

UNIVERSITY OF AMSTERDAM
SYSTEM AND NETWORK ENGINEERING

Lab 7: Mobile IP

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	User	IP
Home Agent	Michiel Appelman	192.168.106.101
Foreign Agent	Rawi Ramdhan	192.168.206.202
Mobile Node	Michiel Appelman	192.168.106.150
Corresponding Node	Rawi Ramdhan	192.168.106.151

Setup

IPconfiguration of Home Agent (Michiel) connected on port 6

```

1 eth1      Link encap:Ethernet  HWaddr 00:18:8b:f7:ca:92
           inet addr:192.168.106.101  Bcast:192.168.106.255  Mask
           :255.255.255.0
3           inet6 addr: fe80::218:8bff:fef7:ca92/64 Scope:Link
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
5           RX packets:2541828 errors:0 dropped:0 overruns:0 frame
           :0
           TX packets:11567812 errors:0 dropped:0 overruns:0
           carrier:0
7           collisions:0 txqueuelen:1000
           RX bytes:199558602 (190.3 MiB)  TX bytes:4066820819
           (3.7 GiB)
9           Interrupt:17

```

Added static route on Home Agent:

```
route add -net 192.168.206.0 netmask 255.255.255.0 dev eth1
```

IPconfiguration of Foreign Agent (Rawi) connected on port 12

```

1 eth1      Link encap:Ethernet  HWaddr b8:ac:6f:8b:81:0f
           inet addr:192.168.206.202  Bcast:192.168.206.255  Mask
           :255.255.255.0
3           inet6 addr: fe80::baac:6fff:fe8b:810f/64 Scope:Link
           UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
5           RX packets:247 errors:0 dropped:0 overruns:0 frame:0
           TX packets:123 errors:0 dropped:0 overruns:0 carrier:0
7           collisions:0 txqueuelen:1000
           RX bytes:23631 (23.6 KB)  TX bytes:11491 (11.4 KB)
9           Interrupt:17 Memory:dc000000-dc012800

```

Added static route on Foreign Agent:

```
1 sudo route add -net 192.168.106.0 netmask 255.255.255.0 dev eth1
```

Connectivity test from Home Agent to Foreign Agent:

```

1 root@alpha:/home/mike# ping 192.168.206.202
PING 192.168.206.202 (192.168.206.202) 56(84) bytes of data.

```

```

3 64 bytes from 192.168.206.202: icmp_req=1 ttl=63 time=0.230 ms
  64 bytes from 192.168.206.202: icmp_req=2 ttl=63 time=0.319 ms
5 64 bytes from 192.168.206.202: icmp_req=3 ttl=63 time=0.183 ms
  ^C
7 --- 192.168.206.202 ping statistics ---
  3 packets transmitted, 3 received, 0% packet loss, time 2003ms
9 rtt min/avg/max/mdev = 0.183/0.244/0.319/0.056 ms

```

Dynamics Mobile IP configuration

Installing Dynamics (this output is from Foreign agent). Compiling in MacOS X failed, we installed a VM instead.

```

1 2043 wget \url{http://downloads.sourceforge.net/project/
    dynamics/dynamics/0.8.1/dynamics-0.8.1.tar.gz?r=http%3A%2F%2
    Fsourceforge.net%2Fprojects%2Fdynamics%2F&ts=1368531282&
    use_mirror=switch|
    2044 mv \url{dynamics-0.8.1.tar.gz\?r=http\:%2F%2Fsourceforge
        .net%2Fprojects%2Fdynamics%2F dynamics-0.8.1.tar.gz}
3 2046 tar -xvf dynamics-0.8.1.tar.gz
    2047 cd dynamics-0.8.1/
5 2048 ./configure
    2052 wget ftp://ftp.gmplib.org/pub/gmp/gmp-5.1.1.tar.xz
7 2053 tar -xvf gmp-5.1.1.tar.xz
    2054 cd gmp-5.1.1/
9 2055 ./configure
    2056 ./configure
11 2057 make
    2058 make install
13 2059 sudo make install
    2060 cd ..
15 2062 cd dynamics-0.8.1/
    2063 ./configure
17 2064 make
    2065 sudo make install

```

Enable forwarding on foreign agent:

```

cat /proc/sys/net/ipv4/ip_forward
2 1

```

Enable forwarding on Home agent:

```

cat /proc/sys/net/ipv4/ip_forward
2 1

```

Generate Public key hash on Foreign-Agent

```

1 sudo rsakeygen /etc/dynfad.key 1024
2 Generating 1024 bits long RSA key to file /etc/dynfad.key
   Generating keys...
4 If the process seems to stop, please move the mouse or write
   something
   on the keyboard to generate enough random data for the keys.
6 generating p: .....
   generating q:
   .....
8 RSA key generated successfully
   RSA public key extension hash: 923C207166DC3ECFE12DC0D1CEED6662

```

Edit configuration file on Foregin-Agent

```

1 administrator@warsaw:~/dynamics-0.8.1$ sudo cat /usr/local/etc/
   dynfad.conf | grep "^[^#]"
INTERFACES_BEGIN
3 eth1      3      1      20      192.168.206.202
INTERFACES_END
5 NetworkAccessIdentifier "[eth0]@example.com"
   HighestFAIPAddress 192.168.206.202
7 UpperFAIPAddress 192.168.206.202
   HighestFA TRUE
9 UDPPort 434
   UpperFAUDPPort 434
11 HAUDPPort 434
   RegistrationTTLCheck 1
13 TunnelDevice "TUNL"
   RoutingTableStart 1
15 RoutingTableEnd 252
   AUTHORIZEDNETWORKS_BEGIN
17 0.0.0.0/0.0.0.0
   AUTHORIZEDNETWORKS_END
19 AllowMobileNodes TRUE
   FA_SECURITY_BEGIN
21 FA_SECURITY_END
   FAKeyFile "/etc/dynfad.key"
23 EnableChallengeResponse FALSE
   ChallengeWindow 2
25 ChallengeLength 4
   RequireChallenge FALSE
27 ChallengeInRegReply TRUE
   RequireMNFASecAssoc FALSE
29 MaxBindings 100
   MaxPending 5
31 DeletePendingAfter 7
   EnableFADecapsulation TRUE
33 EnableTriangleTunneling TRUE

```



```

DEBUG_FLAGS[
    ffffffffffffffffffffffbfffffebf
]
2 HA command line parsing
  Initializing interfaces
4     eth1: ifindex=3 forcing address Listening UDP on
      192.168.106.101:434 dev[N/A]
  Listening UDP on 192.168.106.255:434 dev[eth1]
6  Listening UDP on 255.255.255.255:434 dev[eth1]
  192.168.106.101 => socket=6
8  sending agent advertisement
    * IP header, len=20
10 * header, len=8
    * agentadv ext, len=12
12 * Dynamics ext, len=13
    * total len: 53
14 ** send_agent_advs: next agentadv: 1368531918.41068 diff = 10014
    msec
  set_expr_timer (now=1368531908.026646)
16   next_agentadv in 10.014422 sec

```

Mobile IP analysis

At Home-Agent

1. Advertisement message sent from Home Agent to the Nemo Network. What is the Care-Of-Address (COA) specified in the advertisement?

Tcpdump is available on <http://www.cloudshark.org/captures/1e7a4f6f949e?filter=ip.src%3D%3D192.168.106.0%2F24>

The COA is 192.168.106.101 (see figure 1)

```

Ext: Mobility Agent Advertisement Extension
  Extension Type: Mobility Agent Advertisement Extension (16)
  Length: 10
  Sequence Number: 433
  Registration Lifetime: 600
  > Flags: 0x2000
    Care-Of-Address: 192.168.106.101 (192.168.106.101)
Ext: Unknown ext 134
  Extension Type: Unknown (134)

```

Figure 1: COA

2. Registration request message sent from MN in the Home Network to HA and corresponding reply message. Record the Care-Of-Address specified in the registration request message. Specify the home address and home agent address in the message.

Tcpdump is available on <http://www.cloudshark.org/captures/>

988fb87631de
Home address: 192.168.106.101
Home agent: 192.168.106.150

```
Membership Report / Join group 224.0.0.2 for any sources
Reg Request: HoA=192.168.106.150 HA=192.168.106.101 CoA=192.168.106.150
Reg Reply: HoA=192.168.106.150 HA=192.168.106.101, Code=0
Mobile IP Advertisement (Does not route common traffic)
Membership Report / Join group 224.0.0.2 for any sources
```

Figure 2: address

At Foreign-Agent

1. Foreign Agent advertisement sent to foreign network. Record the Care-Of-Address specified in the advertisement.

Tcpdump is available on <http://www.cloudshark.org/captures/5965ebf92410?filter=ip.src%3D%3D192.168.206.0%2F24%20or%20ip.src%3D%3D192.168.106.0%2F24>

COA: 192.168.206.202

2. Registration request message from MN and corresponding reply. Record the Care-Of-Address specified in the registration request message. Record the home address and home agent address in the message.

Home address: 192.168.106.150

Home agent: 192.168.106.101

COA: 192.168.206.202

```
141 Reg Request: HoA=192.168.106.150 HA=192.168.106.101 CoA=192.168.206.202
249 Reg Request: HoA=192.168.106.150 HA=192.168.106.101 CoA=192.168.206.202
288 Reg Reply: HoA=192.168.106.150 HA=192.168.106.101, Code=0
144 Reg Reply: HoA=192.168.106.150 HA=192.168.106.101, Code=0
```

Figure 3: Home address

3. Draw registration workflow between MN, FA and HA.

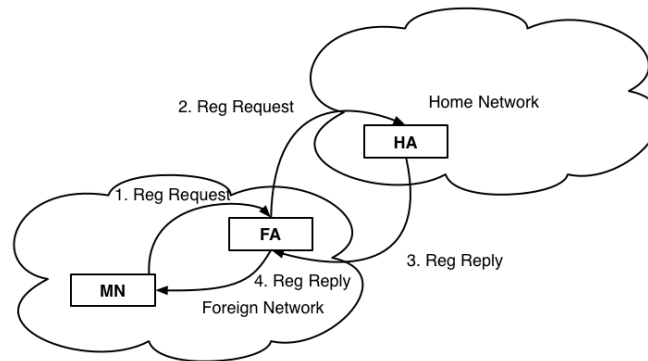


Figure 4: workflow

At Mobile Node

1. Using ping to verify and measure RTT from MN to CN when the MN is at the Home network and Foreign network. Compare these two results.

Ping from MN to CN @ home:

```
average 1.305 ms
```

Ping from MN to CN @ foreign:

```
1 average 1.848 ms
```

2. Compare UDP throughput from MN to CN at the home network and foreign network by using iperf: run the iperf server on the CN and iperf client on the MN.

Local network Iperf

```
1 4] local 192.168.106.151 port 5001 connected with
   192.168.106.150 port 54227
[ 4] 0.0-10.3 sec 69.2 MBytes 56.6 Mbits/sec 0.105 ms
   137/49512 (0.28%)
3 [ 4] 0.0-10.3 sec 1 datagrams received out-of-order
```

Foreign network Iperf

```
1 [ 4] local 192.168.106.151 port 5001 connected with
   192.168.106.150 port 47232
[ 4] 0.0-10.3 sec 105 MBytes 85.7 Mbits/sec 0.119 ms
   54/74860 (0.072%)
3 [ 4] 0.0-10.3 sec 1 datagrams received out-of-order
```


3. Observe the routing table when MN is at the Home network and at the Foreign network. Draw and describe the network traffic flow from MN to CN when the MN is at the Foreign network.

```

1 root@mininet-vm:~# route
  Kernel IP routing table
3 Destination      Gateway            Genmask           Flags Metric Ref
    Use Iface
  192.168.106.0    *                  255.255.255.0     U        0      0
    0 eth0
5 root@mininet-vm:~# ping -i 0.1 -c 50 192.168.106.151^C
  root@mininet-vm:~# route
7 Kernel IP routing table
  Destination      Gateway            Genmask           Flags Metric Ref
    Use Iface
9 default          192.168.206.202  0.0.0.0           UG        0      0
    0 eth0
  192.168.202.2    *                  255.255.255.255   UH        0      0
    0 eth0
11 192.168.206.202 *                  255.255.255.255   UH        0      0
    0 eth0
  192.168.208.2    *                  255.255.255.255   UH        0      0
    0 eth0

```