TCP/IP Protocol Suite (Forouzan)

Exercises Solution

Source code is **available on GitHub**.
Made with **typst typesetting**.

Legends

- **Bold texts** are used for decoration or emphasis.
- ~~Strike-through~~ refers to out of syllabus/ context.
- Highlighted texts are some optional texts :)

Terms & Conditions

- This is just a **sample**, nothing more, nothing less :)
- I have tried to put things like **summary**, and obviously this is not the solution that I will submit or recommended! I am in no way responsible for any illegal use of this file.
- If you need direct solutions for submitting your assignment, please ask DeepSeek, ChatGPT, Google Gemini, Anthropic Claude, Hugging Chat, Le Chat Mistral or any other predictive models (LLM).

And yah, can be **inaccurate**! Feel free to **criticize**.

Contents

Revision 03
Try to directly open the file from Rising Flare, to avoid missing any updates.

1 Chapter 19: Domain Name System (DNS)

1.1 Exercises

1. Determine which of the following is an FQDN and which is a PQDN:
   a. xxx b. xxx.yyy. c. xxx.yyy.net d. zzz.yyy.xxx.edu.

   Ans: a, c = **PQDN**; b, d = **FQDN**

   সাধারণত FQDN এর শেষে একটি dot থাকে, যা DNS সার্ভারকে বলে দেয় যে এটি একটি সম্পূর্ণ ডোমেইন নাম।

2. Determine which of the following is an FQDN and which is a PQDN:
   a. mil. b. edu. c. xxx.yyy.net d. zzz.yyy.xxx.edu

   Ans: a, b = **FQDN**; c, d = **PQDN**

3. Find the value of the flags field (in hexadecimal) for a query message requesting an address and demanding a recursive answer.

   Ans: 0x0100
   Here, our flag field will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
0	0000	0	0	1	0	000	0000

4. Find the value of the flags field (in hexadecimal) for an unauthoritative message carrying an inverse response. The resolver had asked for a recursive response, but the recursive answer was not available.

   Ans: 0x8900
   Here, our flag field will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
1	0001	0	0	1	0	000	0000

5. Analyze the flag 0x8F80.

   Ans: Here, our flag field will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
1	0001	1	1	1	1	000	0000

   - QR = 1 (Response)
   - Opcode = 0001 (Inverse Query)
   - AA = 1 (Authoritative Answer)
   - TC = 1 (Truncated)
   - RD = 1 (Recursion Desired)
   - RA = 1 (Recursion Available)
   - rCode = 0000 (No Error)

6. Analyze the flag 0x0503. Is it valid?

   Ans: Here, our flag field will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
0	0000	1	0	1	0	000	0011

- QR = 0 (Query)
- Opcode = 0000 (Standard Query)
- AA = 1 (Authoritative Answer - don't care)
- TC = 0 (Not Truncated - don't care)
- RD = 1 (Recursion Desired)
- RA = 0 (Recursion Available - don't care)
- rCode = 0001 (Format Error)

Here AA is a don't care condition, so it's value will not matter. And the rCode is not valid, as it should be 0000 (No Error) for a valid query. Becuase only the authoritative server can make the judgement for rCode. So, this flag is **not valid**.

7. Is the size of a question record fixed?

   Ans: Nope.

8. Is the size of a resource record fixed?

   Ans: Nope.

9. What is the size of a question record containing the domain name `fhda.edu`?

   Ans: Question record = Query name + Query type + Query class
   Here, query type and query class are fixed at 2 bytes each.
   Query name is variable length, but in this case, it will be stored like,

4	'fhda'	3	'edu'	0

   So here 10 byte or 80 bit can store the query name.
   Question Record Size = 10 (query name) + 2 (query type) + 2 (query class) = 14 bytes.

10. What is the size of a question record containing an IP address?

    Ans: Question record = Query name + Query type + Query class
    Here, query type and query class are fixed at 2 bytes each.
    Query name is variable length, but in this case, it will be stored like,

3	'aaa'	3	'aaa'	3	'aaa'	3	'aaa'	7	'in-addr'	4	'arpa'	0

    Here for the maximum cases around 30 bytes will be requried to store the query name.
    Question Record Size = 30 (query name) + 2 (query type) + 2 (query class) = 34 bytes.

11. What is the size of a resource record containing the domain name `fhda.edu`?

    Ans: Resource record = Name + Type + Class + TTL + Data length + RDATA
    Here, Name is variable length, but in this case, it will be stored like,

4	'fhda'	3	'edu'	0

    So here 10 byte or 80 bit can store the query name.
    Type and Class are fixed at 2 bytes each.
    TTL is fixed at 4 bytes.
    Data length is fixed at 2 bytes.
    RDATA is the IP address, which is 4 bytes (written in octets).

    Resource Record Size = 10 (name) + 2 (type) + 2 (class) + 4 (ttl) + 2 (data length) + 4 (rdata)
                         = 24 bytes.

12. What is the size of a resource record containing an IP address?

আগের প্রশ্নটির অনুরূপ, তবে এখানে domain নাম যেকোনো একটা ধরে নিতে হবে (variable length)। এখন এটা standard response হবে নাকি inverse response, তা আমি নিশ্চিত নই।

13. What is the size of a query message requesting the IP address for `challenger.atc.fhda.edu`?

Ans: Query message = Header + Question record

Header is fixed at 12 bytes.

Question record = Query name + Query type + Query class
Here, query type and query class are fixed at 2 bytes each.
Query name is variable length, but in this case, it will be stored like,

10	'challenger'	3	'atc'	4	'fhda'	3	'edu'	0

So here 25 byte can store the query name.
Question Record Size = 25 (query name) + 2 (query type) + 2 (query class) = 29 bytes.

Finally,
Query Message Size = 12 (header) + 29 (question record) = 41 bytes.

14. What is the size of a query message requesting the domain name for 185.34.23.12?

Ans: Query message = Header + Question record

Header is fixed at 12 bytes.

Question record = Query name + Query type + Query class
Here, query type and query class are fixed at 2 bytes each.
Query name is variable length, but in this case, it will be stored like,

2	'12'	2	'23'	2	'34'	3	'185'	7	'in-addr'	4	'arpa'	0

So here 27 byte can store the query name.
Question Record Size = 27 (query name) + 2 (query type) + 2 (query class) = 31 bytes.

Finally,
Query Message Size = 12 (header) + 31 (question record) = 43 bytes.

15. What is the size of the response message responding to the query message in Exercise 13?

Ans: Response message = Header + Question record + Answer record

Header is fixed at 12 bytes.

Question record = Query name + Query type + Query class
Here, query type and query class are fixed at 2 bytes each.
Query name is variable length, but in this case, it will be stored like,

10	'challenger'	3	'atc'	4	'fhda'	3	'edu'	0

So here 25 byte can store the query name.
Question Record Size = 25 (query name) + 2 (query type) + 2 (query class) = 29 bytes.

Answer record = Name + Type + Class + TTL + Data length + RDATA
Here,

1. lName is variable length, but in this case, Name is variable length, but in this case, we can use compression, which will cost 2 bytes.
2. Type and Class are fixed at 2 bytes each.
3. TTL is fixed at 4 bytes.
4. Data length is fixed at 2 bytes.
5. RDATA is the IP address, which is assumed to be 4 bytes (written in octets).
6. Answer Record Size = 2 (name) + 2 (type) + 2 (class) + 4 (ttl) + 2 (data length) + 4 (rdata) = 16 bytes.

==আমি এখানে name = ২ বাইট ধরেছি, কিন্তু যদি compression না থাকে তাহলে কিন্তু ঠিকই ২৫ বাইট দরকার হবে।==

Finally,

Response Message Size = 12 (header) + 29 (question record) + 16 (answer record) = 57 bytes.

16. What is the size of the response message responding to the query message in Exercise 14?

   Ans: Response message = Header + Question record + Answer record

   Header is fixed at 12 bytes.

   Question record = Query name + Query type + Query class
   Here, query type and query class are fixed at 2 bytes each.
   Query name is variable length, but in this case, it will be stored like,

2	'12'	2	'23'	2	'34'	3	'185'	7	'in-addr'	4	'arpa'	0

   So here 27 byte can store the query name.
   Question Record Size = 27 (query name) + 2 (query type) + 2 (query class) = 31 bytes.

   Answer record = Name + Type + Class + TTL + Data length + RDATA
   Here,
   1. Name is variable length, but in this case, we can use compression, which will cost 2 bytes.
   2. Type and Class are fixed at 2 bytes each.
   3. TTL is fixed at 4 bytes.
   4. Data length is fixed at 2 bytes.
   5. RDATA is considered variable length, but in this case, let use consider it to be 16 bytes.

   Answer Record Size = 2 (name) + 2 (type) + 2 (class) + 4 (ttl) + 2 (data length) + 16 (rdata) = 28 bytes.

   Finally,
   Response Message Size = 12 (header) + 31 (question record) + 28 (answer record) = **71 bytes**.

   ==এখানে আমি আন্দাজে ১৬ বাইট RDATA ধরেছি। যেটা নিঃসন্দেহে ভুল। সঠিক কি করা উচিত, তা আমি জানি না।==

17. Redo Example 19.1 using a response message with one answer record and one authoritative record which defines "fhda.edu." as the authoritative server.

   Ans: Here for this case, our flag field will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
1	0000	1	0	1	1	000	0000

   It can be representyed in hexadecimal as 0x8580.

   So, the response message will be like,

0x1333	0x8580

1	1
1	0
4 'chal' 4 'fhda' 3 'edu' 0	
1	1
0xC00C	
1	1
1200	
4	153 18 8 105
0xC00C	
2	1
1200	
10	4 'fhda' 3 'edu' 0

এখানে query type 2 ধরা হয়েছে authoritative server এর জন্য।

18. Redo Exercise 17, but add one additional record that defines the address of the authoritative server as 153.18.9.0.

    Ans: Here the flag field will as same as previous one, 0x8580.
    So, the response message will be like,

0x1333	0x8580
1	1
1	1
4 'chal' 4 'fhda' 3 'edu' 0	
1	1
0xC00C	
1	1
1200	
4	153 18 8 105
0xC00C	
2	1
1200	
10	4 'fhda' 3 'edu' 0
0xC00C	
2	1
1200	
4	153 18 9 0

19. A DNS client is looking for the IP address of xxx.yyy.com. Show the query message with values for each field.

    Ans: The query message will be like,

0x1333	0x0100

1	0
0	0
3 'xxx' 3 'yyy' 3 'com' 0	
1	1

Here the flag field is 0x0100, which means it is a standard query with recursion desired. The flag will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
0	0000	0	0	1	0	000	0000

20. Show the response message of a DNS server to Exercise 19. Assume the IP address is 201.34.23.12.

Ans: The response message will be like,

0x1333	0x8180
1	1
0	0
3 'xxx' 3 'yyy' 3 'com' 0	
1	1
0xC00C	
1	1
1200	
4	201 34 23 12

Here the flag field is 0x8180, which means it is a standard response with recursion available. The flag will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
1	0000	0	0	1	1	000	0000

21. A DNS client is looking for the IP addresses corresponding to xxx.yyy.com and aaa.bbb.edu. Show the query message.

Ans: The query message will be like,

0x1333	0x0100
2	0
0	0
3 'xxx' 3 'yyy' 3 'com' 0	
1	1
3 'aaa' 3 'bbb' 3 'edu' 0	
1	1

Here the flag field is 0x0100, which means it is a standard query with recursion desired. The flag will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode

0	0000	0	0	1	0	000	0000

22. Show the response message of a DNS server to the query in Exercise 21 if the addresses are 14.23.45.12 and 131.34.67.89.

Ans: The response message will be like,

0x1333	0x8180
2	2
0	0
3 'xxx' 3 'yyy' 3 'com' 0	
1	1
3 'aaa' 3 'bbb' 3 'edu' 0	
1	1
0xC00C	
1	1
1200	
4	14 23 45 12
0xC01D	
1	1
1200	
4	131 34 67 89

Here the flag field is 0x8180, which means it is a standard response with recursion available. The flag will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
1	0000	0	0	1	1	000	0000

এবং 0xC00C হল xxx.yyy.com এর address।
এখানে 0xC01D হল aaa.bbb.edu এর address।

23. Show the response message of Exercise 22 if the DNS server can resolve the first enquiry but not the second.

Ans: The response message will be like,

0x1333	0x8180
2	1
0	0
3 'xxx' 3 'yyy' 3 'com' 0	
1	1
3 'aaa' 3 'bbb' 3 'edu' 0	
1	1
0xC00C	
1	1

1200	
4	14 23 45 12

Here the flag field is 0x8180, which means it is a standard response with recursion available. The flag will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
1	0000	0	0	1	1	000	0000

24. A DNS client is looking for the name of the computer with IP address 132.1.17.8. Show the query message.

   Ans: The query message will be like,

0x1333	0x0900
1	0
0	0
1 '8' 2 '17' 1 '1' 3 '132' 7 'in-addr' 4 'arpa' 0	
12	1

Here the flag field is 0x0900, which means it is a standard query with recursion desired. The flag will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
0	0001	0	0	1	0	000	0000

25. Show the response message sent by the server to the query in Exercise 24.

   Ans: The response message will be like,

0x1333	0x8980
1	1
0	0
1 '8' 2 '17' 1 '1' 3 '132' 7 'in-addr' 4 'arpa' 0	
12	1
0xC00C	
12	1
1200	
13	3 'aaa' 3 'bbb' 3 'edu' 0

<mark>এখানে 3 'aaa' 3 'bbb' 3 'edu' 0 মনমতো ধরে নিয়েছি :)</mark>

Here the flag field is 0x8980, which means it is an inverse query with recursion available. The flag will be like,

QR	Opcode	AA	TC	RD	RA	Three 0s	rCode
1	0001	0	0	1	1	000	0000

26. ~~Encapsulate the query message of Exercise 24 in a UDP user datagram.~~

27. ~~Encapsulate the response message of Exercise 25 in a UDP user datagram.~~

উপরের দুটো প্রশ্ন UDP user diagram এর অংশ পড়ানোর সময় কভার হবে আশা করি :)

"Never trust anyone too much; remember, the devil was once an angel."
— Ken Kaneki, Tokyo Ghoul