Communication Networks 2

SS 2019

Assignment 4

Group 08

Name	Mat.Nummer
Constantin SCHIEBER	01228774
Andreas HIRTENLEHNER	01327273

May 29, 2019

1 Description of the Solution

We implemented a ns3 simulation based on the given specification and with the help of the examples provided in the ns3 documentation. Furthermore, the generation of an XML-File for the tool `NetAnim` is implemented to visualize the created network. We create another `NetAnim` compatible XML-File that contains the routing tables of the network nodes. Static routing tables are computed at compile time with the `Ipv4GlobalRoutingHelper` library.

The `EnablePcapAll` function enables pcap output on all devices in the network. Note that this function needs to be invoked on `p2p` and `csma` device types separately. This generates files of the type `prefix-A-B` where `A` is the node-id and `B` is the device-id. We expect 3 nodes with ID 0 to 2 and two devices with IDs 1 and 2. A third device ID 0 is present in the routing tables and refers to the local loopback interface. Subsequently, four pcap files are generated:

- `assignment4-0-1`
- `assignment4-1-1`
- `assignment4-1-2`
- `assignment4-2-1`

1.1 Expected Results

We expect about 9 seconds of recorded data.

1.1.1 Node 0, Interface 1

Observations at Node 0, Interface 1 should show an outgoing `ICMP` packet to the address `10.0.148.2` every 0.2 seconds with a length of 1052 bytes (1024 bytes payload + 28 bytes protocol overhead). An incoming `ICMP` packet from the source `10.0.148.2` to the destination `10.0.20.1` should arrive after a time of approximately $30ms+2\cdot2ms = 64ms$. The `ttl` of the incoming packet should be decreased by one, as Node 2 is traversed. The sent packets should use P2P Frames.

1.1.2 Node 1, Interface 1 (P2P)

Interface 1 on Node 1 receives messages from Node 0 every 0.2 seconds. These messages are then forwarded into the subnet `10.0.148.0` and the answer from the pinged host should (this time relayed from Interface 2) be received after 4ms. Packets should still use P2P Frames.

```
PING 10.0.148.2 56(84) bytes of data.
1032 bytes from 10.0.148.2: icmp_seq=0 ttl=63 time=83 ms
1032 bytes from 10.0.148.2: icmp_seq=1 ttl=63 time=65 ms
...
```

Listing 1: Ping output from the ns3 simulation

1.1.3 Node 1, Interface 2 (CSMA)

Interface 2 on Node 1 forwards the packet to its destination `10.0.148.2` and should record an answer from the destination after 4ms. Packets should have been switched to Ethernet Frames, which most likely will increase the total length of the packets.

1.1.4 Node 2, Interface 1 (CSMA)

Node 2 should record a packet on Interface 1 every 0.2 seconds and an outgoing answer to this packet should be recorded immediately. Packets should still use Ethernet Frames.

1.1.5 Output of Ping

We expect a constant output from the ping tool, i.e. 1032 transmitted bytes, a ttl of 63 and a time of 64ms.

1.2 Observed Results and Explanation of Deviation

The observed results match our expectation for the most part. We didn't consider that Nodes 1 and 2 may use the Address Resolution Protocol (ARP) at the start of the simulation. The total packet length under the usage of P2P Frames is **1054** and not 1052 (`20 Byte Ipv4 + 8 Byte ICMP + 2 Byte P2P`) as the size of the P2P frame was not considered. The total packet length for Ethernet Frames increases to **1070** (`18 Byte Ethernet + 20 Byte IPv4 + 8 Byte ICMP`).

The ping tool reports a time of 83ms for the first ping (Listing 1), this can be attributed to the fact that ARP packets are exchanged in the beginning and the first ping is delayed by that (Listing 2).

```
1 0.000000 00:00:00_00:00:03 Broadcast ARP 64  64
2 0.004012 00:00:00_00:00:04 00:00:00_00:00:03 ARP 64  64
4 0.017114 00:00:00_00:00:04 Broadcast ARP 64  64
5 0.017114 00:00:00_00:00:03 00:00:00_00:00:04 ARP 64  64
```

Listing 2: ARP messages that delay the first ping