Homework 1 for Evolving Internet

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1 Problem 1: Mobile IP extended

1.1 Point *a*

When the internet was designed, they aimed to solve the issue of localization using a hierarchical system. For example, at a university, two different LANs had to represent two distinct departments. A hierarchical system is also an efficient way to distribute the complexity of the network: routers only need to know the devices „below" them and the one „above" them. If a flat system were used, every device would need to know the IP addresses of every other device, which would be entirely unfeasible from an engineering perspective.

Changing the IP is a common operation for mobile devices, but logical shifts within the network can also occur for fixed devices. This creates a challenge for connections, as layer 4 protocols like TCP/UDP do not address this specific issue; in fact, they rely on a stable connection to function properly. As a result, the connection is interrupted if the IP changes. This happens because the IP is treated as the identifier within the network for solving the localization problem.

1.2 Point *b*

The caller `CR` wants to sends some packets to the callee `CE` but they are both located outside their home network. So, `CR` will sends packets to the visited foreign agent that will sends the packeges on behalf of `CR`. It will send them to the home network of `CE`. The home agent of `CE` will redirect the packeges to the network where `CE` is located. `CE` will respond sending the packeges to `CR`'s visited foreign agent.

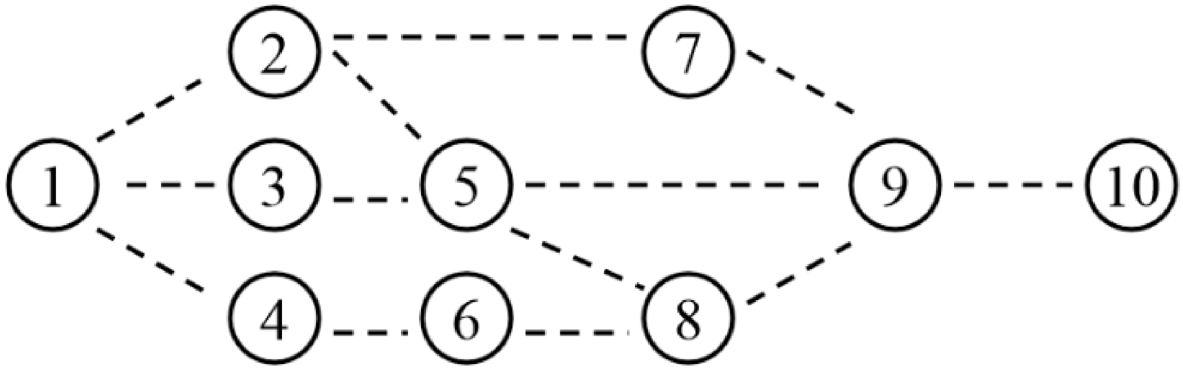
1.3 Point *c*

Mobile IP is said to preserve privacy because if a device moves between the networks only the home and the newest foreign agent will know about it and not all the other networks and devices.

It's said to be scalable because it's easy to add a new network or device (with a new IP). This operations doesn't add complexity to the algorithms used.

2 Exercise 2

Let's consider the following network:



2.1 Part 1

Let's consider the OSPF protocol deployed in Internet routers and run it on wireless nodes of the network.

2.1.1 Point *a*

Each node will generate a broadcast message with its state to its neighbors and each of this message will be forworded by each nodes. So, the overhead will be approximately N^2 times the average neighbors of the nodes where N are the number of nodes. In this particular network the overhead is about 250 (2.5×10^2).

2.1.2 Point *b*

Tab. 1: Rounting table of 1, 2 and 3

De-st	**Next**	**Hops**
1	-	-
2	2	1
3	3	1
4	4	1
5	3	2
6	4	2
7	2	2
8	4	3
9	3	3
10	3	4

De-st	**Next**	**Hops**
1	1	1
2	-	-
3	1	2
4	1	2
5	5	1
6	1	3
7	7	1
8	7	2
9	1	2
10	7	3

De-st	**Next**	**Hops**
1	1	1
2	1	2
3	-	-
4	1	2
5	5	1
6	5	3
7	5	3
8	5	2
9	5	2
10	5	3

Tab. 2: Rounting table of 4, 5 and 6

De-st	**Next**	**Hops**
1	1	1
2	1	2
3	1	2
4	-	-
5	1	3

De-st	**Next**	**Hops**
1	3	2
2	2	1
3	3	1
4	3	3
5	-	-

De-st	**Next**	**Hops**
1	4	2
2	8	3
3	8	3
4	4	1
5	8	2

6	6	1
8	6	2
7	1	3
9	6	3
10	6	4

6	8	2
7	2	2
8	8	1
9	9	1
10	9	2

6	-	-
7	8	3
8	8	1
9	8	2
10	8	3

Tab. 3: Rounting table of 7, 8, 9 and 10

Dest	Next	Hops
1	2	2
2	2	1
3	2	3
4	2	3
5	2	2
6	9	3
7	-	-
8	9	2
9	9	1
10	9	2

Dest	Next	Hops
1	6	3
2	5	2
3	5	2
4	6	2
5	5	1
6	6	1
7	9	2
8	-	-
9	9	1
10	9	2

Dest	Next	Hops
1	5	3
2	5	2
3	5	2
4	5	3
5	5	1
6	8	2
7	7	1
8	8	1
9	-	-
10	10	1

Dest	Next	Hops
1	9	4
2	9	3
3	9	3
4	9	4
5	9	2
6	9	3
7	9	2
8	9	2
9	9	1
10	-	-

2.2 Part 2

2.2.1 Point *a*

To determinate the MPR, each node will send an `HELLO` message to its neighbors. Then, they will reply with the list of their neighbors (minus the original node). Then the node, knowing all its neighbors's neighbors, can decide to select a subset of its neighbors that maximise the reach to its two-hop neighbors.

This is the list of MPR for each node:

- Node 1 will select {2, 4} because they can reach {5, 6, 7};
- Node 2 will select {1, 5} because they can reach {3, 4, 8, 9};
- Node 3 will select {1, 5} because it can reach {2, 4, 8, 9};
- Node 4 will select {1, 6} because it can reach {2, 3, 8};
- Node 5 will select {3, 8, 9} because they can reach {1, 6, 7, 10};
- Node 6 will select {4, 8} because it can reach {1, 5, 9};
- Node 7 will select {2, 9} because it can reach {1, 5, 8, 10};
- Node 8 will select {5, 6, 9} because they can reach {2, 3, 6, 7, 10};
- Node 9 will select {5, 8} because they can reach {2, 3, 6};
- Node 10 will select {9} because it can reach {5, 7, 8}.

2.2.2 Point *b*

The logical topology of the network will be the same as the original topology because all the links are needed.

2.2.3 Point c

Tab. 4: Rounting table of 1, 2 and 3

Dest	Next	Hops
1	-	-
2	2	1
3	3	1
4	4	1
5	2	2
6	4	2
7	2	2
8	4	3
9	2	3
10	2	4

Dest	Next	Hops
1	1	1
2	-	-
3	1	2
4	1	2
5	5	1
6	1	3
7	7	1
8	5	2
9	1	2
10	5	3

Dest	Next	Hops
1	1	1
2	1	2
3	-	-
4	1	2
5	5	1
6	5	3
7	5	3
8	5	2
9	5	2
10	5	3

Tab. 5: Rounting table of 4, 5 and 6

Dest	Next	Hops
1	1	1
2	1	2
3	1	2
4	-	-
5	1	3
6	6	1
8	6	2
7	1	3
9	6	3
10	6	4

Dest	Next	Hops
1	3	2
2	2	1
3	3	1
4	3	3
5	-	-
6	8	2
7	9	2
8	8	1
9	9	1
10	9	2

Dest	Next	Hops
1	4	2
2	8	3
3	8	3
4	4	1
5	8	2
6	-	-
7	8	3
8	8	1
9	8	2
10	8	3

Tab. 6: Rounting table of 7, 8, 9 and 10

Dest	Next	Hops
1	2	2
2	2	1
3	2	3
4	2	3
5	2	2
6	9	3
7	-	-
8	9	2
9	9	1

Dest	Next	Hops
1	6	3
2	5	2
3	5	2
4	6	2
5	5	1
6	6	1
7	9	2
8	-	-
9	9	1

Dest	Next	Hops
1	5	3
2	5	2
3	5	2
4	5	3
5	5	1
6	8	2
7	7	1
8	8	1
9	-	-

Dest	Next	Hops
1	9	4
2	9	3
3	9	3
4	9	4
5	9	2
6	9	3
7	9	2
8	9	2
9	9	1

10	9	2

10	9	2

10	10	1

10	-	-

2.2.4 Point *d*

In OLSR, link state information is generated and forwarded only by nodes selected as MPRs. So the overhead of OLSR will be about $M \times N$ times the average neighbors of the MPRs where M is the number of the MPRs and N is the number of the nodes. This is less than OSPF's overhead because M could be less than N.