

Problem Sheet #2

Problem 2.1: *longest prefix matching and binary tries*

(1+2+1+1+1 = 6 points)

prefix	interface	next hop
96.0.0.0/3	if0	R0
96.0.0.0/4	if1	R3
64.0.0.0/2	if2	R2
64.0.0.0/3	if1	R1
0.0.0.0/0	if4	R4

A router forwarding table is shown above. The router can deliver packets over interfaces if0, if1 and if2 to the routers R0, R1, R2, R3, or R4. Assume the router does the longest prefix match.

- Identify the address ranges for each entry in the forwarding table.
- Identify the next hop for the packets addressed to the following destination:
 - 118.67.112.97
 - 133.160.3.8
 - 11.42.35.72
 - 109.211.278.78
 - 98.4.4.4
 - 73.78.2.1
- Draw the uncompressed binary trie for above forwarding table
- Draw the compressed binary trie for above forwarding table
- Can the forwarding table be rewritten with fewer entries but represent the same forwarding behavior? If yes, how does the smaller forwarding table look like and why does it work? If no, why not?

Solution:

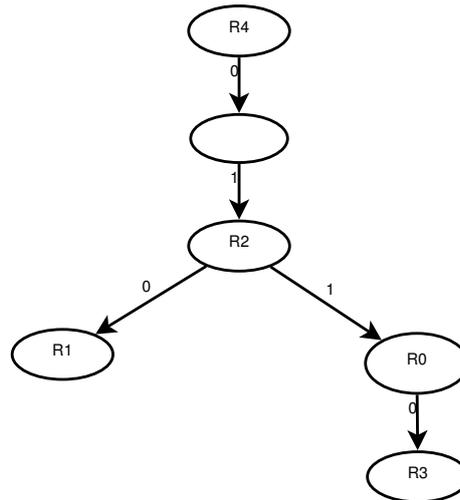
- Address ranges:

prefix	address range
96.0.0.0/3	96.0.0.0 - 127.255.255.255
96.0.0.0/4	96.0.0.0 - 111.255.255.255
64.0.0.0/2	64.0.0.0 - 127.255.255.255
64.0.0.0/3	64.0.0.0 - 95.255.255.255
0.0.0.0/0	0.0.0.0 - 255.255.255.255

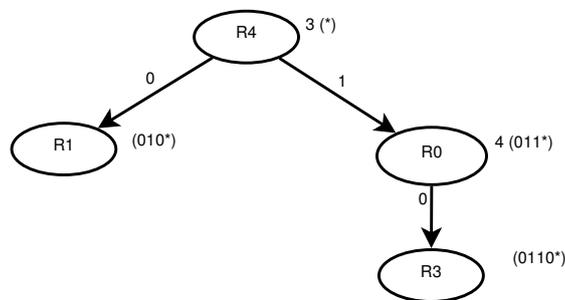
- Next hops:

destination	next hop
118.67.112.97	R0
133.160.3.8	R4
11.42.35.72	R4
109.211.278.78	R3
98.4.4.4	R3
73.78.2.1	R1

c) uncompressed binary trie



d) compressed binary trie



e) Yes, the entry for 64.0.0.0/2 can be removed because due to longest prefix matching, addresses within that range will instead be forwarded by rules for the prefixes 64.0.0.0/3, 96.0.0.0/3 or 96.0.0.0/4. In addition one can see that R2 vanishes in the compressed trie.

Problem 2.2: address resolution protocol (ARP)

(2+2 = 4 points)

- a) What is gratuitous ARP? In which situations are gratuitous ARPs useful?
- b) What is proxy ARP? Describe a situation in which proxy ARPs are useful.

Solution:

- a) Gratuitous ARP is a technique used by a host to broadcast an ARP request for its own IP address, whenever its configuration bindings change. This is done to update the ARP cache entries of every other host on the logical link. Without a gratuitous ARP request, old entries in the cache would persist until a timeout has occurred.
- b) Proxy ARP is a technique typically used by a router to respond to ARP requests with his own MAC address on behalf of other hosts. This essentially directs traffic to the hosts the router is proxying for to the router and then the router can forward the traffic to the target host (“send it to me, and I’ll get it to where it needs to go”).

A typical scenario for the usage of proxy ARP is that someone at the edge of the Internet needs to cut a “hole” into an IP address space (e.g., cutting a /28 network out of a /24 network) without being able to install proper forwarding table entries for the /28 network into the hosts and routers on the /24 network.