Ethereal Lab: DNS

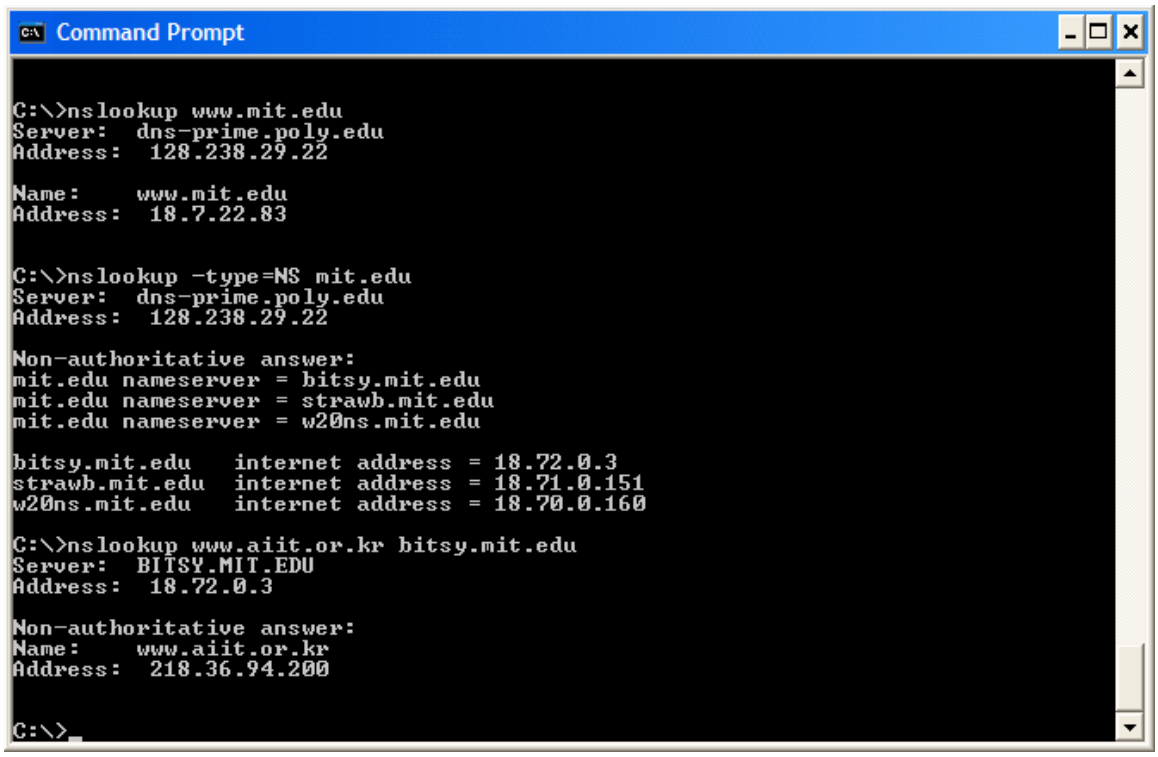
As described in Section 2.5 of the textbook, the Domain Name System (DNS) translates hostnames to IP addresses, fulfilling a critical role in the Internet infrastructure. In this lab, we'll take a closer look at the client side of DNS. Recall that the client's role in the DNS is relatively simple – a client sends a *query* to its local DNS server, and receives a *response* back. As shown in Figures 2.26 and 2.18 in the textbook, much can go on within the network, invisible to the DNS clients, as the hierarchical DNS servers communicate with each other to either recursively or iteratively resolve the client's DNS query. From the DNS client's standpoint, however, the protocol is quite simple – a query is formulated to the local DNS server and a response is received from that server.

Before beginning this lab, you'll probably want to review DNS by reading Section 2.5 of the text. In particular, you may want to review the material on **local DNS servers**, **DNS caching**, **DNS records and messages**, and the **TYPE field** in the DNS record.

1. nslookup

In this lab, we'll make use of the nslookup tool, which is available in most Linux/Unix and Microsoft platforms today. To run nslookup in Linux/Unix, you just type **nslookup** on the command line. To run it in Windows, open the Command Prompt and run nslookup on the command line. Read the man page for nslookup to learn about all of its functionalities.

In its most basic operation, the nslookup tool allows the host running the tool to query any specified DNS server for a DNS record. The queried DNS server can be a root DNS server, a top-level-domain DNS server, an authoritative DNS server, or an intermediate DNS server (see the textbook for definitions of these terms). To accomplish this task, nslookup sends a DNS query to the specified DNS server, receives a DNS reply from that same DNS server, and displays the result.



The above screenshot shows the results of three independent nslookup commands (displayed in the Windows Command Prompt). In this example, the client host is located on the campus of Polytechnic University in Brooklyn, where the default local DNS server is dns-prime.poly.edu. When running nslookup, if no DNS server is specified, then nslookup sends the query to the default DNS server, which in this case is dns-prime.poly.edu. Consider the first command:

```
nslookup www.mit.edu
```

In words, this command is saying “please send me the IP address for the host www.mit.edu”. As shown in the screenshot, the response from this command provides two pieces of information: (1) the name and IP address of the DNS server that provides the answer; and (2) the answer itself, which is the host name and IP address of www.mit.edu. Although the response came from the local DNS server at Polytechnic University, it is quite possible that this local DNS server iteratively contacted several other DNS servers to get the answer, as described in Section 2.5 of the textbook.

Now consider the second command:

```
nslookup –type=NS mit.edu
```

In this example, we have provided the option “-type=NS” and the domain “mit.edu”. This causes nslookup to send a query for a type-NS record to the default local DNS server. In words, the query is saying, “please send me the host names of the authoritative DNS for mit.edu”. (When the –type option is not used, nslookup uses the default, which is to

query for type A records.) The answer, displayed in the above screenshot, first indicates the DNS server that is providing the answer (which is the default local DNS server) along with three MIT nameservers. Each of these servers is indeed an authoritative DNS server for the hosts on the MIT campus. However, nslookup also indicates that the answer is "non-authoritative," meaning that this answer came from the cache of some server rather than from an authoritative MIT DNS server. Finally, the answer also includes the IP addresses of the authoritative DNS servers at MIT. (Even though the type-NS query generated by nslookup did not explicitly ask for the IP addresses, the local DNS server returned these "for free" and nslookup displays the result.)

Now finally consider the third command:

```
nslookup www.aiit.or.kr bitsy.mit.edu
```

In this example, we indicate that we want the query sent to the DNS server bitsy.mit.edu rather than to the default DNS server (dns-prime.poly.edu). Thus, the query and reply transaction takes place directly between our querying host and bitsy.mit.edu. In this example, the DNS server bitsy.mit.edu provides the IP address of the host www.aiit.or.kr, which is a web server at the Advanced Institute of Information Technology (in Korea).

Now that we have gone through a few illustrative examples, you are perhaps wondering about the general syntax of nslookup commands. The syntax is:

```
nslookup –option1 –option2 host-to-find dns-server
```

In general, nslookup can be run with zero, one, two or more options. And as we have seen in the above examples, the dns-server is optional as well; if it is not supplied, the query is sent to the default local DNS server.

Now that we have provided an overview of nslookup, it is time for you to test drive it yourself. Do the following:

1) Run nslookup to obtain the IP address of a Web server in Asia.
2) Run nslookup to determine the authoritative DNS servers for a university in Europe.
3) Run nslookup so that one of the DNS servers obtained in Question 2 is queried for the mail servers for Yahoo! mail.

2. Tracing DNS with Ethereal

Part 2.1: Now that we are familiar with nslookup, we're ready to examine the operation of DNS. Let's first examine the DNS packets that are generated by ordinary Web-surfing activity.

- Open Ethereal and load the file dns-ethereal-trace-1. Enter "ip.addr ==128.238.38.160" into the filter. This is the IP address on which the trace was captured. This filter removes all packets that neither originate nor are destined to the capturing host. The packet capture was generated by opening a web browser, and then visiting the web page: http://www.ietf.org. Once the page was loaded, packet capture was stopped.

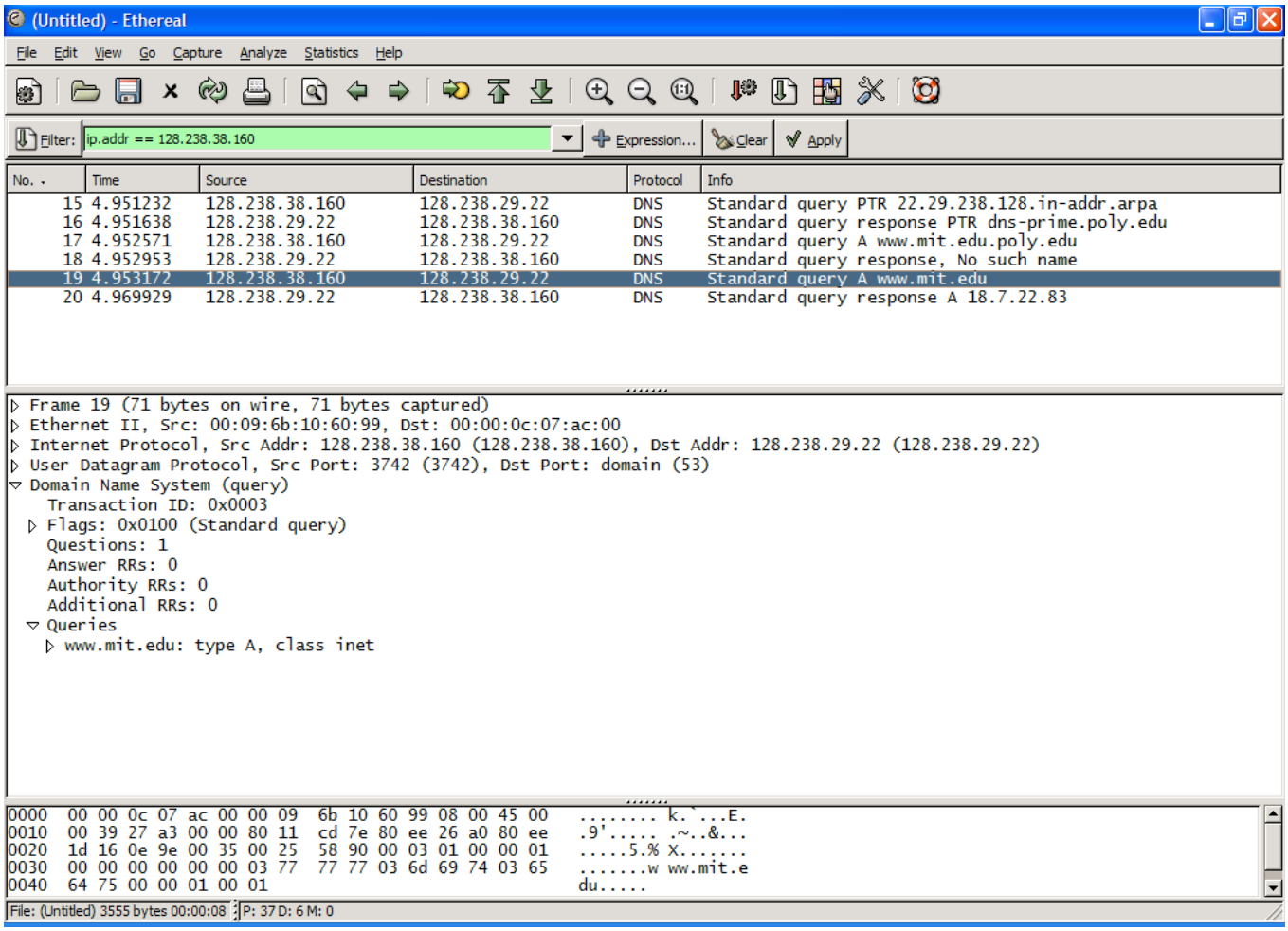
Answer the following questions:

1. Locate the DNS query and response messages. Are then sent over UDP or TCP?
2. What is the destination port for the DNS query message? What is the source port of DNS response message?
3. To what IP address is the DNS query message sent? This is the IP address of a local DNS server.
4. Examine the DNS query message. What "Type" of DNS query is it? Does the query message contain any "answers"?
5. Examine the DNS response message. How many "answers" are provided? What do each of these answers contain?
6. Consider the subsequent TCP SYN packet sent by the host. Does the destination IP address of the SYN packet correspond to any of the IP addresses provided in the DNS response message?
7. This web page contains images. Before retrieving each image, does the host issue new DNS queries?

Part 2.2: Now let's examine with nslookup.

- Load dns-ethereal-trace-2. This trace was created by performing an nslookup on www.mit.edu

The trace should look like the following:



We see from the above screenshot that nslookup actually sent three DNS queries and received three DNS responses. For the purpose of this assignment, in answering the following questions, ignore the first two sets of queries/responses, as they are specific to nslookup and are not normally generated by standard Internet applications. You should instead focus on the last query and response messages.

1. What is the destination port for the DNS query message? What is the source port of DNS response message?
2. To what IP address is the DNS query message sent?
3. Examine the DNS query message. What "Type" of DNS query is it? Does the query message contain any "answers"?
4. Examine the DNS response message. How many "answers" are provided? What do each of these answers contain?

Part 2.3: Now load the following file: dns-ethereal-trace-3. This trace was generated by issuing the following command:

```
nslookup –type=NS mit.edu
```

Answer the following questions:

1. To what IP address is the DNS query message sent
2. Examine the DNS query message. What "Type" of DNS query is it? Does the query message contain any "answers"?
3. Examine the DNS response message. What MIT nameservers does the response message provide? Does this response message also provide the IP addresses of the MIT namesers?

Part 2.4: Now load the trace file dns-ethereal-trace-4. This trace was created with the following command:

```
nslookup www.aiit.or.kr ip_address_of_bitsy.mit.edu
```

Answer the following questions:

1. To what IP address is the DNS query message sent? What does the IP address correspond to?
2. Examine the DNS query message. What "Type" of DNS query is it? Does the query message contain any "answers"?
3. Examine the DNS response message. How many "answers" are provided? What does each of these answers contain?