Assignment 8, CSL 858

Due date: April 20, 2007 (Friday)

Topics: BGP, MPLS, VPN

AS1 in Figure 1 has the following characteristics.

- All routers run OSPF as the interior gateway protocol (IGP).
- All routers are equipped with MPLS which can be used to set up label switching paths internal to the AS.
- The border routers run BGP.

State any assumptions that you make to solve the problems.

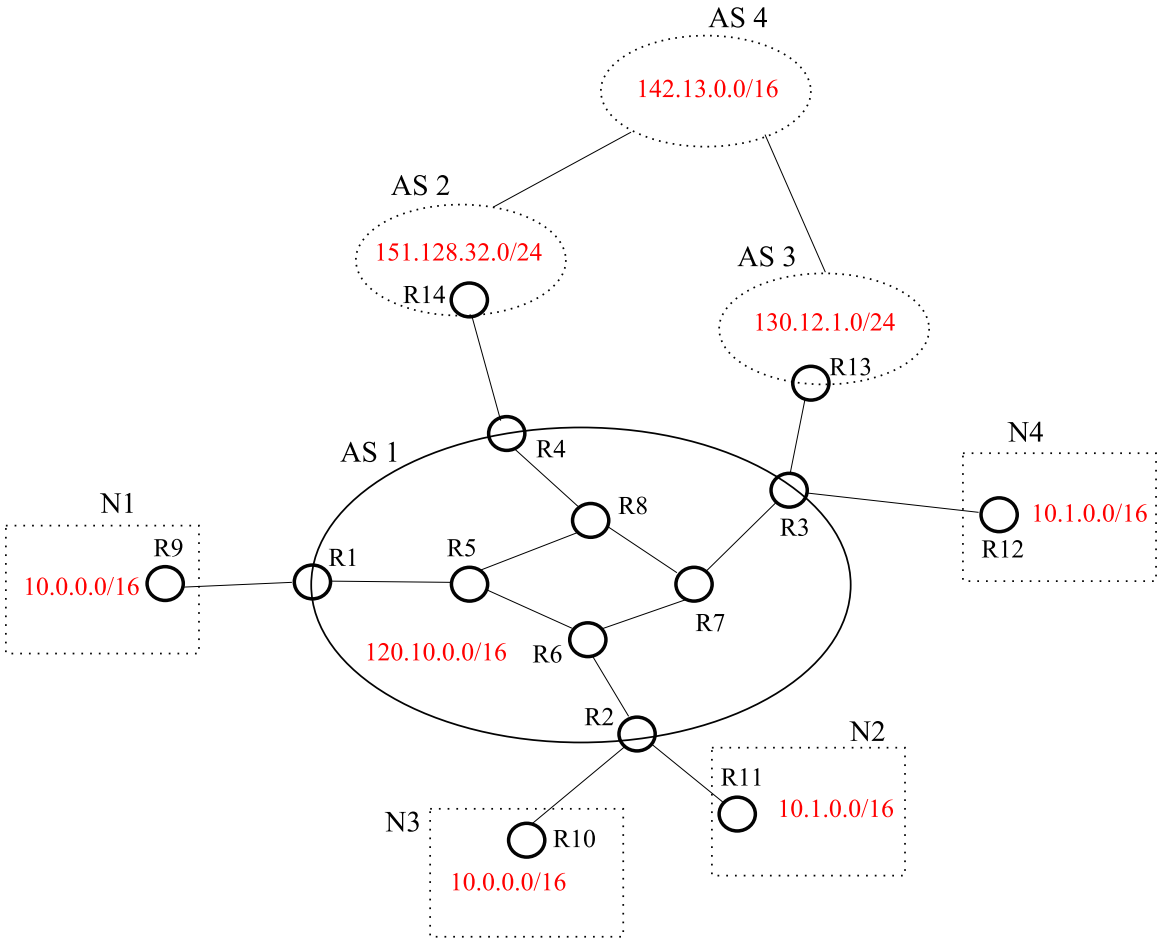

Figure 1: Routing topology

1. Corresponding to each of the 4 ASes is an IP-prefix as shown. AS2 advertizes the paths `[151.128.32.0/24 AS2]`, `[142.13.0.0/16 AS2-AS4]` and `[130.12.1.0/24 AS2-AS4-AS3]` to AS1. AS3 advertizes the paths `[130.12.1.0/24 AS3]`, `[142.13.0.0/16 AS3-AS4]` and `[151.128.32.0/24 AS3-AS4-AS2]` to AS1.

   Show how AS1 can choose the BGP-attributes of these paths so that

(a) it uses R4–R14 to forward packets with destination prefix 151.128.32.0/24,

(b) it uses R3–R13 to forward packets with destination prefix 130.12.1.0/24,

(c) it uses "hot-potato" routing to forward packets with destination prefix 142.13.0.0/16,

(d) it hides the fact from AS3 that it uses R4–R14 to forward packets with 151.128.32.0/24,

(e) it hides the fact from AS2 that it uses R3–R13 to forward packets with destination prefix 130.12.1.0/24.

2. Set up label switched paths along the shortest paths (lowest OSPF weight) between pairs of border routers of AS 1. (By "set up" I mean assign appropriate labels along the path.) Show the MPLS forwarding table at each router in AS 1. Assume that the OSPF link weights for all links are equal. (In case there is no unique shortest path, choose any one with the minimum weight).

3. N1–N2 and N3–N4 are two different VPNs. Set up label switched paths for these two VPNs. Show the VRF's for these two VPNs at R1, R2, and R3. Show the new entries in the MPLS forwarding tables of the routers of AS1.

4. Explain how the routers of AS1 would forward the following packets toward their destinations.

   - Packet generated by R1 with destination 142.13.5.4.
   - Packet from N3 with destination 10.1.3.5.
   - Packet generated by R6 with destination 130.12.1.2. Note that only the border routers run BGP.