Communication Networks

Exercise 7

Routing project

Overview current assignment

Old exam multiple choice question

Solutions will be published next week
08.04 around 11:00
Routing project timetable

Week 1

- 16.03 Project start
- First 2 weeks Q1.1 - 1.5 Intra-domain routing

Week 2

- 30.03+ Q2.1 - 2.2 Inter-domain routing

Week 3

- Remaining Q3.1 - 3.5 Routing policies
- 06.04 Q3.5 active

Week 4

- 09.04 Project end
- Today
The deadline for the routing project is today at midnight

You can still ask us questions during the exercise session or later today.

Submit your configs (newest version) as well as your report via email. Subject: [comm net] groupX project 1

Please send the email to: lvanbever@ethz.ch, thomahol@ethz.ch and buehlert@ethz.ch
Routing project

**Overview current assignment**

Old exam multiple choice question

Solutions will be published next week
Today’s exercise consists of two old BGP exam questions

As normal, you will receive detailed solutions next week, unlike for the old exams online.

BGP is a main topic of the lecture, you can also expect a large BGP part in this year’s final exam.
Task 1: Putting everything together (exam 2016)
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```
prefix  | LP  | AS-PATH length
--------|-----|-----------------
p1      | 200 | 10              
p2      | 110 | 3               
p3      | 100 | 2               
```

```
prefix  | LP  | AS-PATH length
--------|-----|-----------------
p1      | 100 | 1               
p2      | 110 | 2               
p3      | 100 | 3               
```

```
prefix  | LP  | AS-PATH length
--------|-----|-----------------
p1      | 100 | 2               
p2      | 100 | 1               
p3      | 100 | 2               
```

Local preference

IGP weight

Used by OSPF
Task 1: Putting everything together (exam 2016)

Your goal: find the used egress and internal next hop for all routers (A, B, C, D, E) and each prefix (p1, p2, p3)

Use (part of) the BGP decision algorithm:

- Local preference value (higher is better)
- AS path length (shorter is better)
- IGP path to the next-hop (lowest cost is preferred)
Task 1: Putting everything together (exam 2016)

Example: we want to find the egress and internal NH for prefix $pN$. We know that X advertises the best route
Task 1: Putting everything together (exam 2016)

Example: we want to find the egress and internal NH for prefix $p_N$. We know that X advertises the best route.
Task 2: BGP Hijack (exam 2018)

Consider the Internet topology consisting of 11 Autonomous Systems (ASes) in the Figure below. Single-headed plain arrows point from providers to their customers (AS A is the provider of AS E), while double-headed dashed arrows connect peers (AS A and AS B are peers). Each AS is made up of a single BGP router and applies the default selection and exportation BGP policies based on their customers, peers and providers.

In this task, the routers break ties using the AS number of the neighbor: in case multiple routes are equally good, the router selects the route of the neighbor with the lowest AS number (alphabetical order).

AS G is the origin of prefix 20.0.0.0/22 and advertises it to its neighbors. Independently of what the external advertisements are, AS G always prefers its internal route to reach any IP destination in 20.0.0.0/22.

An Internet topology with 11 ASes. AS K aims at hijacking traffic destined to AS G.

a) AS K wants to hijack all the traffic going to AS G for 20.0.0.0/22. It starts advertising the exact same prefix. From which ASes is it able to attract the traffic?

b) AS K is not satisfied by the result. What can it do to attract traffic destined to AS G from more of the ASes? List the ASes from which it is able to attract the traffic and explain why this works.

c) The ASes from which AS K manages to attract the traffic realize what is happening as all their traffic to 20.0.0.0/22 goes to a dead-end (AS K).

Show how AS K could still deliver the traffic to the real destination (AS G) by poisoning the AS path while attracting as much traffic as possible. In addition, list the ASes from which it can attract the traffic.

d) Can you think of a different way for AS K to achieve similar results as in (iii) without poisoning the AS path? Explain.
Task 2: BGP Hijack (exam 2018)

Consider the Internet topology consisting of 11 Autonomous Systems (ASes) in the Figure below. Single-headed plain arrows point from providers to their customers (AS A is the provider of AS E), while double-headed dashed arrows connect peers (AS A and AS B are peers). Each AS is made up of a single BGP router and applies the default selection and exportation BGP policies based on their customers, peers and providers.

In this task, the routers break ties using the AS number of the neighbor: in case multiple routes are equally good, the router selects the route of the neighbor with the lowest AS number (alphabetical order).

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d) Can you think of a different way for AS K to achieve similar results as in (iii) without poisoning the AS path? Explain.
Task 2: BGP Hijack (exam 2018)

Apply your knowledge from the lecture and question 3.5 from the routing project

Hijacker’s goal 1: attract/hijack as much traffic as possible (from as many ASes as possible)

Hijacker’s goal 2: keep a return path open to perform an interception rather than a blackhole attack
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Exam 2017 - Task 3: Warm-up (true/false questions)

Normally, we always ask a set of true/false questions at the beginning of each larger exam topic.

Rules:

You select the correct answer: +1 point
You select the wrong answer: -1 point
You do not select anything: 0 point
In each true/false block you cannot receive fewer than zero points
In the classical BGP selection and exportation policies (with providers, peers, customers), an Autonomous System (AS) will never announce a route received from a provider to another provider.
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True
An AS has full control over its outgoing traffic.
An AS has full control over its outgoing traffic.

True
The forwarding table of a BGP router contains all routes received from its BGP peers whereas the routing table only contains the BGP best path.
The forwarding table of a BGP router contains all routes received from its BGP peers whereas the routing table only contains the BGP best path.

False
Exam 2017 - Task 3: True/false question 4

Tier-1s only have Tier-2s as customers.
Tier-1s only have Tier-2s as customers.

False
Exam 2017 - Task 3: True/false question 5

The path [G, D, A, B, E, H] from AS G to AS H is valid.
In the classical BGP selection and exportation policies (with providers, peers, customers), an Autonomous System (AS) will never announce a route received from a provider to another provider.

Solution: Yes, due to economic reasons an AS should not let a provider transit.

An AS has full control over its outgoing traffic.

Solution: Yes, the sending AS has the last word.

The forwarding table of a BGP router contains all routes received from its BGP peers whereas the routing table only contains the BGP best path.

Solution: No, the routing table contains all received routes whereas the forwarding table only contains a single entry per prefix for the best path.

Tier-1s only have Tier-2s as customers.

Solution: No. They can also have Tier-2, Tier-3, ... as customers.

Consider the simple BGP network in Figure 7. Single-headed plain arrows point from providers to their customers (AS A is the provider of AS D), while double-headed dashed arrows connect peers (AS D and AS E are peers). Each AS in the network originates a unique prefix that it advertises to all its BGP neighbors. Each AS also applies the default selection and exportation BGP policies based on their customers, peers and providers.

The path \([G, D, A, B, E, H]\) from AS G to AS H is valid.

Solution: Yes, as it consists of two customer to provider, then one peer to peer and finally two provider to customer links.

AS A receives at least one route traversing the link between AS C and AS F.

Solution: No, AS A will never see a route for AS C or AS F as the network is partitioned.

True
AS A receives at least one route traversing the link between AS C and AS F.
AS A receives at least one route traversing the link between AS C and AS F.

False
AS A’s best route to reach AS I has an AS-PATH length of 4.
AS A’s best route to reach AS I has an AS-PATH length of 4.

False
AS D uses the path [D, E, H] to reach AS H.
AS D uses the path [D, E, H] to reach AS H.

True
true ⇨ false
In the classical BGP selection and exportation policies (with providers, peers, customers), an Autonomous System (AS) will never announce a route received from a provider to another provider.
Solution: Yes, due to economic reasons an AS should not let a provider transit.

true ⇨ false
An AS has full control over its outgoing traffic.
Solution: Yes, the sending AS has the last word.

true ⇨ false
The forwarding table of a BGP router contains all routes received from its BGP peers whereas the routing table only contains the BGP best path.
Solution: No, the routing table contains all received routes whereas the forwarding table only contains a single entry per prefix for the best path.

true ⇨ false
Tier-1s only have Tier-2s as customers.
Solution: No. They can also have Tier-2, Tier-3, ... as customers.

Consider the simple BGP network in Figure 7. Single-headed plain arrows point from providers to their customers (AS A is the provider of AS D), while double-headed dashed arrows connect peers (AS D and AS E are peers). Each AS in the network originates a unique prefix that it advertises to all its BGP neighbors. Each AS also applies the default selection and exportation BGP policies based on their customers, peers and providers.

AS A \[\rightarrow\] AS B \[\rightarrow\] AS C
\[\rightarrow\] AS D \[\rightarrow\] AS E \[\rightarrow\] AS F
\[\rightarrow\] AS G \[\rightarrow\] AS H \[\rightarrow\] AS I

true ⇨ false
The path \([G, D, A, B, E, H]\) from AS G to AS H is valid.
Solution: Yes, as it consists of two customer to provider, then one peer to peer and finally two provider to customer links.

true ⇨ false
AS A receives at least one route traversing the link between AS C and AS F.
Solution: No, AS A will never see a route for AS C or AS F as the network is partitioned.

true ⇨ false
AS A's best route to reach AS I has an AS-PATH length of 4.
Solution: No. AS A cannot reach AS I.

true ⇨ false
AS D uses the path \([D, E, H]\) to reach AS H.
Solution: Yes, AS D gets from both AS A and AS E an advertisement. It prefers the path via AS E as it is its peer.

true ⇨ false
AS H uses the path \([H, I, F]\) to reach AS F.
Solution: No, the path is not valid as there is a peer link followed by a provider link.

AS H uses the path \([H, I, F]\) to reach AS F.
AS H uses the path [H, I, F] to reach AS F.

False
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