

# Principles of Internetworking Protocols

Assignment Six (20 marks)

(Due on April 7)

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## Instructions:

1. Submit a pdf file for your answers to i-Learning before 11:59 on April 7. Put down your name, student ID and program/year in your submission.
2. Late submission will not be accepted.
3. Observe also the penalty for plagiarism as stated in the Course Overview slides.

## Question 1: Binary tries for longest prefix matching

[10 MARKS] A forwarding table consists of six entries: 160.10.8.0/21, 160.10.12.0/22, 160.10.10.0/23, 160.10.8.0/24, 160.10.9.0/24, and 160.10.12.0/24. Complete the binary trie below for these six entries, and 160.10.8.0/21 is already included. A shaded node corresponds to an entry in the forwarding table.

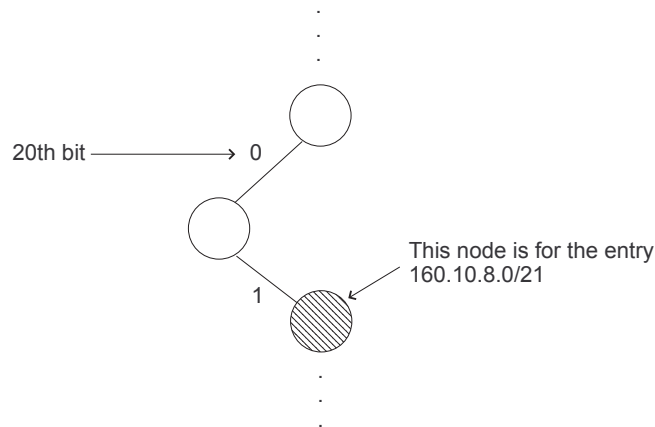


Figure 1: An incomplete binary trie for the five forwarding table entries.

## Question 2: Path MTU discovery

[10 MARKS] There are public utilities for discovering the path MTU, and one of them is `mturoute`. The underlying algorithm of `mturoute` is to send a number of ICMP echo requests to a destination with different sizes, and the DF (don't fragment) bit is turned on. Therefore, receiving no ICMP

echo reply means that the corresponding ICMP packet size is too big. Thus, the path MTU is estimated by the largest IP packet size for which an ICMP echo reply is received. Figure 2 shows the output of running `mturoute` by Rocky.



```
C:\Users\RockyChang\Desktop>mturoute www.polyu.edu.hk
* ICMP Fragmentation is not permitted. *
* Speed optimization is enabled. *
* Maximum payload is 10000 bytes. *
.- ICMP payload of 1472 bytes failed. (IP_REQ_TIMED_OUT)
+ ICMP payload of 92 bytes succeeded.
+ ICMP payload of 782 bytes succeeded.
.- ICMP payload of 1127 bytes failed. (IP_REQ_TIMED_OUT)
+ ICMP payload of 954 bytes succeeded.
.- ICMP payload of 1040 bytes failed. (IP_REQ_TIMED_OUT)
.- ICMP payload of 997 bytes failed. (IP_REQ_TIMED_OUT)
+ ICMP payload of 975 bytes succeeded.
+ ICMP payload of 986 bytes succeeded.
+ ICMP payload of 991 bytes succeeded.
+ ICMP payload of 994 bytes succeeded.
+ ICMP payload of 995 bytes succeeded.
+ ICMP payload of 996 bytes succeeded.
Path MTU: 1024 bytes.
```

Figure 2: The output of discovering path MTU from the `mturoute` program.

1. [3 MARKS] If an ICMP echo reply is not received, the `mturoute` program will send two more ICMP echo request messages before giving up. Altogether how many ICMP echo request messages were sent in this run? No packet loss was observed in this run.
2. [3 MARKS] How many ICMP echo reply messages were received in this run?
3. [4 MARKS] Why did the `mturoute` program report the path MTU as 1024 bytes? The IP packet carries no option.