address to use for this bootstrap query.
    :param source_port: (int) Source port to use for this bootstrap query.

    :return:
        - tuple: On success, returns (root_ip, root_ns_name).
    """
    for bootstrap in self.BOOTSTRAP_DNS_SERVERS:
        try:
            res = resolver.Resolver()
            res.nameservers = [bootstrap]
            ans = res.resolve('.', rdatatype.NS)
            root_ns = str(ans[0]).rstrip('.')
            ans_a = res.resolve(root_ns, rdatatype.A)
            root_ip = str(ans_a[0])
            return root_ip, root_ns
        except Exception:
            pass
    raise Exception("Failed to discover root server IP from all bootstrap servers.")

def _initialize_root_server(self):
        """Initialize root server IP for this worker thread"""
        try:
            # query public DNS to get current root server IP
            server_ip, _ = self.queryRoot(self.source_ip, self.source_port)
            print(f"Worker {self.worker_id} initialized with root IP: {server_ip}")
            return server_ip
        except Exception as e:
            # fallback to hardcoded root server if bootstrap fails
            print(f"Worker {self.worker_id} failed to init root server: {e}. Falling back to 198.41.0.4.")
            return '198.41.0.4'  # a.root-servers.net
```

In **queryRoot()**, I discover a valid root server IP using a list of public DNS bootstraps (e.g. 8.8.8.8, 1.1.1.1). For each bootstrap, I configure a **dnspython resolver** to query the root zone ('.') for **NS records** by retrieving a nameserver name and then resolve this name to an **A record** to obtain its IP. I loop through bootstraps on failure, which raise an exception only if all fail and fall back to a hardcoded IP (198.41.0.4) in **_initialize_root_server()**. The result is cached per worker, which maker sure all subsequent queries start from a reliable root **(Task 1.4)**.

Iterative Query Implementation

```
    def query(self, query_name, qtype):
        """
        Fixed iterative DNS query implementation with CNAME following
        """
        current_server = self.root_server_cache
        max_hops = 20
        hop_count = 0
        all_answers = [] #collect all answers including CNAMEs and final A records

        while hop_count < max_hops:
            hop_count += 1

            # create DNS query with RD=0 for iterative queries
            q = DNSRecord.question(query_name, QTYPE.get(qtype, 'A'))
            q.header.rd = 0
            q.header.ra = 0

            try:
                query_data = q.pack()
                self.udp_sock.sendto(query_data, (current_server, 53)) #send query
                data, _ = self.udp_sock.recvfrom(4096) #receive response
                response = DNSRecord.parse(data) #parse response

                # process all resource records in answer section
                if response.rr:
                    cname_found = False

                    for rr in response.rr:
                        # add all answers to our collection
                        all_answers.append(rr)

                        # if we find a CNAME, we need to follow it
                        if rr.rtype == QTYPE.CNAME:
                            cname_found = True
                            # update query_name to follow CNAME chain
                            query_name = str(rr.rdata).rstrip('.')
                            # reset server to root and continue
                            current_server = self.root_server_cache
                            hop_count = 0 #reset hop count for new query
                            break  # break to process the CNAME

                    # if we found a CNAME, continue with the new query
                    if cname_found:
                        continue

                    # if we have direct answers(not CNAME), return all collected answers
                    if all_answers:
                        return all_answers

```

```
                # if no direct answers, look for referrals in authority section
                if response.auth:
                    #find NS records in authority section
                    ns_records = []
                    for auth in response.auth:
                        if auth.rtype == QTYPE.NS:
                            ns_records.append(str(auth.rdata).rstrip('.'))

                    # look for A records of nameservers in additional section
                    if ns_records and response.ar:
                        for ar in response.ar:
                            if ar.rtype == QTYPE.A and str(ar.rname).rstrip('.') in ns_records:
                                current_server = str(ar.rdata)
                                break
                        continue

                    # if we have NS records but no glue records, we need to resolve NS first
                    elif ns_records:
                        ns_ip = self.resolve_nameserver(ns_records[0])
                        if ns_ip:
                            current_server = ns_ip
                            continue

                # if we get here and have answers, return them
                if all_answers:
                    return all_answers
                return None

            except socket.timeout:
                if current_server in self.BOOTSTRAP_DNS_SERVERS:
                    next_index = (self.BOOTSTRAP_DNS_SERVERS.index(current_server) + 1) % len(self.BOOTSTRAP_DNS_SERVERS)
                    current_server = self.BOOTSTRAP_DNS_SERVERS[next_index]
                    continue
                return all_answers if all_answers else None
            except Exception as e:
                print(f"Query error for {query_name}: {e}")
                return all_answers if all_answers else None

        return all_answers if all_answers else None

    def resolve_nameserver(self, ns_name):
        ns_rrs = self.query(ns_name, QTYPE.A)
        if ns_rrs:
            for rr in ns_rrs:
                if rr.rtype == QTYPE.A:
                    return str(rr.rdata)
        return None
```

In **query()**, I limited iterations to 20 hops to prevent loops and cycle bootstraps. I make a question packet with RD=0 and RA=0 to make sure it's iterative querying. Then, I send it via a UDP socket. If the answer section contains RRs, I handle CNAMEs by updating the query name and reset sever to root with a reset hop count to allow full traversal. If we found a CNAME, I continue with the new query. If we have direct answers (not CNAME), I return all collected answers. If there are no direct answers, I look for referrals in authority section by finding NS records in authority section and A records of nameservers in additional section. If glue A records are in additional section, I use them directly. Otherwise, I call **resolve_nameserver()** to query the NS's A record **(Task 1.3)**.

CacheManager Explanation

I initialized the cache with a file path (**dns_cache.pkl**), a maximum size 200 entries and an auto-save trigger for every 30 writes. A threading.Lock is for thread safety and I load the cache from disk to restore prior state.

```
def _load_from_file(self):
        try:
            # open cache file in binary read mode
            with open(self.cache_file, 'rb') as f:
                data = pickle.load(f) #deserialize the cache data using pickle
                now = time.time() #get current timestamp for expiration check
                valid_cache = OrderedDict()#create new ordered dict for valid entries

                # iterate through all cached items and filter out expired ones
                for key, (record, expiry) in data.items():
                    if expiry > now:  #only keep entries that haven't expired
                        valid_cache[key] = (record, expiry)
                print(f"Loaded {len(valid_cache)} valid cache entries from {self.cache_file}")
                return valid_cache
        except (FileNotFoundError, EOFError, pickle.UnpicklingError):
            # return empty cache if file doesn't exist or is corrupted
            print(f" No existing cache file found or cache is empty. Starting with fresh cache.")
            return OrderedDict()
```

For **_load_from_file(self)**, I use **pickle.load()** to deserialize the cache file into an **OrderedDict**. Then I filter entries by comparing expiry to **time.time()** to keep only unexpired records. **(Task 2.1)**

```
def save_to_file(self):
    with self.lock: #acquire lock to prevent concurrent modifications during save
        with open(self.cache_file, 'wb') as f:
            pickle.dump(self.cache, f) #serialize and write entire cache to file
        print(f"Cache saved to {self.cache_file} ({len(self.cache)} entries)")
```

For **save_to_file(self)**, I serializes the cache by using **pickle.dump()** in binary write mode. I use the lock to prevent concurrent write issues. I logs the number of saved entries for verification **(Task 2.2)**.

```
def readCache(self, domain_name, qtype_str):
        key = (domain_name.lower(), qtype_str) #create cache key from lowercase domain and query type
        with self.lock: #thread-safe access to cache
            if key in self.cache:
                record, expiry = self.cache[key] #unpack the cached record and its expiration time
                now = time.time()
                if expiry > now: #check if record is still valid
                    self.cache.move_to_end(key) #move to end to mark as recently used (LRU)
                    return record
                else:
                    del self.cache[key] #remove expired entry from cache
        return None #return None if no valid cache entry found
```

For **readCache(self, domain_name, qtype_str)**, I make a key as **(domain_name.lower(), qtype_str)** for case-insensitive lookups. Then, under **lock**, I check whether the key exists by verifying **expiry > time.time()** and returns **DNSRecord**. If it's valid, I update LRU order with **move_to_end()**. (**Task 2.3 and 2.4**)

```
    def writeCache(self, domain_name, qtype_str, response_record):
        key = (domain_name.lower(), qtype_str) #create cache key
        now = time.time()

        # determine TTL based on response type
        if response_record.header.rcode == 3: #NXDOMAIN
            ttl = 60 #shorter TTL for negative caching
        else:
            ttl = 300 #standard 5-minute TTL for successful responses

        expiry = now + ttl #calculate absolute expiration timestamp

        with self.lock: #thread-safe cache modification
            self.cache[key] = (response_record, expiry) #store record with expiration
            self.cache.move_to_end(key) #mark as recently used

            # auto save logic - save every N writes
            self.write_count += 1
            if self.write_count >= self.auto_save_count:
                self.save_to_file()
                self.write_count = 0 #reset counter

            # enforce LRU eviction if cache exceeds maximum size
            if len(self.cache) > self.max_size:
                removed_key = self.cache.popitem(last=False)  #remove least recently used item
                print(f"Cache full, evicted: {removed_key[0]}")
```

For **writeCache(self, domain_name, qtype_str, response_record)**, I create a key and sets TTL (**60s** for NXDOMAIN, **300s** for others) for calculating expiry time. Then, I store **(response_record, expiry)** under lock and then I update LRU order. Then, I trigger **save_to_file()** every 30 writes and evicts the oldest entry if it's over max_size. **(Task 2.5)**

```
def force_save(self):
    """Force immediate cache save"""
    self.save_to_file()
```

I added **force_save(self)** to force immediate cache persistence, especially to make sure there is no data loss when there's shutdown or server stops(which is called in DNS Server Class). **(Task 2.2)**

ReplyGenerator Class Explanation

```
    def replyForNotFound(income_record):
        """Generate NXDOMAIN response for non-existent domains"""
        header = DNSHeader(id=income_record.header.id, qr=1, rcode=3) #qr=1 (response), rcode=3 (NXDOMAIN)
        record = DNSRecord(header, q=income_record.q) #include original question
        return record
```

For **replyForNotFound** Method, I create a DNSHeader with the same transaction ID as the incoming query (income_record.header.id). I set qr=1 to mean a response and rcode=3 for NXDOMAIN. I maintain the original question **(income_record.q)** to make sure that the client can match the response. I make empty answer section because **NXDOMAIN** responses do not usually include resource records (RRs).

```
    def myReply(income_record, rr_list):
        """Generate successful response with resource records"""
        header = DNSHeader(id=income_record.header.id, qr=1, aa=0, ra=0)
        response = DNSRecord(header, q=income_record.q)
        for rr in rr_list:
            response.add_answer(rr)
        return response
```

For **myReply** Method,I make the header with the original transaction ID, qr=1 for response, aa=0 (non-authoritative beacuse the server is iterative) and ra=0. I put the original question and iterate through rr_list to add each RR (A or CNAME) to the answer section by using add_answer().

```
            self.redirect_map = {
            "www.google.com": "127.0.0.2",
            "google.com": "127.0.0.1",
            "doubleclick.net": "0.0.0.0",
            "www.google-analytics.com": "0.0.0.1",
            "friendly.name": "8.8.8.8"
         }

```

```
    def replyForRedirect(income_record, redirect_ip, ttl=300):
        header = DNSHeader(id=income_record.header.id, qr=1, aa=0, ra=0)
        response = DNSRecord(header, q=income_record.q)
        #A record resource record pointing to redirect IP
        rr = RR(income_record.q.qname, QTYPE.A, rdata=A(redirect_ip),
ttl=ttl)
        response.add_answer(rr)  #add the forged A record to answer section
        return response
```

For **replyForRedirect()** method, I set the header with the original transaction ID, qr=1, aa=0, and ra=0 to say a non-authoritative and non-recursive response. I still retain the original question and create a single A RR with the specified redirect_ip and a default TTL of 300 seconds by using RR and A. I add the RR to the answer section and return the DNSRecord **(Task 3.2)**.

```
self.blocklist = {
    "malware-site.com",
    "phishing-attack.net",
    "ads.annoying-tracker.com",
    "stats.unwanted-data-miner.org",
    "distracting-social-media.com"
}

def replyForBlocked(income_record, reason="Blocked due to security policy"):
    header = DNSHeader(id=income_record.header.id, qr=1, rcode=5)
    response = DNSRecord(header, q=income_record.q)
    if reason:
        #TXT record containing the block reason
        txt_rr = RR(income_record.q.qname, QTYPE.TXT, rdata=TXT(reason),
ttl=0)
        response.add_answer(txt_rr) #add TXT record to answer section
    return response
```

For **replyForBlocked()** method, I set the header with the original transaction ID, qr=1, and rcode=5 for REFUSED. I also put the original question. And if a reason is provided, I add a TXT RR with the reason and TTL=0 to prevent caching. Finally, I return the DNSRecord with the header, question, and optional TXT RR **(Task 3.3)**.

Test Results

This is the screenshots of test results from test.py file.

```
------------------------------------------------
--- [Thread-04] Result for www.sina.com.cn (took 0.57s) ---
; <<>> DiG 9.17.12 <<>> @127.0.0.1 www.sina.com.cn a -p 5533
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 16276
;; flags: qr rd; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;www.sina.com.cn.               IN      A

;; ANSWER SECTION:
www.sina.com.cn.        60      IN      CNAME   spool.grid.sinaedge.com.
spool.grid.sinaedge.com. 60     IN      A       121.194.5.14

;; Query time: 495 msec
;; SERVER: 127.0.0.1#5533(127.0.0.1) (UDP)
;; WHEN: Thu Oct 23 00:30:20 ;; MSG SIZE  rcvd: 86
------------------------------------------------
```

```
------------------------------------------------
--- [Thread-05] Result for www.google.com (took 0.24s) ---
; <<>> DiG 9.17.12 <<>> @127.0.0.1 www.google.com a -p 5533
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 34737
;; flags: qr rd; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;www.google.com.                        IN      A

;; ANSWER SECTION:
www.google.com.         300     IN      A       127.0.0.1

;; Query time: 1 msec
;; SERVER: 127.0.0.1#5533(127.0.0.1) (UDP)
;; WHEN: Sat Oct 25 16:08:42 ;; MSG SIZE  rcvd: 48
------------------------------------------------
--- [Thread-02] Result for www.tsinghua.edu.cn (took 0.39s) ---
; <<>> DiG 9.17.12 <<>> @127.0.0.1 www.tsinghua.edu.cn a -p 5533
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 42415
;; flags: qr rd; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;www.tsinghua.edu.cn.           IN      A

;; ANSWER SECTION:
www.tsinghua.edu.cn.    7200    IN      A       101.6.15.66

;; Query time: 145 msec
;; SERVER: 127.0.0.1#5533(127.0.0.1) (UDP)
;; WHEN: Sat Oct 25 16:08:42 ;; MSG SIZE  rcvd: 53
------------------------------------------------
```

```
------------------------------------------------
--- [Thread-04] Result for www.sina.com.cn (took 0.76s) ---
; <<>> DiG 9.17.12 <<>> @127.0.0.1 www.sina.com.cn a -p 5533
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 38394
;; flags: qr rd; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;www.sina.com.cn.               IN      A

;; ANSWER SECTION:
www.sina.com.cn.        60      IN      CNAME   spool.grid.sinaedge.com.
spool.grid.sinaedge.com. 60     IN      A       121.194.5.14

;; Query time: 509 msec
;; SERVER: 127.0.0.1#5533(127.0.0.1) (UDP)
;; WHEN: Sat Oct 25 16:08:42 ;; MSG SIZE  rcvd: 86
------------------------------------------------
--- [Thread-03] Result for www.bilibili.com (took 0.86s) ---
; <<>> DiG 9.17.12 <<>> @127.0.0.1 www.bilibili.com a -p 5533
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 12554
;; flags: qr rd; QUERY: 1, ANSWER: 7, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;www.bilibili.com.              IN      A

;; ANSWER SECTION:
www.bilibili.com.       300     IN      CNAME   gz.w.bilicdn1.com.
gz.w.bilicdn1.com.      90      IN      A       139.159.246.60
gz.w.bilicdn1.com.      90      IN      A       139.159.252.156
gz.w.bilicdn1.com.      90      IN      A       8.134.32.222
gz.w.bilicdn1.com.      90      IN      A       8.134.50.24
gz.w.bilicdn1.com.      90      IN      A       8.134.64.214
gz.w.bilicdn1.com.      90      IN      A       139.159.241.37

;; Query time: 608 msec
;; SERVER: 127.0.0.1#5533(127.0.0.1) (UDP)
;; WHEN: Sat Oct 25 16:08:43 ;; MSG SIZE  rcvd: 158
------------------------------------------------
```

```
--------------------------------------------------
--- [Thread-00] Result for www.baidu.com (took 0.92s) ---
; <<>> DiG 9.17.12 <<>> @127.0.0.1 www.baidu.com a -p 5533
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 30652
;; flags: qr rd; QUERY: 1, ANSWER: 3, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;www.baidu.com.                 IN      A

;; ANSWER SECTION:
www.baidu.com.          1200    IN      CNAME   www.a.shifen.com.
www.a.shifen.com.       120     IN      A       182.61.200.110
www.a.shifen.com.       120     IN      A       182.61.200.108

;; Query time: 673 msec
;; SERVER: 127.0.0.1#5533(127.0.0.1) (UDP)
;; WHEN: Sat Oct 25 16:08:43 ;; MSG SIZE  rcvd: 90
--------------------------------------------------
--- [Thread-01] Result for www.taobao.com (took 1.01s) ---
; <<>> DiG 9.17.12 <<>> @127.0.0.1 www.taobao.com a -p 5533
; (1 server found)
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 26108
;; flags: qr rd; QUERY: 1, ANSWER: 3, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
;www.taobao.com.                        IN      A

;; ANSWER SECTION:
www.taobao.com.         600     IN      CNAME   www.taobao.com.danuoyi.tbcache.com.
www.taobao.com.danuoyi.tbcache.com. 60 IN A     222.192.186.120
www.taobao.com.danuoyi.tbcache.com. 60 IN A     222.192.186.122

;; Query time: 759 msec
;; SERVER: 127.0.0.1#5533(127.0.0.1) (UDP)
;; WHEN: Sat Oct 25 16:08:43 ;; MSG SIZE  rcvd: 109
--------------------------------------------------

============================================================
All 8 queries completed in 1.01 seconds.
------------------------------------------------------------
```

```
📊 DNS Query Test Summary:

✅ SUCCESS (7 queries):
   (0.24s) - www.google-analytics.com  -> 0.0.0.0
   (0.24s) - www.google.com            -> 127.0.0.1
   (0.39s) - www.tsinghua.edu.cn       -> 101.6.15.66
   (0.76s) - www.sina.com.cn           -> 121.194.5.14
   (0.86s) - www.bilibili.com          -> 139.159.241.37
   (0.92s) - www.baidu.com             -> 182.61.200.108
   (1.01s) - www.taobao.com            -> 222.192.186.122

⚠️ NXDOMAIN (0 queries):
   None

❌ TIMEOUT (0 queries):
   None

❓ OTHER ERRORS (1 queries):
   (0.24s) - ads.annoying-tracker.com  -> REFUSED

------------------------------------------------------------
```

Cache Test

The total time needed is **1.01 seconds** for the **first time** when there is no cache.

But I stop server with Ctrl+C , so cache will be saved in dns_cache.pkl. Then I start Server again and test. The query time is much **lower** now because of the cache(**0.08 seconds**). That means that our cache is working properly.

This is the screenshot of the test result for second time.

```
============================================================
All 8 queries completed in 0.08 seconds.
============================================================

📊 DNS Query Test Summary:

✅ SUCCESS (7 queries):
   (0.07s) - www.google.com             -> 127.0.0.1
   (0.07s) - www.bilibili.com           -> 139.159.241.37
   (0.07s) - www.google-analytics.com   -> 0.0.0.0
   (0.07s) - www.taobao.com             -> 222.192.186.122
   (0.07s) - www.baidu.com              -> 182.61.200.108
   (0.08s) - www.sina.com.cn            -> 121.194.5.14
   (0.08s) - www.tsinghua.edu.cn        -> 101.6.15.66

⚠️ NXDOMAIN (0 queries):
   None

❌ TIMEOUT (0 queries):
   None

❓ OTHER ERRORS (1 queries):
   (0.08s) - ads.annoying-tracker.com   -> REFUSED
```

Testing Redirect and Filter Domains

```
============================================================
All 10 queries completed in 0.10 seconds.
============================================================

📊 DNS Query Test Summary:

✅ SUCCESS (5 queries):
   (0.07s) - friendly.name              -> 8.8.8.8
   (0.08s) - doubleclick.net            -> 0.0.0.0
   (0.08s) - www.google.com             -> 127.0.0.1
   (0.09s) - www.google-analytics.com   -> 0.0.0.0
   (0.09s) - google.com                 -> 127.0.0.1

⚠️NXDOMAIN (0 queries):
   None

❌ TIMEOUT (0 queries):
   None

❓ OTHER ERRORS (5 queries):
   (0.09s) - distracting-social-media.com -> REFUSED
   (0.09s) - malware-site.com           -> REFUSED
   (0.09s) - stats.unwanted-data-miner.org -> REFUSED
   (0.09s) - phishing-attack.net        -> REFUSED
   (0.09s) - ads.annoying-tracker.com   -> REFUSED

============================================================
```

All are handled correctly.

Concurrency Test

I tried with 25 domains in test.py and here is the results(**Task 3.1** and **Task 3.5**).

1st time

```
============================================================
All 25 queries completed in 2.18 seconds.
============================================================

📊 DNS Query Test Summary:

✅ SUCCESS (25 queries):
   (0.29s) - www.tsinghua.edu.cn       -> 101.6.15.66
   (0.33s) - www.sjtu.edu.cn           -> 202.120.2.114
   (0.34s) - www.tsinghua.edu.cn       -> 101.6.15.66
   (0.34s) - www.xjtu.edu.cn           -> 202.117.1.13
   (0.34s) - www.fudan.edu.cn          -> 202.120.224.81
   (0.47s) - www.stackoverflow.com     -> 172.64.155.249
   (0.57s) - www.sina.com.cn           -> 121.194.5.14
   (0.60s) - www.oppo.com              -> 116.31.102.53
   (0.64s) - www.vivo.com.cn           -> 60.188.140.123
   (0.76s) - www.bilibili.com          -> 8.134.50.24
   (0.77s) - www.pku.edu.cn            -> 162.105.131.160
   (0.78s) - www.weibo.com             -> 121.194.0.143
   (0.80s) - www.zhihu.com             -> 61.240.220.8
   (0.86s) - www.baidu.com             -> 182.61.200.108
   (0.89s) - www.taobao.com            -> 222.192.186.120
   (0.93s) - www.ifeng.com             -> 43.141.52.46
   (0.97s) - www.sohu.com              -> 111.22.248.166
   (1.15s) - www.github.com            -> 20.205.243.166
   (1.15s) - www.163.com               -> 222.192.186.76
   (1.30s) - www.lenovo.com.cn         -> 112.90.40.12
   (1.35s) - www.cctv.com              -> 222.200.254.75
   (1.36s) - www.mi.com                -> 222.200.254.219
   (1.54s) - www.hp.com                -> 23.200.143.68
   (1.56s) - www.asus.com.cn           -> 153.101.64.230
   (2.16s) - www.dell.com              -> 220.160.38.206

⚠️NXDOMAIN (0 queries):
   None

❌ TIMEOUT (0 queries):
   None

❓ OTHER ERRORS (0 queries):
   None
```

2nd time

```
============================================================
All 25 queries completed in 0.17 seconds.
============================================================

📊 DNS Query Test Summary:

✅ SUCCESS (25 queries):
   (0.11s) - www.vivo.com.cn           -> 60.188.140.123
   (0.12s) - www.baidu.com             -> 182.61.200.108
   (0.13s) - www.zhihu.com             -> 61.240.220.8
   (0.14s) - www.github.com            -> 20.205.243.166
   (0.14s) - www.ifeng.com             -> 43.141.52.46
   (0.14s) - www.asus.com.cn           -> 153.101.64.230
   (0.14s) - www.dell.com              -> 220.160.38.206
   (0.14s) - www.oppo.com              -> 116.31.102.53
   (0.14s) - www.xjtu.edu.cn           -> 202.117.1.13
   (0.14s) - www.bilibili.com          -> 8.134.50.24
   (0.15s) - www.stackoverflow.com     -> 172.64.155.249
   (0.15s) - www.tsinghua.edu.cn       -> 101.6.15.66
   (0.15s) - www.lenovo.com.cn         -> 112.90.40.12
   (0.15s) - www.sjtu.edu.cn           -> 202.120.2.114
   (0.15s) - www.weibo.com             -> 121.194.0.143
   (0.16s) - www.163.com               -> 222.192.186.76
   (0.16s) - www.mi.com                -> 222.200.254.219
   (0.16s) - www.sina.com.cn           -> 121.194.5.14
   (0.16s) - www.fudan.edu.cn          -> 202.120.224.81
   (0.16s) - www.taobao.com            -> 222.192.186.120
   (0.16s) - www.pku.edu.cn            -> 162.105.131.160
   (0.16s) - www.tsinghua.edu.cn       -> 101.6.15.66
   (0.16s) - www.hp.com                -> 23.200.143.68
   (0.16s) - www.cctv.com              -> 222.200.254.75
   (0.16s) - www.sohu.com              -> 111.22.248.166

⚠️NXDOMAIN (0 queries):
   None

❌ TIMEOUT (0 queries):
   None

❓ OTHER ERRORS (0 queries):
   None

------------------------------------------------------------
```

3rd time

```
============================================================
All 25 queries completed in 0.23 seconds.
============================================================

📊 DNS Query Test Summary:

✅ SUCCESS (25 queries):
   (0.14s) - www.sjtu.edu.cn           -> 202.120.2.114
   (0.14s) - www.mi.com                -> 222.200.254.219
   (0.15s) - www.tsinghua.edu.cn       -> 101.6.15.66
   (0.15s) - www.sina.com.cn           -> 121.194.5.14
   (0.15s) - www.bilibili.com          -> 8.134.50.24
   (0.15s) - www.163.com               -> 222.192.186.76
   (0.15s) - www.zhihu.com             -> 61.240.220.8
   (0.15s) - www.taobao.com            -> 222.192.186.120
   (0.17s) - www.github.com            -> 20.205.243.166
   (0.17s) - www.dell.com              -> 220.160.38.206
   (0.17s) - www.hp.com                -> 23.200.143.68
   (0.17s) - www.lenovo.com.cn         -> 112.90.40.12
   (0.17s) - www.weibo.com             -> 121.194.0.143
   (0.18s) - www.asus.com.cn           -> 153.101.64.230
   (0.18s) - www.fudan.edu.cn          -> 202.120.224.81
   (0.18s) - www.oppo.com              -> 116.31.102.53
   (0.18s) - www.pku.edu.cn            -> 162.105.131.160
   (0.18s) - www.vivo.com.cn           -> 60.188.140.123
   (0.18s) - www.stackoverflow.com     -> 172.64.155.249
   (0.18s) - www.tsinghua.edu.cn       -> 101.6.15.66
   (0.18s) - www.sohu.com              -> 111.22.248.166
   (0.18s) - www.cctv.com              -> 222.200.254.75
   (0.18s) - www.baidu.com             -> 182.61.200.108
   (0.19s) - www.ifeng.com             -> 43.141.52.46
   (0.22s) - www.xjtu.edu.cn           -> 202.117.1.13

⚠️NXDOMAIN (0 queries):
   None

❌ TIMEOUT (0 queries):
   None

❓ OTHER ERRORS (0 queries):
   None

------------------------------------------------------------
```

So, second and third time finish less than 0.3 seconds. So our server can handle concurrent requests.

And this is the screenshots of the result from **wireshark**.

Initialization

For 192.5.5.241(1st worker),

```
> Frame 161: 94 bytes on wire (752 bits), 94 bytes captured (752 bits) on interface \Device\NPF_{037B466A-8156-4D52-E
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 223.5.5.5, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49670
v Domain Name System (response)
    Transaction ID: 0xd9ca
  > Flags: 0x8180 Standard query response, No error
    Questions: 1
    Answer RRs: 1
    Authority RRs: 0
    Additional RRs: 0
  v Queries
    v f.root-servers.net: type A, class IN
        Name: f.root-servers.net
        [Name Length: 18]
        [Label Count: 3]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Answers
    v f.root-servers.net: type A, class IN, addr 192.5.5.241
        Name: f.root-servers.net
        Type: A (1) (Host Address)
        Class: IN (0x0001)
        Time to live: 3275 (54 minutes, 35 seconds)
        Data length: 4
        Address: 192.5.5.241
    [Request In: 158]
    [Time: 0.016028000 seconds]
```

```
> Frame 157: 475 bytes on wire (3800 bits), 475 bytes captured (3800 bits) on interface \Device\NPF
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 223.5.5.5, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49669
v Domain Name System (response)
    Transaction ID: 0x7b45
  > Flags: 0x8180 Standard query response, No error
    Questions: 1
    Answer RRs: 13
    Authority RRs: 0
    Additional RRs: 0
  v Queries
    v <Root>: type NS, class IN
        Name: <Root>
        [Name Length: 6]
        [Label Count: 1]
        Type: NS (2) (authoritative Name Server)
        Class: IN (0x0001)
  v Answers
    > <Root>: type NS, class IN, ns f.root-servers.net
    > <Root>: type NS, class IN, ns d.root-servers.net
    > <Root>: type NS, class IN, ns l.root-servers.net
    > <Root>: type NS, class IN, ns a.root-servers.net
    > <Root>: type NS, class IN, ns i.root-servers.net
    > <Root>: type NS, class IN, ns k.root-servers.net
    > <Root>: type NS, class IN, ns m.root-servers.net
    > <Root>: type NS, class IN, ns h.root-servers.net
    > <Root>: type NS, class IN, ns b.root-servers.net
    > <Root>: type NS, class IN, ns g.root-servers.net
    > <Root>: type NS, class IN, ns j.root-servers.net
    > <Root>: type NS, class IN, ns e.root-servers.net
    > <Root>: type NS, class IN, ns c.root-servers.net
    [Request In: 151]
    [Time: 0.006910000 seconds]
```

there will be other 19 workers for initialization. I don't put screesnshots of these here. Now I will paste the screenshots of query for domain.

Query for Domain

Baidu

```
> Frame 370: 533 bytes on wire (4264 bits), 533 bytes captured (4264 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 199.7.83.42, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49714
v Domain Name System (response)
    Transaction ID: 0x3770
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 13
    Additional RRs: 14
  v Queries
    > www.baidu.com: type A, class IN
  v Authoritative nameservers
    > com: type NS, class IN, ns j.gtld-servers.net
    > com: type NS, class IN, ns c.gtld-servers.net
    > com: type NS, class IN, ns g.gtld-servers.net
    > com: type NS, class IN, ns e.gtld-servers.net
    > com: type NS, class IN, ns m.gtld-servers.net
    > com: type NS, class IN, ns h.gtld-servers.net
    > com: type NS, class IN, ns l.gtld-servers.net
    > com: type NS, class IN, ns a.gtld-servers.net
    > com: type NS, class IN, ns b.gtld-servers.net
    > com: type NS, class IN, ns i.gtld-servers.net
    > com: type NS, class IN, ns d.gtld-servers.net
    > com: type NS, class IN, ns f.gtld-servers.net
    > com: type NS, class IN, ns k.gtld-servers.net
  v Additional records
    > a.gtld-servers.net: type A, class IN, addr 192.5.6.30
    > b.gtld-servers.net: type A, class IN, addr 192.33.14.30
    > c.gtld-servers.net: type A, class IN, addr 192.26.92.30
    > d.gtld-servers.net: type A, class IN, addr 192.31.80.30
    > e.gtld-servers.net: type A, class IN, addr 192.12.94.30
    > f.gtld-servers.net: type A, class IN, addr 192.35.51.30
    > g.gtld-servers.net: type A, class IN, addr 192.42.93.30
    > h.gtld-servers.net: type A, class IN, addr 192.54.112.30
    > i.gtld-servers.net: type A, class IN, addr 192.43.172.30
    > j.gtld-servers.net: type A, class IN, addr 192.48.79.30
    > k.gtld-servers.net: type A, class IN, addr 192.52.178.30
    > l.gtld-servers.net: type A, class IN, addr 192.41.162.30
    > m.gtld-servers.net: type A, class IN, addr 192.55.83.30
    > a.gtld-servers.net: type AAAA, class IN, addr 2001:503:a83e::2:30
    [Request In: 363]
    [Time: 0.025484000 seconds]
```

```
> Frame 395: 387 bytes on wire (3096 bits), 387 bytes captured (3096 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 192.5.6.30, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49722
v Domain Name System (response)
    Transaction ID: 0x137c
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 5
    Additional RRs: 11
  v Queries
    > www.baidu.com: type A, class IN
  v Authoritative nameservers
    > baidu.com: type NS, class IN, ns ns2.baidu.com
    > baidu.com: type NS, class IN, ns ns3.baidu.com
    > baidu.com: type NS, class IN, ns ns4.baidu.com
    > baidu.com: type NS, class IN, ns ns1.baidu.com
    > baidu.com: type NS, class IN, ns ns7.baidu.com
  v Additional records
    > ns2.baidu.com: type A, class IN, addr 220.181.33.31
    > ns2.baidu.com: type AAAA, class IN, addr 240e:940:603:4:0:ff:b01b:589a
    > ns3.baidu.com: type A, class IN, addr 153.3.238.93
    > ns3.baidu.com: type A, class IN, addr 36.155.132.78
    > ns4.baidu.com: type A, class IN, addr 111.45.3.226
    > ns4.baidu.com: type A, class IN, addr 14.215.178.80
    > ns1.baidu.com: type A, class IN, addr 110.242.68.134
    > ns1.baidu.com: type AAAA, class IN, addr 240e:bf:b801:1002:0:ff:b024:26de
    > ns7.baidu.com: type A, class IN, addr 180.76.76.92
    > ns7.baidu.com: type AAAA, class IN, addr 240e:940:603:4:0:ff:b01b:589a
    > ns7.baidu.com: type AAAA, class IN, addr 240e:bf:b801:1002:0:ff:b024:26de
    [Request In: 371]
    [Time: 0.250401000 seconds]
```

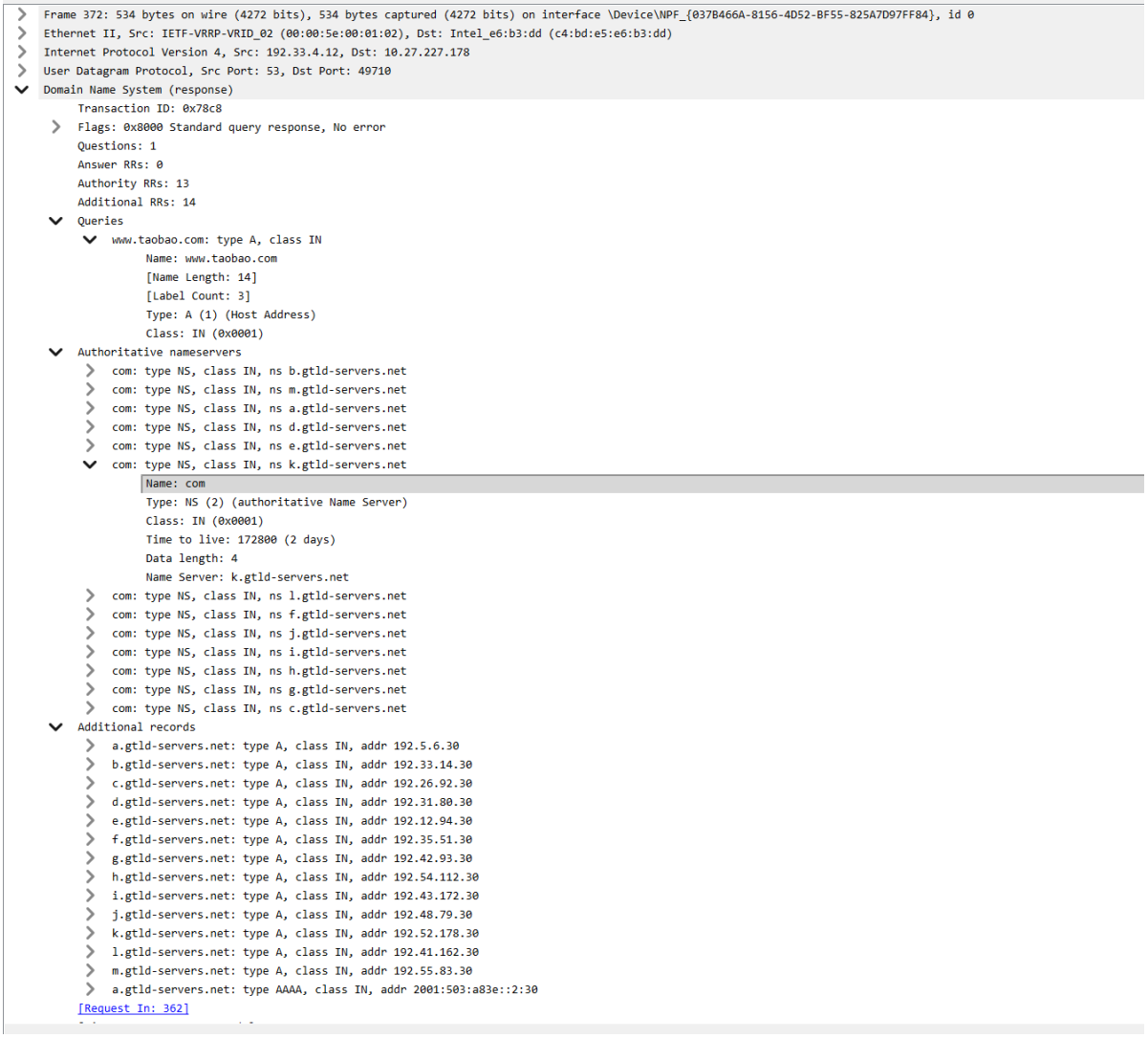
```
Frame 402: 103 bytes on wire (824 bits), 103 bytes captured (824 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 220.181.33.31, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49732
Domain Name System (response)
    Transaction ID: 0xadb1
    Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 1
    Authority RRs: 0
    Additional RRs: 0
    Queries
        www.baidu.com: type A, class IN
            Name: www.baidu.com
            [Name Length: 13]
            [Label Count: 3]
            Type: A (1) (Host Address)
            Class: IN (0x0001)
    Answers
        www.baidu.com: type CNAME, class IN, cname www.a.shifen.com
            Name: www.baidu.com
            Type: CNAME (5) (Canonical NAME for an alias)
            Class: IN (0x0001)
            Time to live: 1200 (20 minutes)
            Data length: 18
            CNAME: www.a.shifen.com
    [Request In: 396]
    [Time: 0.046827000 seconds]
```

```
Frame 411: 536 bytes on wire (4288 bits), 536 bytes captured (4288 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 199.7.83.42, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49735
Domain Name System (response)
    Transaction ID: 0xf82d
    Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 13
    Additional RRs: 14
    Queries
        www.a.shifen.com: type A, class IN
            Name: www.a.shifen.com
            [Name Length: 16]
            [Label Count: 4]
            Type: A (1) (Host Address)
            Class: IN (0x0001)
    Authoritative nameservers
        com: type NS, class IN, ns a.gtld-servers.net
        com: type NS, class IN, ns j.gtld-servers.net
        com: type NS, class IN, ns i.gtld-servers.net
        com: type NS, class IN, ns l.gtld-servers.net
        com: type NS, class IN, ns d.gtld-servers.net
        com: type NS, class IN, ns e.gtld-servers.net
        com: type NS, class IN, ns f.gtld-servers.net
        com: type NS, class IN, ns m.gtld-servers.net
        com: type NS, class IN, ns h.gtld-servers.net
        com: type NS, class IN, ns g.gtld-servers.net
        com: type NS, class IN, ns c.gtld-servers.net
        com: type NS, class IN, ns b.gtld-servers.net
        com: type NS, class IN, ns k.gtld-servers.net
    Additional records
        a.gtld-servers.net: type A, class IN, addr 192.5.6.30
        b.gtld-servers.net: type A, class IN, addr 192.33.14.30
        c.gtld-servers.net: type A, class IN, addr 192.26.92.30
        d.gtld-servers.net: type A, class IN, addr 192.31.80.30
        e.gtld-servers.net: type A, class IN, addr 192.12.94.30
        f.gtld-servers.net: type A, class IN, addr 192.35.51.30
        g.gtld-servers.net: type A, class IN, addr 192.42.93.30
        h.gtld-servers.net: type A, class IN, addr 192.54.112.30
        i.gtld-servers.net: type A, class IN, addr 192.43.172.30
        j.gtld-servers.net: type A, class IN, addr 192.48.79.30
        k.gtld-servers.net: type A, class IN, addr 192.52.178.30
        l.gtld-servers.net: type A, class IN, addr 192.41.162.30
        m.gtld-servers.net: type A, class IN, addr 192.55.83.30
        a.gtld-servers.net: type AAAA, class IN, addr 2001:503:a83e::2:30
    [Request In: 403]
    [Time: 0.033757000 seconds]
```

```
> Frame 435: 334 bytes on wire (2672 bits), 334 bytes captured (2672 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 110.242.68.134, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49742
v Domain Name System (response)
    Transaction ID: 0x08fe
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 5
    Additional RRs: 9
  v Queries
    > www.a.shifen.com: type A, class IN
  v Authoritative nameservers
    > a.shifen.com: type NS, class IN, ns ns3.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns4.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns5.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns1.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns2.a.shifen.com
  v Additional records
    > ns1.a.shifen.com: type A, class IN, addr 110.242.68.42
    > ns2.a.shifen.com: type A, class IN, addr 220.181.33.32
    > ns3.a.shifen.com: type A, class IN, addr 153.3.238.162
    > ns3.a.shifen.com: type A, class IN, addr 36.155.132.12
    > ns4.a.shifen.com: type A, class IN, addr 14.215.177.229
    > ns4.a.shifen.com: type A, class IN, addr 111.20.4.28
    > ns5.a.shifen.com: type A, class IN, addr 180.76.76.95
    > ns5.a.shifen.com: type AAAA, class IN, addr 240e:bf:b801:1006:0:ff:b04f:346b
    > ns5.a.shifen.com: type AAAA, class IN, addr 240e:940:603:a:0:ff:b08d:239d
    [Request In: 429]
    [Time: 0.067285000 seconds]
```

```
> Frame 440: 366 bytes on wire (2928 bits), 366 bytes captured (2928 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 110.242.68.42, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49744
v Domain Name System (response)
    Transaction ID: 0x5c81
  > Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 2
    Authority RRs: 5
    Additional RRs: 9
  v Queries
    > www.a.shifen.com: type A, class IN
  v Answers
    > www.a.shifen.com: type A, class IN, addr 182.61.200.108
    > www.a.shifen.com: type A, class IN, addr 182.61.200.110
  v Authoritative nameservers
    > a.shifen.com: type NS, class IN, ns ns1.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns2.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns3.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns4.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns5.a.shifen.com
  v Additional records
    > ns1.a.shifen.com: type A, class IN, addr 110.242.68.42
    > ns2.a.shifen.com: type A, class IN, addr 220.181.33.32
    > ns3.a.shifen.com: type A, class IN, addr 36.155.132.12
    > ns3.a.shifen.com: type A, class IN, addr 153.3.238.162
    > ns4.a.shifen.com: type A, class IN, addr 14.215.177.229
    > ns4.a.shifen.com: type A, class IN, addr 111.20.4.28
    > ns5.a.shifen.com: type A, class IN, addr 180.76.76.95
    > ns5.a.shifen.com: type AAAA, class IN, addr 240e:bf:b801:1006:0:ff:b04f:346b
    > ns5.a.shifen.com: type AAAA, class IN, addr 240e:940:603:a:0:ff:b08d:239d
    [Request In: 436]
    [Time: 0.059012000 seconds]
```

Taobao


Frame 372: 534 bytes on wire (4272 bits), 534 bytes captured (4272 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 192.33.4.12, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49710
Domain Name System (response)
Transaction ID: 0x78c8
Flags: 0x8000 Standard query response, No error
Questions: 1
Answer RRs: 0
Authority RRs: 13
Additional RRs: 14
Queries
www.taobao.com: type A, class IN
Name: www.taobao.com
[Name Length: 14]
[Label Count: 3]
Type: A (1) (Host Address)
Class: IN (0x0001)
Authoritative nameservers
com: type NS, class IN, ns b.gtld-servers.net
com: type NS, class IN, ns m.gtld-servers.net
com: type NS, class IN, ns a.gtld-servers.net
com: type NS, class IN, ns d.gtld-servers.net
com: type NS, class IN, ns e.gtld-servers.net
com: type NS, class IN, ns k.gtld-servers.net
Name: com
Type: NS (2) (authoritative Name Server)
Class: IN (0x0001)
Time to live: 172800 (2 days)
Data length: 4
Name Server: k.gtld-servers.net
com: type NS, class IN, ns l.gtld-servers.net
com: type NS, class IN, ns f.gtld-servers.net
com: type NS, class IN, ns j.gtld-servers.net
com: type NS, class IN, ns i.gtld-servers.net
com: type NS, class IN, ns h.gtld-servers.net
com: type NS, class IN, ns g.gtld-servers.net
com: type NS, class IN, ns c.gtld-servers.net
Additional records
a.gtld-servers.net: type A, class IN, addr 192.5.6.30
b.gtld-servers.net: type A, class IN, addr 192.33.14.30
c.gtld-servers.net: type A, class IN, addr 192.26.92.30
d.gtld-servers.net: type A, class IN, addr 192.31.80.30
e.gtld-servers.net: type A, class IN, addr 192.12.94.30
f.gtld-servers.net: type A, class IN, addr 192.35.51.30
g.gtld-servers.net: type A, class IN, addr 192.42.93.30
h.gtld-servers.net: type A, class IN, addr 192.54.112.30
i.gtld-servers.net: type A, class IN, addr 192.43.172.30
j.gtld-servers.net: type A, class IN, addr 192.48.79.30
k.gtld-servers.net: type A, class IN, addr 192.52.178.30
l.gtld-servers.net: type A, class IN, addr 192.41.162.30
m.gtld-servers.net: type A, class IN, addr 192.55.83.30
a.gtld-servers.net: type AAAA, class IN, addr 2001:503:a83e::2:30
[Request In: 362]

```
> Frame 394: 450 bytes on wire (3600 bits), 450 bytes captured (3600 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 192.5.6.30, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49723
v Domain Name System (response)
    Transaction ID: 0xb0b6
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 4
    Additional RRs: 16
  v Queries
    v www.taobao.com: type A, class IN
        Name: www.taobao.com
        [Name Length: 14]
        [Label Count: 3]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Authoritative nameservers
    > taobao.com: type NS, class IN, ns ns4.taobao.com
    > taobao.com: type NS, class IN, ns ns5.taobao.com
    > taobao.com: type NS, class IN, ns ns6.taobao.com
    > taobao.com: type NS, class IN, ns ns7.taobao.com
  v Additional records
    > ns4.taobao.com: type AAAA, class IN, addr 2401:b180:4100::4
    > ns4.taobao.com: type A, class IN, addr 47.241.207.13
    > ns4.taobao.com: type A, class IN, addr 47.241.207.15
    > ns4.taobao.com: type A, class IN, addr 47.88.74.33
    > ns4.taobao.com: type A, class IN, addr 47.88.74.35
    > ns5.taobao.com: type A, class IN, addr 140.205.122.33
    > ns5.taobao.com: type A, class IN, addr 140.205.122.34
    > ns5.taobao.com: type AAAA, class IN, addr 2401:b180:4100::5
    > ns6.taobao.com: type A, class IN, addr 140.205.122.35
    > ns6.taobao.com: type A, class IN, addr 140.205.122.36
    > ns6.taobao.com: type AAAA, class IN, addr 2401:b180:4100::6
    > ns7.taobao.com: type A, class IN, addr 106.11.35.25
    > ns7.taobao.com: type A, class IN, addr 106.11.35.26
    > ns7.taobao.com: type A, class IN, addr 106.11.41.149
    > ns7.taobao.com: type A, class IN, addr 106.11.41.150
    > ns7.taobao.com: type AAAA, class IN, addr 2401:b180:4100::7
    [Request In: 373]
    [Time: 0.248405000 seconds]
```

```
> Frame 413: 122 bytes on wire (976 bits), 122 bytes captured (976 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 47.241.207.13, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49731
v Domain Name System (response)
    Transaction ID: 0x16f3
  > Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 1
    Authority RRs: 0
    Additional RRs: 0
  v Queries
    v www.taobao.com: type A, class IN
        Name: www.taobao.com
        [Name Length: 14]
        [Label Count: 3]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Answers
    v www.taobao.com: type CNAME, class IN, cname www.taobao.com.danuoyi.tbcache.com
        Name: www.taobao.com
        Type: CNAME (5) (Canonical NAME for an alias)
        Class: IN (0x0001)
        Time to live: 600 (10 minutes)
        Data length: 36
        CNAME: www.taobao.com.danuoyi.tbcache.com
    [Request In: 397]
    [Time: 0.087388000 seconds]
```

```
> Frame 417: 554 bytes on wire (4432 bits), 554 bytes captured (4432 bits) on interface \Device\NPF_{037B466A-8156-4[
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 192.33.4.12, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49738
v Domain Name System (response)
    Transaction ID: 0x59ea
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 13
    Additional RRs: 14
  v Queries
    > www.taobao.com.danuoyi.tbcache.com: type A, class IN
  v Authoritative nameservers
    > com: type NS, class IN, ns k.gtld-servers.net
    > com: type NS, class IN, ns h.gtld-servers.net
    > com: type NS, class IN, ns d.gtld-servers.net
    > com: type NS, class IN, ns l.gtld-servers.net
    > com: type NS, class IN, ns i.gtld-servers.net
    > com: type NS, class IN, ns g.gtld-servers.net
    > com: type NS, class IN, ns f.gtld-servers.net
    > com: type NS, class IN, ns b.gtld-servers.net
    > com: type NS, class IN, ns a.gtld-servers.net
    > com: type NS, class IN, ns j.gtld-servers.net
    > com: type NS, class IN, ns c.gtld-servers.net
    > com: type NS, class IN, ns e.gtld-servers.net
    > com: type NS, class IN, ns m.gtld-servers.net
  v Additional records
    > a.gtld-servers.net: type A, class IN, addr 192.5.6.30
    > b.gtld-servers.net: type A, class IN, addr 192.33.14.30
    > c.gtld-servers.net: type A, class IN, addr 192.26.92.30
    > d.gtld-servers.net: type A, class IN, addr 192.31.80.30
    > e.gtld-servers.net: type A, class IN, addr 192.12.94.30
    > f.gtld-servers.net: type A, class IN, addr 192.35.51.30
    > g.gtld-servers.net: type A, class IN, addr 192.42.93.30
    > h.gtld-servers.net: type A, class IN, addr 192.54.112.30
    > i.gtld-servers.net: type A, class IN, addr 192.43.172.30
    > j.gtld-servers.net: type A, class IN, addr 192.48.79.30
    > k.gtld-servers.net: type A, class IN, addr 192.52.178.30
    > l.gtld-servers.net: type A, class IN, addr 192.41.162.30
    > m.gtld-servers.net: type A, class IN, addr 192.55.83.30
    > a.gtld-servers.net: type AAAA, class IN, addr 2001:503:a83e::2:30
    [Request In: 414]
    [Time: 0.030676000 seconds]
```

```
> Frame 433: 477 bytes on wire (3816 bits), 477 bytes captured (3816 bits) on interface \Device\NPF_{037B466A-8156-4
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 192.5.6.30, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49740
v Domain Name System (response)
    Transaction ID: 0x7a1d
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 4
    Additional RRs: 16
  v Queries
    > www.taobao.com.danuoyi.tbcache.com: type A, class IN
  v Authoritative nameservers
    > tbcache.com: type NS, class IN, ns ns4.taobao.com
    > tbcache.com: type NS, class IN, ns ns5.taobao.com
    > tbcache.com: type NS, class IN, ns ns6.taobao.com
    > tbcache.com: type NS, class IN, ns ns7.taobao.com
  v Additional records
    > ns4.taobao.com: type AAAA, class IN, addr 2401:b180:4100::4
    > ns4.taobao.com: type A, class IN, addr 47.241.207.13
    > ns4.taobao.com: type A, class IN, addr 47.241.207.15
    > ns4.taobao.com: type A, class IN, addr 47.88.74.33
    > ns4.taobao.com: type A, class IN, addr 47.88.74.35
    > ns5.taobao.com: type A, class IN, addr 140.205.122.33
    > ns5.taobao.com: type A, class IN, addr 140.205.122.34
    > ns5.taobao.com: type AAAA, class IN, addr 2401:b180:4100::5
    > ns6.taobao.com: type A, class IN, addr 140.205.122.35
    > ns6.taobao.com: type A, class IN, addr 140.205.122.36
    > ns6.taobao.com: type AAAA, class IN, addr 2401:b180:4100::6
    > ns7.taobao.com: type A, class IN, addr 106.11.35.25
    > ns7.taobao.com: type A, class IN, addr 106.11.35.26
    > ns7.taobao.com: type A, class IN, addr 106.11.41.149
    > ns7.taobao.com: type A, class IN, addr 106.11.41.150
    > ns7.taobao.com: type AAAA, class IN, addr 2401:b180:4100::7
    [Request In: 418]
    [Time: 0.261370000 seconds]
```

```
> Frame 443: 406 bytes on wire (3248 bits), 406 bytes captured (3248 bits) on interface \Device\NPF_{037B466A-8156-4
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 47.241.207.13, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49743
v Domain Name System (response)
    Transaction ID: 0x68b0
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 6
    Additional RRs: 6
  v Queries
    > www.taobao.com.danuoyi.tbcache.com: type A, class IN
  v Authoritative nameservers
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins4.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins5.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins7.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins8.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins6.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins9.tbcache.com
  v Additional records
    > danuoyins4.tbcache.com: type A, class IN, addr 118.178.223.202
    > danuoyins5.tbcache.com: type A, class IN, addr 205.204.111.111
    > danuoyins7.tbcache.com: type A, class IN, addr 8.134.229.26
    > danuoyins8.tbcache.com: type A, class IN, addr 203.107.13.144
    > danuoyins6.tbcache.com: type A, class IN, addr 8.137.142.54
    > danuoyins9.tbcache.com: type A, class IN, addr 8.145.148.202
    [Request In: 434]
    [Time: 0.106034000 seconds]
```

```
> Frame 445: 276 bytes on wire (2208 bits), 276 bytes captured (2208 bits) on interface \Device\NPF_{037B466A-8156-4D
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 118.178.223.202, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49745
v Domain Name System (response)
    Transaction ID: 0xec14
  > Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 2
    Authority RRs: 6
    Additional RRs: 0
  v Queries
    > www.taobao.com.danuoyi.tbcache.com: type A, class IN
  v Answers
    > www.taobao.com.danuoyi.tbcache.com: type A, class IN, addr 222.192.186.122
    > www.taobao.com.danuoyi.tbcache.com: type A, class IN, addr 222.192.186.120
  v Authoritative nameservers
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins4.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins5.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins6.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins7.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins8.tbcache.com
    > danuoyi.tbcache.com: type NS, class IN, ns danuoyins9.tbcache.com
    [Request In: 444]
    [Time: 0.036122000 seconds]
```

Tsinghua

```
> Frame 378: 430 bytes on wire (3440 bits), 430 bytes captured (3440 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 170.247.170.2, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49716
v Domain Name System (response)
    Transaction ID: 0xff26
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 6
    Additional RRs: 11
  v Queries
    v www.tsinghua.edu.cn: type A, class IN
        Name: www.tsinghua.edu.cn
        [Name Length: 19]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Authoritative nameservers
    > cn: type NS, class IN, ns a.dns.cn
    > cn: type NS, class IN, ns d.dns.cn
    > cn: type NS, class IN, ns e.dns.cn
    > cn: type NS, class IN, ns b.dns.cn
    > cn: type NS, class IN, ns c.dns.cn
    > cn: type NS, class IN, ns ns.cernet.net
  v Additional records
    > ns.cernet.net: type A, class IN, addr 202.112.0.44
    > e.dns.cn: type A, class IN, addr 203.119.29.1
    > d.dns.cn: type A, class IN, addr 203.119.28.1
    > c.dns.cn: type A, class IN, addr 203.119.27.1
    > b.dns.cn: type A, class IN, addr 203.119.26.1
    > a.dns.cn: type A, class IN, addr 203.119.25.1
    > e.dns.cn: type AAAA, class IN, addr 2001:dc7:3::1
    > d.dns.cn: type AAAA, class IN, addr 2001:dc7:1000::1
    > c.dns.cn: type AAAA, class IN, addr 2001:dc7:2::1
    > b.dns.cn: type AAAA, class IN, addr 2001:dc7:1::1
    > a.dns.cn: type AAAA, class IN, addr 2001:dc7::1
    [Request In: 364]
    [Time: 0.072441000 seconds]
```

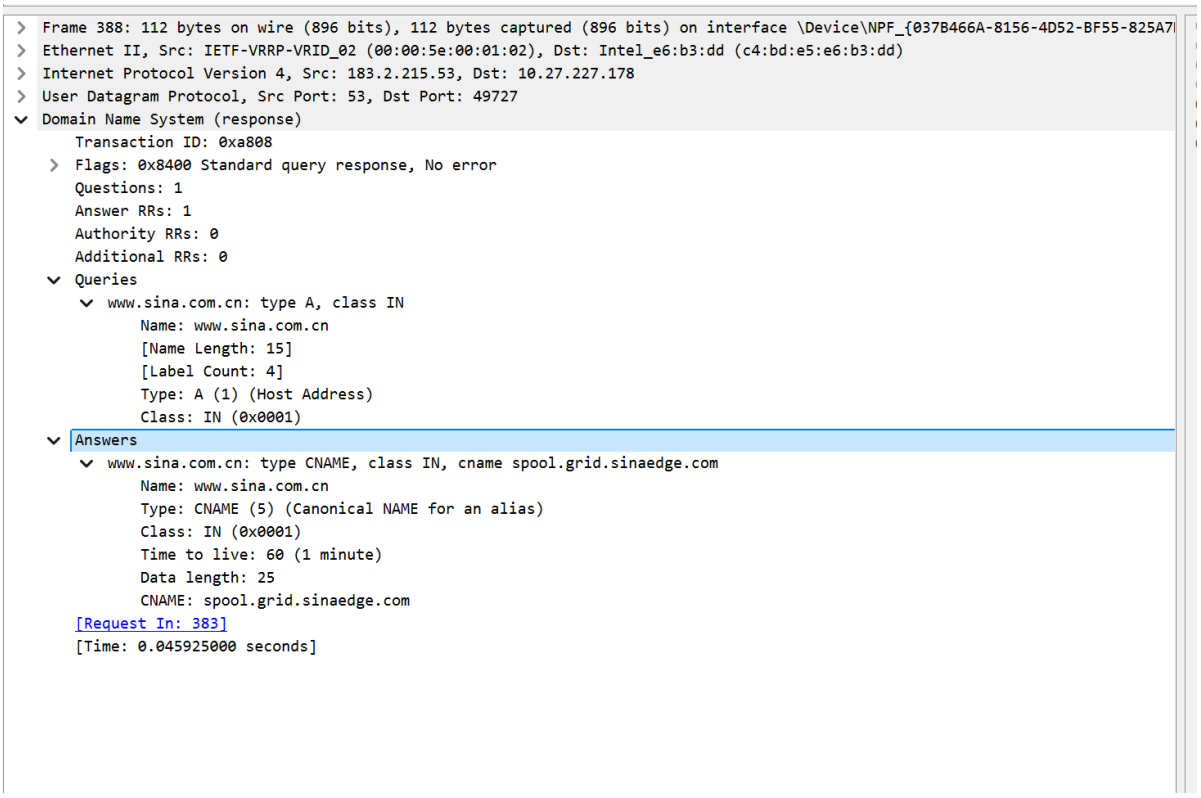
```
> Frame 384: 337 bytes on wire (2696 bits), 337 bytes captured (2696 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 202.112.0.44, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49726
v Domain Name System (response)
    Transaction ID: 0xb03f
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 6
    Additional RRs: 6
  v Queries
    v www.tsinghua.edu.cn: type A, class IN
        Name: www.tsinghua.edu.cn
        [Name Length: 19]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Authoritative nameservers
    > edu.cn: type NS, class IN, ns ns4.cernet.net
    > edu.cn: type NS, class IN, ns dns3.edu.cn
    > edu.cn: type NS, class IN, ns dns2.edu.cn
    > edu.cn: type NS, class IN, ns ns2.cernet.net
    > edu.cn: type NS, class IN, ns dns.edu.cn
    > edu.cn: type NS, class IN, ns ns5.cernet.net
  v Additional records
    > dns3.edu.cn: type A, class IN, addr 101.4.62.35
    > dns2.edu.cn: type A, class IN, addr 202.112.0.13
    > dns.edu.cn: type A, class IN, addr 202.38.109.35
    > dns3.edu.cn: type AAAA, class IN, addr 2001:250:62::35
    > dns2.edu.cn: type AAAA, class IN, addr 2001:da8:1:100::13
    > dns.edu.cn: type AAAA, class IN, addr 2001:250:c006::35
    [Request In: 379]
    [Time: 0.050321000 seconds]
```

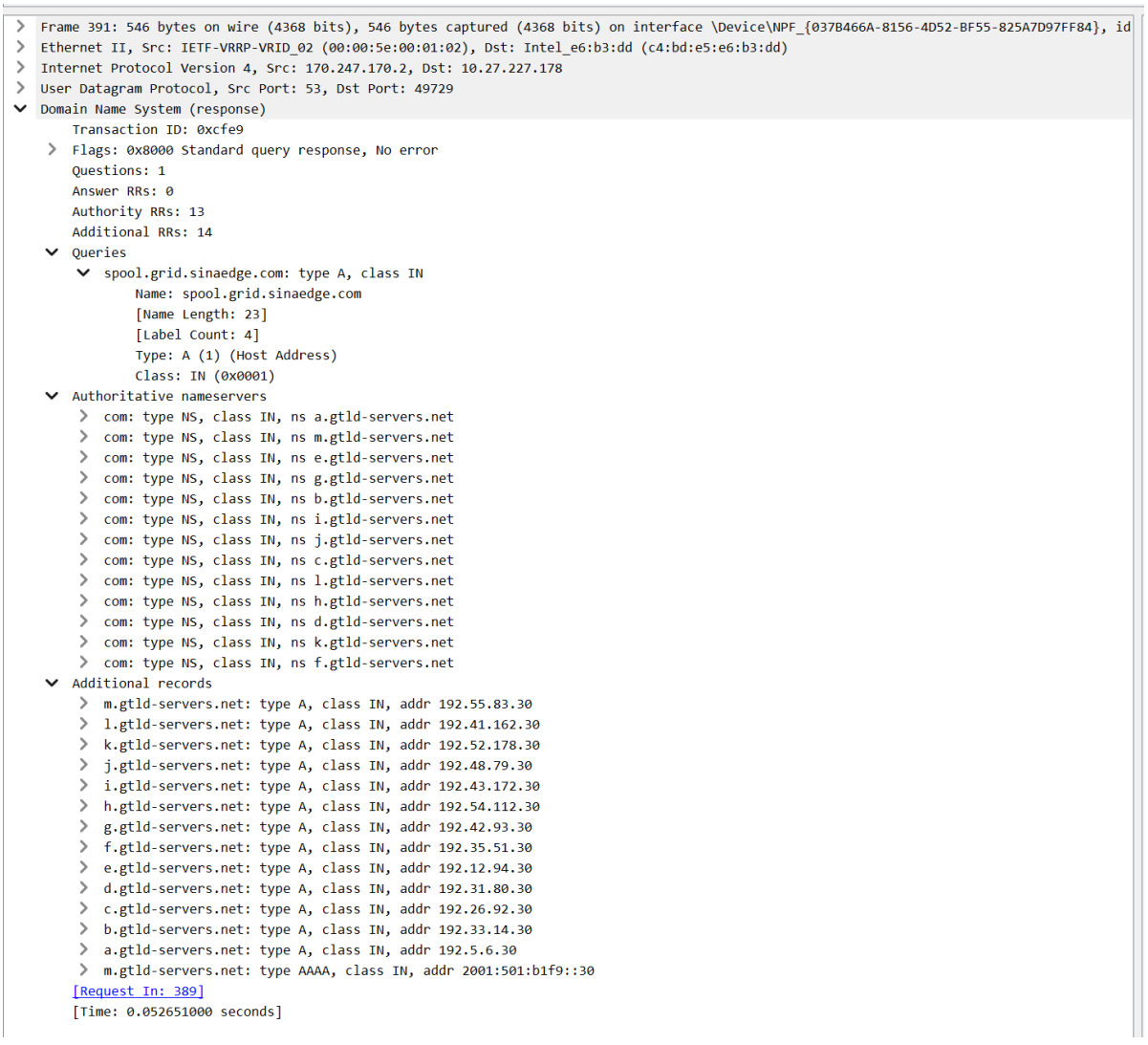
```
> Frame 390: 263 bytes on wire (2104 bits), 263 bytes captured (2104 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 101.4.62.35, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49728
v Domain Name System (response)
    Transaction ID: 0xe33e
  > Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 1
    Authority RRs: 4
    Additional RRs: 4
  v Queries
    v www.tsinghua.edu.cn: type A, class IN
        Name: www.tsinghua.edu.cn
        [Name Length: 19]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Answers
    > www.tsinghua.edu.cn: type A, class IN, addr 101.6.15.66
  v Authoritative nameservers
    > tsinghua.edu.cn: type NS, class IN, ns dns.tsinghua.edu.cn
    > tsinghua.edu.cn: type NS, class IN, ns dns2.tsinghua.edu.cn
    > tsinghua.edu.cn: type NS, class IN, ns dns.edu.cn
    > tsinghua.edu.cn: type NS, class IN, ns dns2.edu.cn
  v Additional records
    > dns.tsinghua.edu.cn: type A, class IN, addr 166.111.8.30
    > dns2.tsinghua.edu.cn: type A, class IN, addr 166.111.8.31
    > dns.tsinghua.edu.cn: type AAAA, class IN, addr 2402:f000:1:801::8:30
    > dns2.tsinghua.edu.cn: type AAAA, class IN, addr 2402:f000:1:801::8:31
    [Request In: 385]
    [Time: 0.040630000 seconds]
```

Sina

```
> Frame 376: 426 bytes on wire (3408 bits), 426 bytes captured (3408 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 170.247.170.2, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49718
v Domain Name System (response)
    Transaction ID: 0x1c53
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 6
    Additional RRs: 11
  v Queries
    v www.sina.com.cn: type A, class IN
        Name: www.sina.com.cn
        [Name Length: 15]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Authoritative nameservers
    > cn: type NS, class IN, ns ns.cernet.net
    > cn: type NS, class IN, ns a.dns.cn
    > cn: type NS, class IN, ns b.dns.cn
    > cn: type NS, class IN, ns c.dns.cn
    > cn: type NS, class IN, ns d.dns.cn
    > cn: type NS, class IN, ns e.dns.cn
  v Additional records
    > ns.cernet.net: type A, class IN, addr 202.112.0.44
    > e.dns.cn: type A, class IN, addr 203.119.29.1
    > d.dns.cn: type A, class IN, addr 203.119.28.1
    > c.dns.cn: type A, class IN, addr 203.119.27.1
    > b.dns.cn: type A, class IN, addr 203.119.26.1
    > a.dns.cn: type A, class IN, addr 203.119.25.1
    > e.dns.cn: type AAAA, class IN, addr 2001:dc7:3::1
    > d.dns.cn: type AAAA, class IN, addr 2001:dc7:1000::1
    > c.dns.cn: type AAAA, class IN, addr 2001:dc7:2::1
    > b.dns.cn: type AAAA, class IN, addr 2001:dc7:1::1
    > a.dns.cn: type AAAA, class IN, addr 2001:dc7::1
    [Request In: 366]
    [Time: 0.056987000 seconds]
```

```
> Frame 382: 211 bytes on wire (1688 bits), 211 bytes captured (1688 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 202.112.0.44, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49725
v Domain Name System (response)
    Transaction ID: 0x900f
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 4
    Additional RRs: 4
  v Queries
    v www.sina.com.cn: type A, class IN
        Name: www.sina.com.cn
        [Name Length: 15]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Authoritative nameservers
    > sina.com.cn: type NS, class IN, ns ns3.sina.com.cn
    > sina.com.cn: type NS, class IN, ns ns2.sina.com.cn
    > sina.com.cn: type NS, class IN, ns ns1.sina.com.cn
    > sina.com.cn: type NS, class IN, ns ns4.sina.com.cn
  v Additional records
    > ns4.sina.com.cn: type A, class IN, addr 183.2.215.53
    > ns3.sina.com.cn: type A, class IN, addr 123.125.29.99
    > ns2.sina.com.cn: type A, class IN, addr 180.149.138.199
    > ns1.sina.com.cn: type A, class IN, addr 221.179.193.14
    [Request In: 377]
    [Time: 0.056228000 seconds]
```


Frame 388: 112 bytes on wire (896 bits), 112 bytes captured (896 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 183.2.215.53, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49727
Domain Name System (response)
Transaction ID: 0xa808
Flags: 0x8400 Standard query response, No error
Questions: 1
Answer RRs: 1
Authority RRs: 0
Additional RRs: 0
Queries
www.sina.com.cn: type A, class IN
Name: www.sina.com.cn
[Name Length: 15]
[Label Count: 4]
Type: A (1) (Host Address)
Class: IN (0x0001)
Answers
www.sina.com.cn: type CNAME, class IN, cname spool.grid.sinaedge.com
Name: www.sina.com.cn
Type: CNAME (5) (Canonical NAME for an alias)
Class: IN (0x0001)
Time to live: 60 (1 minute)
Data length: 25
CNAME: spool.grid.sinaedge.com
[Request In: 383]
[Time: 0.045925000 seconds]


Frame 391: 546 bytes on wire (4368 bits), 546 bytes captured (4368 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 170.247.170.2, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49729
Domain Name System (response)
Transaction ID: 0xcfe9
Flags: 0x8000 Standard query response, No error
Questions: 1
Answer RRs: 0
Authority RRs: 13
Additional RRs: 14
Queries
spool.grid.sinaedge.com: type A, class IN
Name: spool.grid.sinaedge.com
[Name Length: 23]
[Label Count: 4]
Type: A (1) (Host Address)
Class: IN (0x0001)
Authoritative nameservers
com: type NS, class IN, ns a.gtld-servers.net
com: type NS, class IN, ns m.gtld-servers.net
com: type NS, class IN, ns e.gtld-servers.net
com: type NS, class IN, ns g.gtld-servers.net
com: type NS, class IN, ns b.gtld-servers.net
com: type NS, class IN, ns i.gtld-servers.net
com: type NS, class IN, ns j.gtld-servers.net
com: type NS, class IN, ns c.gtld-servers.net
com: type NS, class IN, ns l.gtld-servers.net
com: type NS, class IN, ns h.gtld-servers.net
com: type NS, class IN, ns d.gtld-servers.net
com: type NS, class IN, ns k.gtld-servers.net
com: type NS, class IN, ns f.gtld-servers.net
Additional records
m.gtld-servers.net: type A, class IN, addr 192.55.83.30
l.gtld-servers.net: type A, class IN, addr 192.41.162.30
k.gtld-servers.net: type A, class IN, addr 192.52.178.30
j.gtld-servers.net: type A, class IN, addr 192.48.79.30
i.gtld-servers.net: type A, class IN, addr 192.43.172.30
h.gtld-servers.net: type A, class IN, addr 192.54.112.30
g.gtld-servers.net: type A, class IN, addr 192.42.93.30
f.gtld-servers.net: type A, class IN, addr 192.35.51.30
e.gtld-servers.net: type A, class IN, addr 192.12.94.30
d.gtld-servers.net: type A, class IN, addr 192.31.80.30
c.gtld-servers.net: type A, class IN, addr 192.26.92.30
b.gtld-servers.net: type A, class IN, addr 192.33.14.30
a.gtld-servers.net: type A, class IN, addr 192.5.6.30
m.gtld-servers.net: type AAAA, class IN, addr 2001:501:b1f9::30
[Request In: 389]
[Time: 0.052651000 seconds]

```
> Frame 404: 287 bytes on wire (2296 bits), 287 bytes captured (2296 bits) on interface \Device\NPF_{037B466A-8156-4D
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 192.55.83.30, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49730
v Domain Name System (response)
    Transaction ID: 0x2674
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 6
    Additional RRs: 6
  v Queries
    v spool.grid.sinaedge.com: type A, class IN
        Name: spool.grid.sinaedge.com
        [Name Length: 23]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Authoritative nameservers
    > sinaedge.com: type NS, class IN, ns ns1.sinaedge.com
    > sinaedge.com: type NS, class IN, ns ns2.sinaedge.com
    > sinaedge.com: type NS, class IN, ns ns3.sinaedge.com
    > sinaedge.com: type NS, class IN, ns ns4.sinaedge.com
    > sinaedge.com: type NS, class IN, ns ns5.sinaedge.com
    > sinaedge.com: type NS, class IN, ns ns6.sinaedge.com
  v Additional records
    > ns1.sinaedge.com: type A, class IN, addr 112.90.6.146
    > ns2.sinaedge.com: type A, class IN, addr 125.94.246.134
    > ns3.sinaedge.com: type A, class IN, addr 49.7.37.190
    > ns4.sinaedge.com: type A, class IN, addr 221.179.175.225
    > ns5.sinaedge.com: type A, class IN, addr 116.133.8.38
    > ns6.sinaedge.com: type A, class IN, addr 36.51.254.87
    [Request In: 392]
    [Time: 0.113620000 seconds]
```

```
> Frame 408: 99 bytes on wire (792 bits), 99 bytes captured (792 bits) on interface \Device\NPF_{037B466A-8156-4D52-8
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 112.90.6.146, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49736
v Domain Name System (response)
    Transaction ID: 0x0fdb
  > Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 1
    Authority RRs: 0
    Additional RRs: 0
  v Queries
    v spool.grid.sinaedge.com: type A, class IN
        Name: spool.grid.sinaedge.com
        [Name Length: 23]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Answers
    v spool.grid.sinaedge.com: type A, class IN, addr 121.194.5.14
        Name: spool.grid.sinaedge.com
        Type: A (1) (Host Address)
        Class: IN (0x0001)
        Time to live: 60 (1 minute)
        Data length: 4
        Address: 121.194.5.14
    [Request In: 405]
    [Time: 0.012985000 seconds]
```

BiliBili

```
> Frame 374: 536 bytes on wire (4288 bits), 536 bytes captured (4288 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 192.58.128.30, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49720
v Domain Name System (response)
    Transaction ID: 0x7fe2
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 13
    Additional RRs: 14
  v Queries
    v www.bilibili.com: type A, class IN
          Name: www.bilibili.com
          [Name Length: 16]
          [Label Count: 3]
          Type: A (1) (Host Address)
          Class: IN (0x0001)
  v Authoritative nameservers
    > com: type NS, class IN, ns g.gtld-servers.net
    > com: type NS, class IN, ns b.gtld-servers.net
    > com: type NS, class IN, ns c.gtld-servers.net
    > com: type NS, class IN, ns f.gtld-servers.net
    > com: type NS, class IN, ns e.gtld-servers.net
    > com: type NS, class IN, ns l.gtld-servers.net
    > com: type NS, class IN, ns a.gtld-servers.net
    > com: type NS, class IN, ns i.gtld-servers.net
    > com: type NS, class IN, ns k.gtld-servers.net
    > com: type NS, class IN, ns h.gtld-servers.net
    > com: type NS, class IN, ns m.gtld-servers.net
    > com: type NS, class IN, ns d.gtld-servers.net
    > com: type NS, class IN, ns j.gtld-servers.net
  v Additional records
    > a.gtld-servers.net: type A, class IN, addr 192.5.6.30
    > b.gtld-servers.net: type A, class IN, addr 192.33.14.30
    > c.gtld-servers.net: type A, class IN, addr 192.26.92.30
    > d.gtld-servers.net: type A, class IN, addr 192.31.80.30
    > e.gtld-servers.net: type A, class IN, addr 192.12.94.30
    > f.gtld-servers.net: type A, class IN, addr 192.35.51.30
    > g.gtld-servers.net: type A, class IN, addr 192.42.93.30
    > h.gtld-servers.net: type A, class IN, addr 192.54.112.30
    > i.gtld-servers.net: type A, class IN, addr 192.43.172.30
    > j.gtld-servers.net: type A, class IN, addr 192.48.79.30
    > k.gtld-servers.net: type A, class IN, addr 192.52.178.30
    > l.gtld-servers.net: type A, class IN, addr 192.41.162.30
    > m.gtld-servers.net: type A, class IN, addr 192.55.83.30
    v a.gtld-servers.net: type AAAA, class IN, addr 2001:503:a83e::2:30
          Name: a.gtld-servers.net
          Type: AAAA (28) (IP6 Address)
          Class: IN (0x0001)
          Time to live: 172800 (2 days)
          Data length: 16
          AAAA Address: 2001:503:a83e::2:30
    [Request In: 368]
    [Time: 0.041537000 seconds]
```

```
Frame 398: 462 bytes on wire (3696 bits), 462 bytes captured (3696 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 192.5.6.30, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49724
Domain Name System (response)
    Transaction ID: 0xb494
    Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 2
    Additional RRs: 20
    Queries
        www.bilibili.com: type A, class IN
            Name: www.bilibili.com
            [Name Length: 16]
            [Label Count: 3]
            Type: A (1) (Host Address)
            Class: IN (0x0001)
    Authoritative nameservers
        bilibili.com: type NS, class IN, ns ns3.dnsv5.com
            Name: bilibili.com
            Type: NS (2) (authoritative Name Server)
            Class: IN (0x0001)
            Time to live: 172800 (2 days)
            Data length: 12
            Name Server: ns3.dnsv5.com
        bilibili.com: type NS, class IN, ns ns4.dnsv5.com
            Name: bilibili.com
            Type: NS (2) (authoritative Name Server)
            Class: IN (0x0001)
            Time to live: 172800 (2 days)
            Data length: 6
            Name Server: ns4.dnsv5.com
    Additional records
        ns3.dnsv5.com: type A, class IN, addr 1.12.0.17
        ns3.dnsv5.com: type A, class IN, addr 1.12.0.18
        ns3.dnsv5.com: type A, class IN, addr 1.12.14.17
        ns3.dnsv5.com: type A, class IN, addr 1.12.14.18
        ns3.dnsv5.com: type A, class IN, addr 101.227.168.52
        ns3.dnsv5.com: type A, class IN, addr 108.136.87.44
        ns3.dnsv5.com: type A, class IN, addr 163.177.5.52
        ns3.dnsv5.com: type A, class IN, addr 220.196.136.52
        ns3.dnsv5.com: type AAAA, class IN, addr 2402:4e00:1470:2::f
        ns3.dnsv5.com: type A, class IN, addr 35.165.107.227
        ns4.dnsv5.com: type A, class IN, addr 1.12.0.16
        ns4.dnsv5.com: type A, class IN, addr 1.12.0.19
        ns4.dnsv5.com: type A, class IN, addr 1.12.14.16
        ns4.dnsv5.com: type A, class IN, addr 1.12.14.19
        ns4.dnsv5.com: type A, class IN, addr 112.80.181.106
        ns4.dnsv5.com: type A, class IN, addr 117.135.128.152
        ns4.dnsv5.com: type A, class IN, addr 124.64.205.152
        ns4.dnsv5.com: type A, class IN, addr 13.37.58.163
        ns4.dnsv5.com: type AAAA, class IN, addr 2402:4e00:111:fff::8
        ns4.dnsv5.com: type A, class IN, addr 49.7.107.152
    [Request In: 375]
    [Time: 0.241431000 seconds]
```

```
Frame 400: 107 bytes on wire (856 bits), 107 bytes captured (856 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 1.12.0.17, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49733
Domain Name System (response)
    Transaction ID: 0x99a9
    Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 1
    Authority RRs: 0
    Additional RRs: 0
    Queries
        www.bilibili.com: type A, class IN
            Name: www.bilibili.com
            [Name Length: 16]
            [Label Count: 3]
            Type: A (1) (Host Address)
            Class: IN (0x0001)
    Answers
        www.bilibili.com: type CNAME, class IN, cname gz.w.bilicdn1.com
            Name: www.bilibili.com
            Type: CNAME (5) (Canonical NAME for an alias)
            Class: IN (0x0001)
            Time to live: 300 (5 minutes)
            Data length: 19
            CNAME: gz.w.bilicdn1.com
    [Request In: 399]
    [Time: 0.036484000 seconds]
```

```
> Frame 415: 537 bytes on wire (4296 bits), 537 bytes captured (4296 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 192.58.128.30, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49734
v Domain Name System (response)
    Transaction ID: 0x9713
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 13
    Additional RRs: 14
  v Queries
    v gz.w.bilicdn1.com: type A, class IN
          Name: gz.w.bilicdn1.com
          [Name Length: 17]
          [Label Count: 4]
          Type: A (1) (Host Address)
          Class: IN (0x0001)
  v Authoritative nameservers
    > com: type NS, class IN, ns h.gtld-servers.net
    > com: type NS, class IN, ns e.gtld-servers.net
    > com: type NS, class IN, ns b.gtld-servers.net
    > com: type NS, class IN, ns j.gtld-servers.net
    > com: type NS, class IN, ns g.gtld-servers.net
    > com: type NS, class IN, ns k.gtld-servers.net
    > com: type NS, class IN, ns l.gtld-servers.net
    > com: type NS, class IN, ns f.gtld-servers.net
    > com: type NS, class IN, ns i.gtld-servers.net
    > com: type NS, class IN, ns c.gtld-servers.net
    > com: type NS, class IN, ns a.gtld-servers.net
    > com: type NS, class IN, ns d.gtld-servers.net
    > com: type NS, class IN, ns m.gtld-servers.net
  v Additional records
    > a.gtld-servers.net: type A, class IN, addr 192.5.6.30
    > b.gtld-servers.net: type A, class IN, addr 192.33.14.30
    > c.gtld-servers.net: type A, class IN, addr 192.26.92.30
    > d.gtld-servers.net: type A, class IN, addr 192.31.80.30
    > e.gtld-servers.net: type A, class IN, addr 192.12.94.30
    > f.gtld-servers.net: type A, class IN, addr 192.35.51.30
    > g.gtld-servers.net: type A, class IN, addr 192.42.93.30
    > h.gtld-servers.net: type A, class IN, addr 192.54.112.30
    > i.gtld-servers.net: type A, class IN, addr 192.43.172.30
    > j.gtld-servers.net: type A, class IN, addr 192.48.79.30
    > k.gtld-servers.net: type A, class IN, addr 192.52.178.30
    > l.gtld-servers.net: type A, class IN, addr 192.41.162.30
    > m.gtld-servers.net: type A, class IN, addr 192.55.83.30
    > a.gtld-servers.net: type AAAA, class IN, addr 2001:503:a83e::2:30
    [Request In: 401]
    [Time: 0.041133000 seconds]
```

```
Frame 426: 463 bytes on wire (3704 bits), 463 bytes captured (3704 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 192.5.6.30, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49739
Domain Name System (response)
    Transaction ID: 0xfe68
    Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 2
    Additional RRs: 20
  Queries
    gz.w.bilicdn1.com: type A, class IN
        Name: gz.w.bilicdn1.com
        [Name Length: 17]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  Authoritative nameservers
    bilicdn1.com: type NS, class IN, ns ns3.dnsv5.com
    bilicdn1.com: type NS, class IN, ns ns4.dnsv5.com
  Additional records
    ns3.dnsv5.com: type A, class IN, addr 1.12.0.17
    ns3.dnsv5.com: type A, class IN, addr 1.12.0.18
    ns3.dnsv5.com: type A, class IN, addr 1.12.14.17
    ns3.dnsv5.com: type A, class IN, addr 1.12.14.18
    ns3.dnsv5.com: type A, class IN, addr 101.227.168.52
    ns3.dnsv5.com: type A, class IN, addr 108.136.87.44
    ns3.dnsv5.com: type A, class IN, addr 163.177.5.52
    ns3.dnsv5.com: type A, class IN, addr 220.196.136.52
        Name: ns3.dnsv5.com
        Type: A (1) (Host Address)
        Class: IN (0x0001)
        Time to live: 172800 (2 days)
        Data length: 4
        Address: 220.196.136.52
    ns3.dnsv5.com: type AAAA, class IN, addr 2402:4e00:1470:2::f
    ns3.dnsv5.com: type A, class IN, addr 35.165.107.227
    ns4.dnsv5.com: type A, class IN, addr 1.12.0.16
    ns4.dnsv5.com: type A, class IN, addr 1.12.0.19
    ns4.dnsv5.com: type A, class IN, addr 1.12.14.16
    ns4.dnsv5.com: type A, class IN, addr 1.12.14.19
    ns4.dnsv5.com: type A, class IN, addr 112.80.181.106
    ns4.dnsv5.com: type A, class IN, addr 117.135.128.152
    ns4.dnsv5.com: type A, class IN, addr 124.64.205.152
    ns4.dnsv5.com: type A, class IN, addr 13.37.58.163
    ns4.dnsv5.com: type AAAA, class IN, addr 2402:4e00:111:fff::8
    ns4.dnsv5.com: type A, class IN, addr 49.7.107.152
  [Request In: 416]
  [Time: 0.222580000 seconds]
```

```
Frame 431: 173 bytes on wire (1384 bits), 173 bytes captured (1384 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825A7D97FF84}, id 0
Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
Internet Protocol Version 4, Src: 1.12.0.17, Dst: 10.27.227.178
User Datagram Protocol, Src Port: 53, Dst Port: 49741
Domain Name System (response)
    Transaction ID: 0x19b5
    Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 6
    Authority RRs: 0
    Additional RRs: 0
  Queries
    gz.w.bilicdn1.com: type A, class IN
        Name: gz.w.bilicdn1.com
        [Name Length: 17]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  Answers
    gz.w.bilicdn1.com: type A, class IN, addr 139.159.241.37
    gz.w.bilicdn1.com: type A, class IN, addr 139.159.246.60
    gz.w.bilicdn1.com: type A, class IN, addr 139.159.252.156
    gz.w.bilicdn1.com: type A, class IN, addr 8.134.32.222
    gz.w.bilicdn1.com: type A, class IN, addr 8.134.50.24
    gz.w.bilicdn1.com: type A, class IN, addr 8.134.64.214
  [Request In: 427]
  [Time: 0.034857000 seconds]
```

And for redirect and blocked domain, i captured using **Adaptar for loopback traffic capture.**

Google

```
> Frame 914: 80 bytes on wire (640 bits), 80 bytes captured (640 bits) on interface \Device\NPF_L…
> Null/Loopback
> Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
> User Datagram Protocol, Src Port: 5533, Dst Port: 52682
v Domain Name System (response)
    Transaction ID: 0x9f94
  > Flags: 0x8100 Standard query response, No error
    Questions: 1
    Answer RRs: 1
    Authority RRs: 0
    Additional RRs: 0
  v Queries
    v www.google.com: type A, class IN
        Name: www.google.com
        [Name Length: 14]
        [Label Count: 3]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Answers
    v www.google.com: type A, class IN, addr 127.0.0.1
        Name: www.google.com
        Type: A (1) (Host Address)
        Class: IN (0x0001)
        Time to live: 300 (5 minutes)
        Data length: 4
        Address: 127.0.0.1
    [Request In: 910]
    [Time: 0.001034000 seconds]
```

```
> Frame 428: 306 bytes on wire (2448 bits), 306 bytes captured (2448 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-8…
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 192.5.6.30, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49737
v Domain Name System (response)
    Transaction ID: 0xefd9
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 4
    Additional RRs: 8
  v Queries
    v www.a.shifen.com: type A, class IN
        Name: www.a.shifen.com
        [Name Length: 16]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Authoritative nameservers
    > shifen.com: type NS, class IN, ns dns.baidu.com
    > shifen.com: type NS, class IN, ns ns2.baidu.com
    > shifen.com: type NS, class IN, ns ns3.baidu.com
    > shifen.com: type NS, class IN, ns ns4.baidu.com
  v Additional records
    > dns.baidu.com: type A, class IN, addr 110.242.68.134
    > dns.baidu.com: type AAAA, class IN, addr 240e:bf:b801:1002:0:ff:b024:26de
    > ns2.baidu.com: type A, class IN, addr 220.181.33.31
    > ns2.baidu.com: type AAAA, class IN, addr 240e:940:603:4:0:ff:b01b:589a
    > ns3.baidu.com: type A, class IN, addr 153.3.238.93
    > ns3.baidu.com: type A, class IN, addr 36.155.132.78
    > ns4.baidu.com: type A, class IN, addr 111.45.3.226
    > ns4.baidu.com: type A, class IN, addr 14.215.178.80
    [Request In: 412]
    [Time: 0.236024000 seconds]
```

```
> Frame 435: 334 bytes on wire (2672 bits), 334 bytes captured (2672 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 110.242.68.134, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49742
v Domain Name System (response)
    Transaction ID: 0x08fe
  > Flags: 0x8000 Standard query response, No error
    Questions: 1
    Answer RRs: 0
    Authority RRs: 5
    Additional RRs: 9
  v Queries
    v www.a.shifen.com: type A, class IN
        Name: www.a.shifen.com
        [Name Length: 16]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Authoritative nameservers
    > a.shifen.com: type NS, class IN, ns ns3.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns4.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns5.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns1.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns2.a.shifen.com
  v Additional records
    > ns1.a.shifen.com: type A, class IN, addr 110.242.68.42
    > ns2.a.shifen.com: type A, class IN, addr 220.181.33.32
    > ns3.a.shifen.com: type A, class IN, addr 153.3.238.162
    > ns3.a.shifen.com: type A, class IN, addr 36.155.132.12
    > ns4.a.shifen.com: type A, class IN, addr 14.215.177.229
    > ns4.a.shifen.com: type A, class IN, addr 111.20.4.28
    > ns5.a.shifen.com: type A, class IN, addr 180.76.76.95
    > ns5.a.shifen.com: type AAAA, class IN, addr 240e:bf:b801:1006:0:ff:b04f:346b
    > ns5.a.shifen.com: type AAAA, class IN, addr 240e:940:603:a:0:ff:b08d:239d
    [Request In: 429]
    [Time: 0.067285000 seconds]
```

```
> Frame 440: 366 bytes on wire (2928 bits), 366 bytes captured (2928 bits) on interface \Device\NPF_{037B466A-8156-4D52-BF55-825
> Ethernet II, Src: IETF-VRRP-VRID_02 (00:00:5e:00:01:02), Dst: Intel_e6:b3:dd (c4:bd:e5:e6:b3:dd)
> Internet Protocol Version 4, Src: 110.242.68.42, Dst: 10.27.227.178
> User Datagram Protocol, Src Port: 53, Dst Port: 49744
v Domain Name System (response)
    Transaction ID: 0x5c81
  > Flags: 0x8400 Standard query response, No error
    Questions: 1
    Answer RRs: 2
    Authority RRs: 5
    Additional RRs: 9
  v Queries
    v www.a.shifen.com: type A, class IN
        Name: www.a.shifen.com
        [Name Length: 16]
        [Label Count: 4]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Answers
    > www.a.shifen.com: type A, class IN, addr 182.61.200.108
    > www.a.shifen.com: type A, class IN, addr 182.61.200.110
  v Authoritative nameservers
    > a.shifen.com: type NS, class IN, ns ns1.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns2.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns3.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns4.a.shifen.com
    > a.shifen.com: type NS, class IN, ns ns5.a.shifen.com
  v Additional records
    > ns1.a.shifen.com: type A, class IN, addr 110.242.68.42
    > ns2.a.shifen.com: type A, class IN, addr 220.181.33.32
    > ns3.a.shifen.com: type A, class IN, addr 36.155.132.12
    > ns3.a.shifen.com: type A, class IN, addr 153.3.238.162
    > ns4.a.shifen.com: type A, class IN, addr 14.215.177.229
    > ns4.a.shifen.com: type A, class IN, addr 111.20.4.28
    > ns5.a.shifen.com: type A, class IN, addr 180.76.76.95
    > ns5.a.shifen.com: type AAAA, class IN, addr 240e:bf:b801:1006:0:ff:b04f:346b
    > ns5.a.shifen.com: type AAAA, class IN, addr 240e:940:603:a:0:ff:b08d:239d
    [Request In: 436]
    [Time: 0.059012000 seconds]
```

Google Analytics

```
> Frame 915: 90 bytes on wire (720 bits), 90 bytes captured (720 bits) on interface \Device\NPF_Loc
> Null/Loopback
> Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
> User Datagram Protocol, Src Port: 5533, Dst Port: 52683
v Domain Name System (response)
    Transaction ID: 0xac42
  > Flags: 0x8100 Standard query response, No error
    Questions: 1
    Answer RRs: 1
    Authority RRs: 0
    Additional RRs: 0
  v Queries
    v www.google-analytics.com: type A, class IN
        Name: www.google-analytics.com
        [Name Length: 24]
        [Label Count: 3]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Answers
    v www.google-analytics.com: type A, class IN, addr 0.0.0.0
        Name: www.google-analytics.com
        Type: A (1) (Host Address)
        Class: IN (0x0001)
        Time to live: 300 (5 minutes)
        Data length: 4
        Address: 0.0.0.0
    [Request In: 911]
    [Time: 0.000895000 seconds]
```

Annoying tracker

```
> Frame 909: 117 bytes on wire (936 bits), 117 bytes captured (936 bits) on interface \Device\NPF_L
> Null/Loopback
> Internet Protocol Version 4, Src: 127.0.0.1, Dst: 127.0.0.1
> User Datagram Protocol, Src Port: 5533, Dst Port: 52680
v Domain Name System (response)
    Transaction ID: 0x3d20
  > Flags: 0x8105 Standard query response, Refused
    Questions: 1
    Answer RRs: 1
    Authority RRs: 0
    Additional RRs: 0
  v Queries
    v ads.annoying-tracker.com: type A, class IN
        Name: ads.annoying-tracker.com
        [Name Length: 24]
        [Label Count: 3]
        Type: A (1) (Host Address)
        Class: IN (0x0001)
  v Answers
    v ads.annoying-tracker.com: type TXT, class IN
        Name: ads.annoying-tracker.com
        Type: TXT (16) (Text strings)
        Class: IN (0x0001)
        Time to live: 0 (0 seconds)
        Data length: 31
        TXT Length: 30
        TXT: Blocked due to security policy
    [Request In: 908]
    [Time: 0.001013000 seconds]
```