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BLG609E - Special Topics: 4G Wideband Wireless Network Architectures
(Spring 2012)

Homework - 10: Network Availability

1. Given the following information compute the overall system availability in percentage over a 24 hour period. There are four eNBs in the network. eNB-1 has 50% of the load, and the other three eNBs carry the remaining 50% of the load. eNB-1 has a downtime of 6 hours during the 24 hour period. The other three eNBs do not suffer any downtime. (5 POINTS)

   Overall System Availability is then =

$$\frac{50 * Availability_{ENB-1} + (50/3) * Availability_{ENB-2} + (50/3) * Availability_{ENB-3} + (50/3) * Availability_{ENB-4}}{100}$$

   NOTE: We need to take weighted average of the availabilities of all eNBs with respect to their traffic loads to calculate overall system availability.

$$Availability_{ENB-1} = \frac{\overline{T_{ON-ENB-1}}}{\overline{T_{ON-ENB-1}} + \overline{T_{OFF-ENB-1}}} = \frac{24 - 6 = 18\ hours}{18 + 6 = 24\ hours} = 75\ \%$$

$$Availability_{ENB-2} = \frac{\overline{T_{ON-ENB-2}}}{\overline{T_{ON-ENB-2}} + \overline{T_{OFF-ENB-2}}} = \frac{24 - 0 = 24\ hours}{24\ hours} = 100\ \%$$

   Similarly $Availability_{ENB-3} = Availability_{ENB-4} = 100\%$

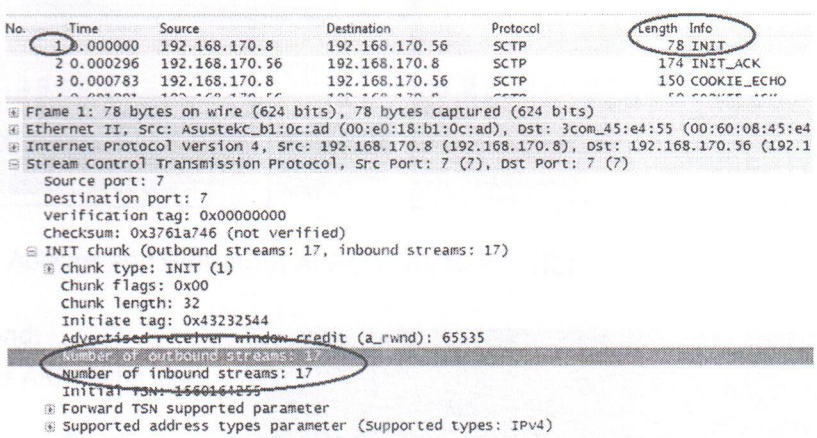
   Overall System Availability =

$$\frac{50 * 75 + \left(\frac{50}{3}\right) * 100 + \left(\frac{50}{3}\right) * 100 + \left(\frac{50}{3}\right) * 100}{100} = 87.5\ \%$$

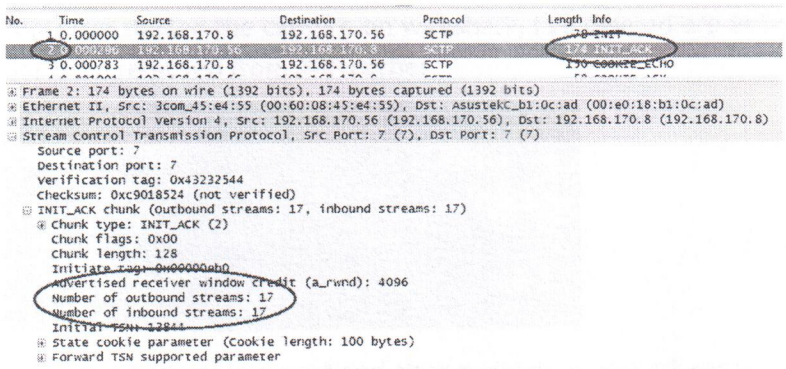
2. Download and open the following SCTP trace:
   http://wiki.wireshark.org/SampleCaptures?action=AttachFile&do=view&target=sctp-_test.cap .
   (5 POINTS). Answer the following questions

a. The SCTP association has how many streams in each direction?

   SCTP INIT message (msg # 1) can be checked for *how many streams the client has wanted* in each direction (outband is wanted, inband is maximum inband streams it supports):



   Did the server acknowledged? Check INIT_ACK (msg #2) (same numbers of streams acknowledged)

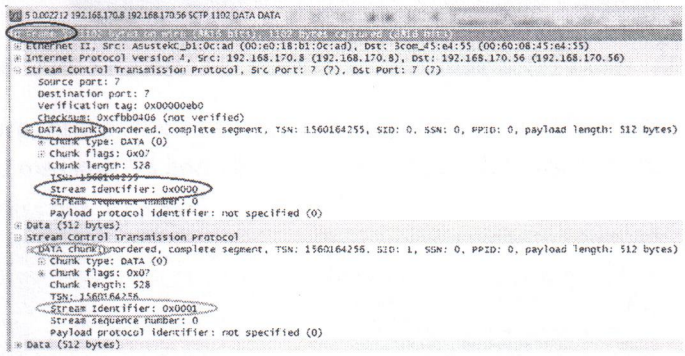


Therefore, after this connection is set up (after cookie ack) there are 17 streams in both directions.

b. The two data chunks in message 5 belong to which two stream identifiers?

Data Chunk 1: Stream Identifier: 0

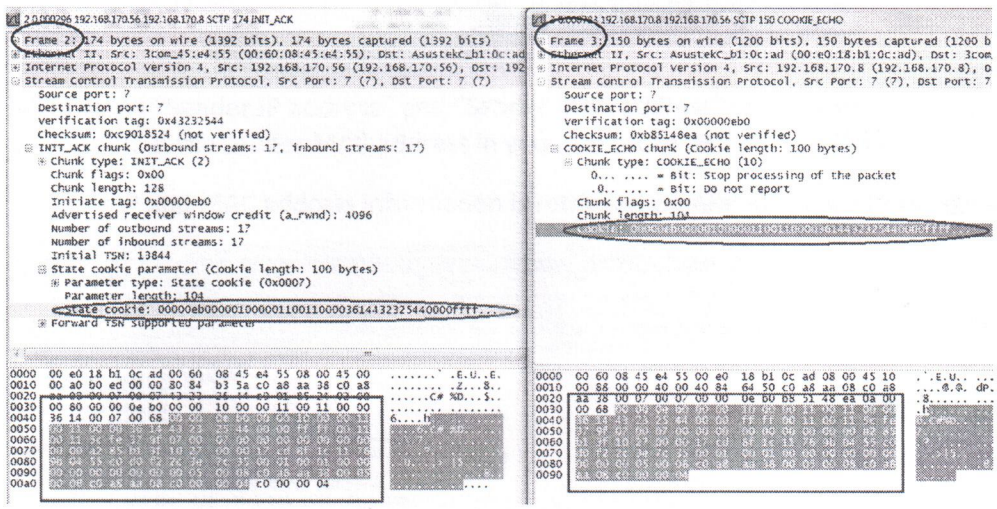
Data Chunk 2: Stream Identifier: 1



c. Is the cookie value in Cookie-echo the same as that in INIT-ACK and what is its value?

Cookie-Echo (msg #3) is checked and cookie value is: 00 00 0e b0 .... 00 04
INIT-ACK (msg #2) is checked and cookie value is: 00 00 0e b0 .... 00 04

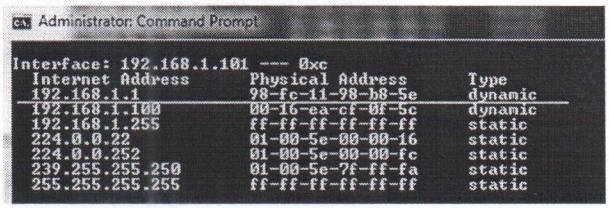
YES, they are same, controlled from cookie content details below.



3. Virtual IP Address and Gratuitous ARP (TOTAL 10 POINTS)

Background:

My PC has ARP cache like:



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After I've started the capture on wireshark, I ve deleted arp entry for 192.168.1.1 and checked it has been removed from ARP cache:

```
C:\Windows\system32>arp -d 192.168.1.1

C:\Windows\system32>arp -a

Interface: 192.168.1.101 --- 0xc
  Internet Address      Physical Address      Type
  192.168.1.100         00-16-ea-cf-0f-5c     dynamic
  192.168.1.255         ff-ff-ff-ff-ff-ff     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static

C:\Windows\system32>
```

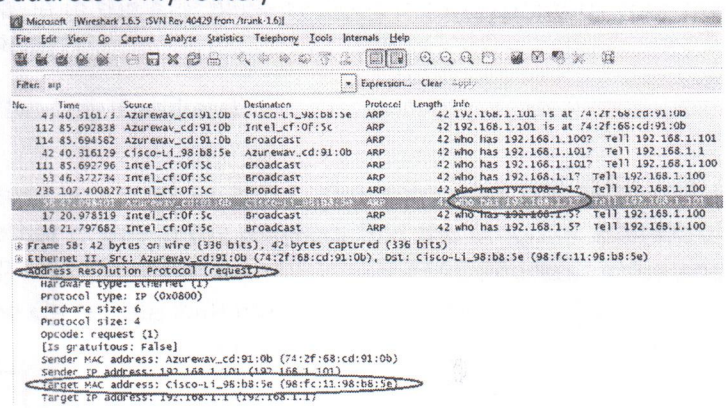
Then, this address is pinged and after a minute wireshark capture is stopped.

```
C:\Windows\system32>ping 192.168.1.1

Pinging 192.168.1.1 with 32 bytes of data:
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64

Ping statistics for 192.168.1.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 1ms, Average = 1ms
```

A. What is the destination MAC address of the "ARP Request"? (2 POINT)

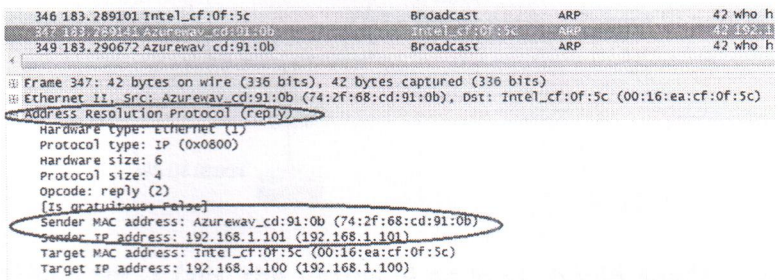
destination MAC should be ff:ff:ff:ff:

When captured packets are filtered with arp, ARP packets can be seen in wireshark. ARP Request message for the deleted arp cache entry is message 58 and 181. They both have the target MAC address of 98:fc:11:98:b8:5e (MAC address of my router)



B. What is the "Sender IP address" and "Sender MAC address" in the ARP Response? Type "arp –a" on your PC. Is the sender MAC address in your arp cache entry? (1 POINT).

Sender's IP and MAC address information is retrieved via ARP Response (message # 347)



IP : 192.168.1.101
MAC : 74:2f:68:cd:91:0b

Sender MAC address is not in the ARP Cache because the MAC address is my PC's MAC address and need not to be discovered and attached with my IP address.

C. What is the destination Ethernet address used in the Gratuitous ARP packet? (2 POINT)

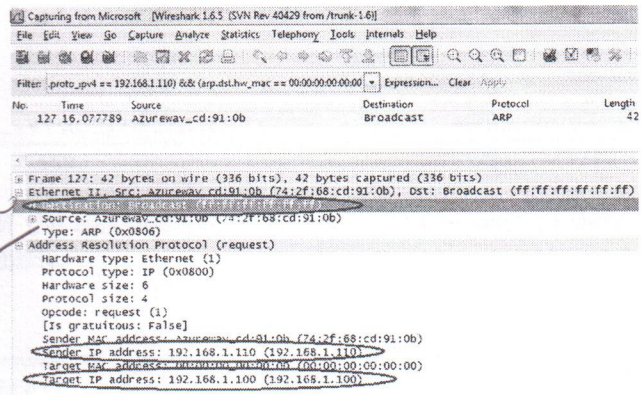
Background: I've started wireshark. Switched off the wireless card and after one minute switched it on again. Thereafter one minute, stopped the wireshark capture. It is expected and observed that after my PC has gotten IP address via DHCP, it sends out a "Gratuitous ARP".

I have applied a filter like: (arp.src.proto_ipv4 == 192.168.1.110) && (arp.dst.hw_mac == 00:00:00:00:00:00) for capturing Gratuitous ARP packet. Because "ARP request contains the sender's protocol address (SPA) in the target field (TPA=SPA), with the target hardware address (THA) set to zero".

Note: My IP was changed to 192.168.1.111 after rebooting wireless adapter.
The destination Ethernet address used in the Gratuitous ARP packet: ff:ff:ff:ff:ff:ff (Broadcast)

(Why the is gratuitous field is false? I have tried many captures with many IP changes but could not find any packet with True field.)

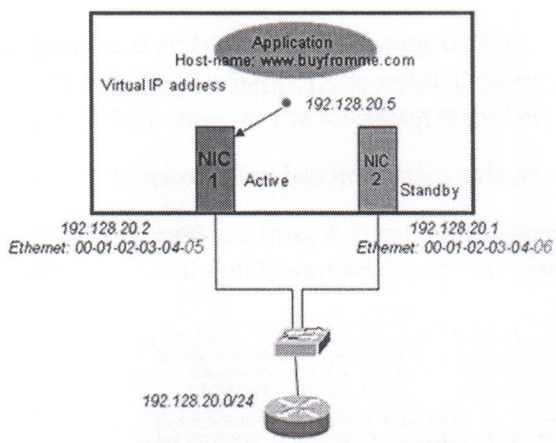
Yes this is a bug in Wireshark software



D. What is the "Target IP address" value in the ARP packet? Does it correspond to your the IP address of your computer? (1 POINT)

The target IP address: 192.168.1.100 (was my IP address)

E. Initially when the virtual IP address is bound to NIC-1, the computer will send out a Gratuitous ARP to inform all the other nodes in the network that the Ethernet address of NIC-1 corresponds to the virtual IP address. What is the "Sender MAC address" value and the "Target IP address" value in the Gratuitous ARP message? (2 POINTS)



In the Gratuitous ARP message:
Sender MAC address value: 00-01-02-03-04-05
Target IP address value: 192.128.20.5

F. When NIC-1 fails, the Virtual IP address should now be bound to NIC-2, i.e all the other nodes in the network need to be informed that the Ethernet address of NIC-2 corresponds to the virtual IP address. What is the "sender MAC address" value and the "Target IP address" value in the Gratuitous ARP message that the computer now sends? (2 POINTS)

In the Gratuitous ARP message:
Sender MAC address value: 00-01-02-03-04-06
Target IP address value: 192.128.20.5