1 BGP

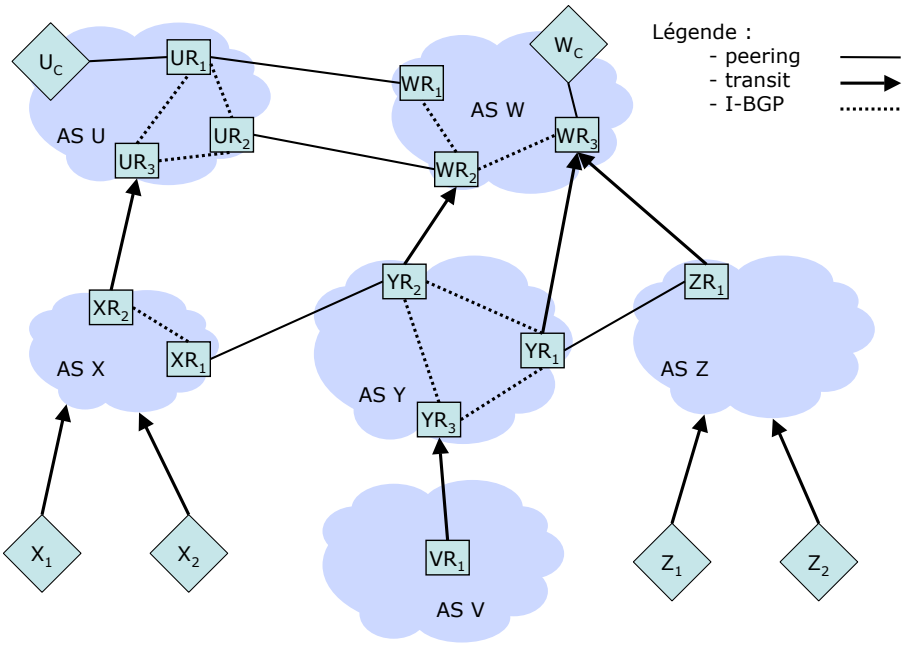

Figure 1: Example network of ASes.

There are six ASes shown in the picture above (U, V, W, X, Y, Z). The diamond-shaped boxes are customers of the ASes (ISP) they are connected to. Some relationships are marked as peering and transit. The circles with names like WR_1 stand for BGP routers. The first letter of such router names indicates the ISP they belong to. Within each AS, the dotted lines show IBGP connections.

1. Which AS does not have correct IBGP interconnections?
2. Consider the relationship between Y and Z. Which of these statements are true?
   - Z will hear routes to V announced by Y, and may also hear routes to V announced by W.
   - Z MUST use a route to V announced to it by Y, since that is a route from a peering relationship.
   - Y will usually not announce routes to Z_1 and Z_2 to W.
   - Y will usually not announce routes to Z_1 and Z_2 to V.
3. U wants to ensure that packets sent to U_C from W are sent to it via UR_1 and not UR_2. Clearly explain how it might try to do this. Can it always ensure that the desired behavior happens? Why or why not?
4. W would like to ensure that packets sent to W_C from X_1 reach it via AS X and U, and packets sent to W_C from X_2 reach it via AS Y. Can this be done with BGP? If so, how?

1 BGP

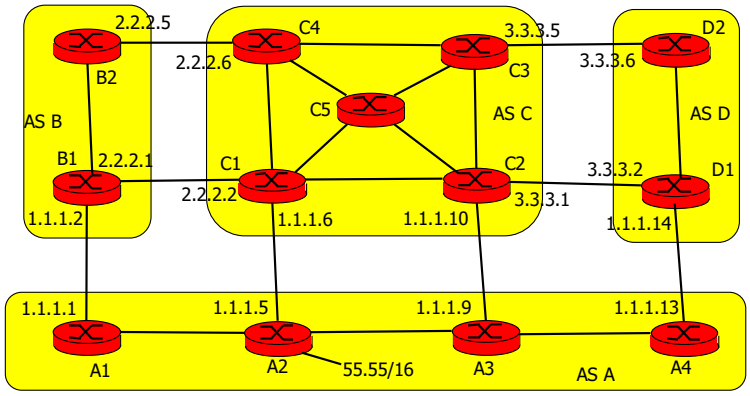

Figure 1: Example of a network

Consider the network in Figure 1. A1 to D2 are routers. There are 4 autonomous systems A - D. All links between routers are shown in the figure and there are no other routers nor prefixes. All routers run RIP inside an AS and BGP for external routing. All physical links are shown in the figure. There are e-BGP sessions between routers belonging to different ASs like between A1-B1. There are all required i-BGP sessions.

The choice of a route within an AS is done according to the following rules:

1. route with the shortest AS path
2. route with the smallest MED
3. route with the shortest IGP distance to the NEXT-HOP of the route
4. route learnt through E-BGP with respect to the one learnt through I-BGP
5. route with the smallest IP address in NEXT-HOP

Routers do not filter routes and accept all announcements.

1. Routers in A send the following announcements:
   - A1 to B1 : `55.55/16, AS-PATH=A, NEXT-HOP=1.1.1.1, MED=20`
   - A2 to C1 : `55.55/16, AS-PATH=A, NEXT-HOP=1.1.1.5, MED=10`
   - A3 to C2 : `55.55/16, AS-PATH=A, NEXT-HOP=1.1.1.9, MED=20`
   - A4 to D1 : `55.55/16, AS-PATH=A, NEXT-HOP=1.1.1.13,MED=30`

   AS A and C are "peers". After convergence, what is the route to `55.55/16` chosen by C1 (explain)? The same question for C2.

2. AS A and C are not "peers". After convergence, what is the route to `55.55/16` chosen by C1 (explain)? The same question for C2.

1 BGP *(6 points)*

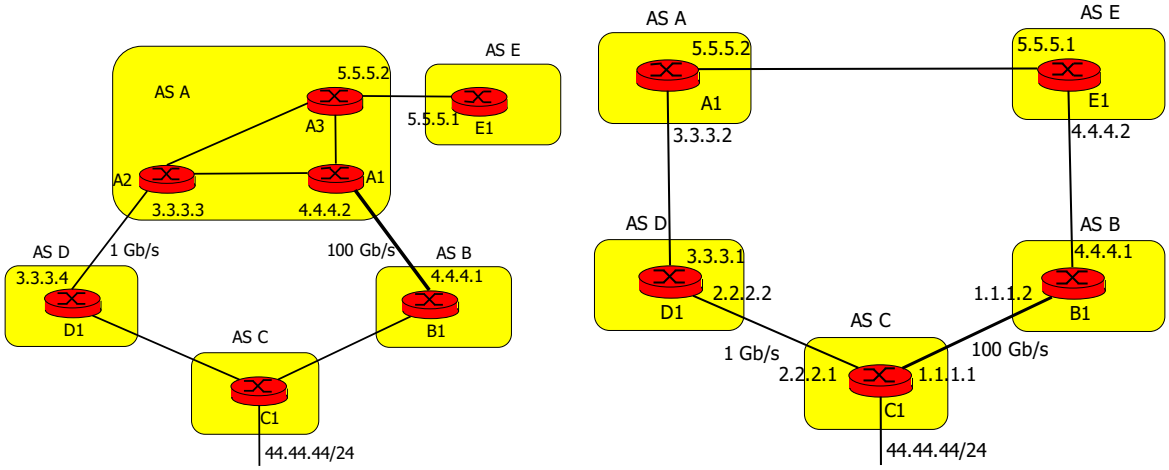

Figure 1: Réseaux BGP

Consider the network in Figure 1.

1. Figure 1a: A wants to use a primary link of 100 Gb/s and use the 1 Gb/s link as a backup. Complete the announcements by A1 and A2 in A:

   - A1 à A3: `44.44.44/24,`
   - A2 à A3: `44.44.44/24,`

2. Follow up to question 1—complete the announcement of A to E:

   - A3 à E1: `44.44.44/24,`

3. Figure 1b: C wants the entrance traffic to its AS to go through the primary link of 100 Gb/s and use the 1 Gb/s link as a backup.

   Complete the announcements by C1 to B1 and D1:

   - C1 à B1: `44.44.44/24,`
   - C1 à D1: `44.44.44/24,`

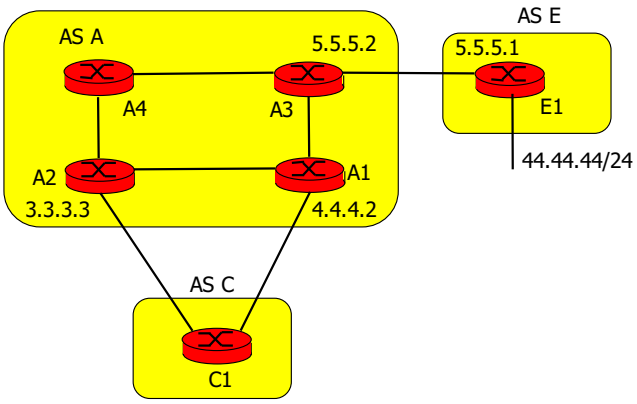

Figure 2: Réseau BGP

4. Figure 2: A wants the traffic to prefix `44.44.44/24` go through A1. Complete the announcements by A1 and A2 to C:
   - A1 à C1: `44.44.44/24,`
   - A2 à C1: `44.44.44/24,`