Term Exam 1, CN 15th/April/2021 Universidad de León, EIII

1. (2 points) Explain the *traceroute* Linux utility by responding to the following questions. Employ as rich and accurate a terminology as possible:

    a. The protocol stack activated at the initiator and at each responder (Router) along with the relevant multiplexing keys at each layer

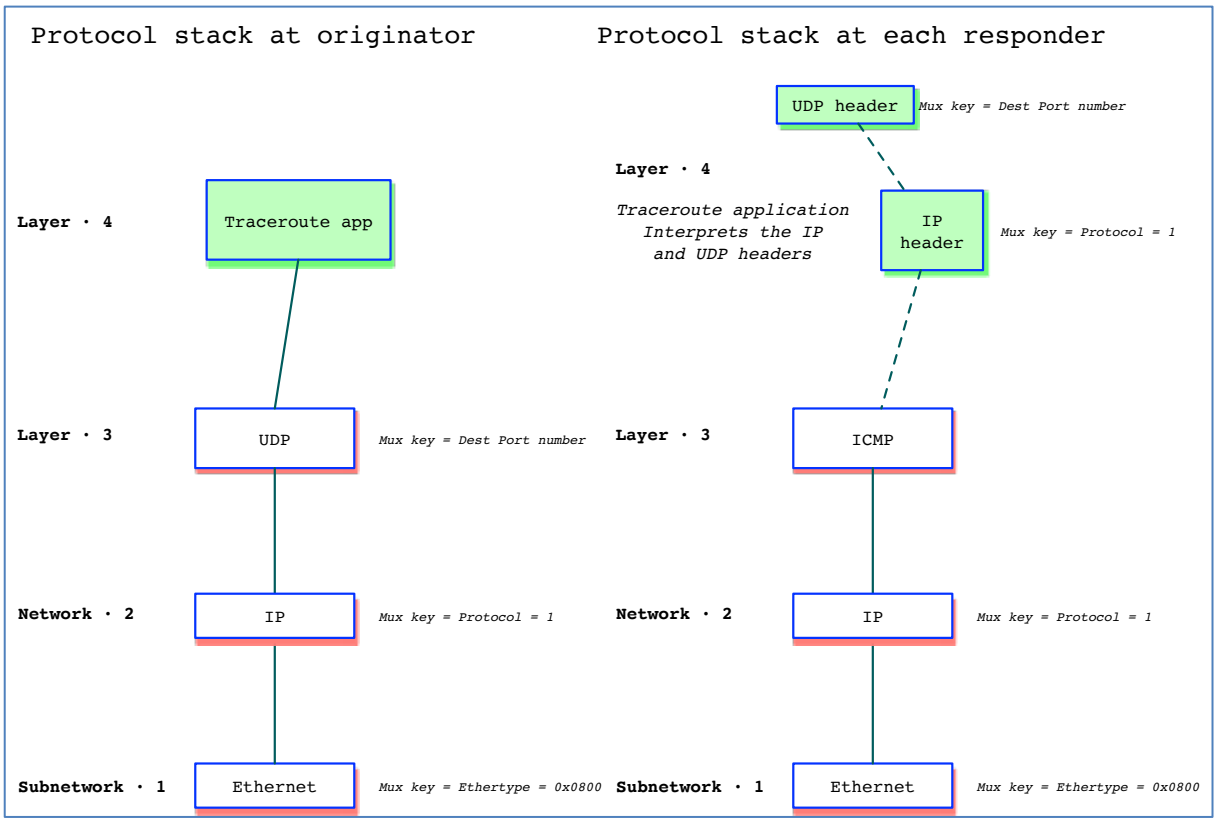


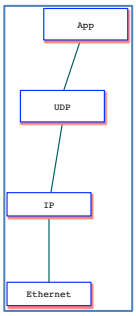
Figure 1. Protocol stacks, traceroute

    b. Explain how the initiator matches each received ICMP TEM to the sent Probe packet so that the ***order*** of the discovered routers on the Internet path can be printed out

Study fig. 1 multiplexing keys.

2. Calculate how much time it takes to transfer two files each of which has a size is **1KB** from a host A to a host B assuming a **direct Ethernet** connection between them. The distance between the sender and the receiver hosts is **250 m** and the transmission speed is **100 Mbps**. Assume that the sending application at host A uses the UDP transport protocol. The IP layer invokes the PF_PACKET socket sendto() call twice, the first time for sending the first frame and the second for the second one. The physical transmission circuit must send the two frames including a pause of 96 bit times in between.

    a. Depict the resulting protocol stack



b. Calculate the total time that it takes to have the two files fully transferred from host A to host B

Total time = Transmit frame 1 + 96 bit times (IFG) + Transmit frame 2 + T_p

Bit time = T_t = 1/100Mbps = 10 ns

T_p : Since Rtt 51,2µs corresponds to 2500 m, we have an Rtt of 5,12µs corresponding to 250 m; then:
T_p = Rtt /2 = 5,12 µs /2 = 2,56 µs

Bits per frame =
64 bit Preamble + 14 B Ether hdr +
20B (IP hdr) + 8B (UDP hdr) + 1KB data +
32 bits (CRC)

c. Calculate the **throughput** attained (Total number of bits sent / total time)
Total time = Total bits / (Total time used for the transfer and including IFG)

- *Size of a UDP segment header is 8 Bytes*
- *Size of an IP packet header is 20 Bytes*
- *Ethernet Datalink header is comprised of:*
  - *Dest. Address (DST MAC): 6 Bytes*
  - *Src. Address (SRC MAC): 6 Bytes*
  - *Ethertype: 2 Bytes*
- $MTU_{Ethernet}$ *= 1500 Bytes*
- *The Physical-layer Ethernet header has two sections:*
  - *Preamble or prolog: 64 bits*
  - *Epilog containing the CRC: 32 bits*
  - *Inter-Frame Gap (IFG) = 96 bit times*

3. Mark which of the following statements about the *Service Interface* are true:

- ☐ a. This interface is used only when transmitting
- ☐ *b. This interface is used when transmitting and when receiving as well*
- ☐ c. This interface is present only in the layers from the OSI architecture
- ☐ *d. This interface is exported by layers 1, 2, 3 and 4 from the Internet Architecture*
  Layer 4 exposes no service interface
- ☐ e. The service interface exported by the subnetwork layer is PF_PACKET in all protocol stacks of present day
  Only in Linux
- ☐ *f. The service interface of all the layers that export it in Linux constitutes a new layer in the operating system known as socket layer.*
  It is known as the "sockets layer"

4. Mark which of the following statements about the *Peer-to-peer* are true:

- ☐ a. This interface is used exclusively when transmitting
- ☐ *b. This interface is used when transmitting and as well as when receiving*
- ☐ c. This interface is invoked programmatically
- ☐ *d. This interface is comprised of legal protocol messages*
- ☐ e. Each service provides its own peer-to-peer interface
- ☐ *f. Each protocol provides its own peer-to-peer interface*

5. What happens when the transmission speed is lower than or equal to C, the Shannon's Channel Capacity?
In that case, the chance of getting an error on transmission goes rapidly to 0; otherwise, it is not impossible to design simple codes for error correction that correct the errors that might happen.

6. Depict in a timing diagram the transmission of the bitstream 1111000010010001 using the NRZ and Manchester line encodings.

   Consult textbook and other published exam and homework solutions (paloalto.unileon.es/cn)

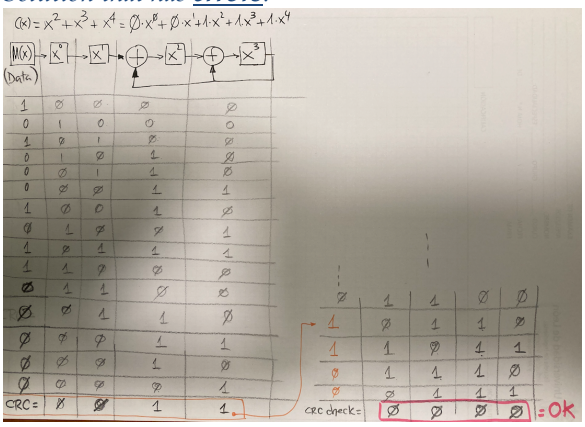
   Using the bitstream from the preceding question,
   depict the timing diagram corresponding to the 4B/5B + NRZ-i encoding

   Consult textbook and other published exam and homework solutions (paloalto.unileon.es/cn)

7. A datalink protocol uses a CRC that is based on the following generator polynomial: C(x) = $x^2 + x^3 + x^4$

   a. a. Calculate the CRC polynomial resulting when transmitting the following data: (Leftmost bit is the MSB): 10100010110

   *Solution that has **errors**:*



   ***Correct** solution used in assessing Term Exam 1:*

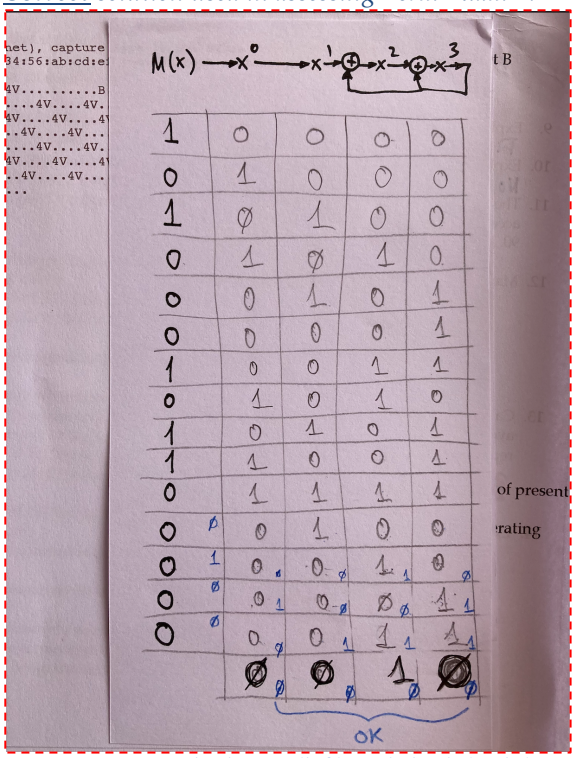


   Figure 2. CRC calculation (left) and check (right)

   b. What operation is executed at the receiver for checking whether some error took place? Calculate the result of that operation and tell whether or not an error took place (That is, probabilistically).
   See fig. 2

c. If the execution of the operation you explained on section b. of this question reports that no error took place, what interpretation should be derived from that fact?
If CRC check is ok, then, probably no error took place

d. Discuss the error-correction capabilities of CRC
See textbook by P & D

8. Explain the techniques employed by Ethernet to delimit the fields of a frame.
Preamble marks frame start; frame end is derived from extinction of ethernet electrical signal. Fields are all fiexd-length. Payload length can vary from min 512 through 1500 Bytes. Payloads of length < 512 must be 0-padded

9. Explain the transparency mechanism used in the Ethernet protocol
Given the provisions form the preceding question, ethernet needs no formal transparency mechanism.

10. The network manager of a coaxial-cable Ethernet network receives a lot of complaints from users losing access to Internet. He observes that this happens when the number of hosts using the network is greater than 90. Explain this problem by applying the concept of scalable connectivity.

The considered Ethernet presents a high number of collisions that reduces considerably the available network bandwidth; that Ethernet doesn't scale properly to size 90, probably due to a high utilization level from each host

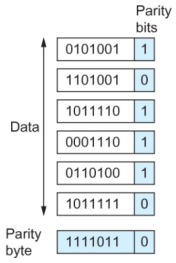
11. Mark which of the following equipment implement the IP protocol

a. An Internet host
b. A router
c. A LAN switch
d. An Ethernet hub
e. None of the above equipment

12. Calculate the Rtt of an Earth-Mars link which has an average distance of 225 millions of Km. Assume that the average electromagnetic wave propagation speed is $3 \cdot 10^8$ m/s. Assume that the responder generates the reply in 0 s.

Rtt = 2 · T_p; T_p = 225 10^6 10^3 m / (3 10^8m/s) = 225 ·10/3 s= 2250/3 s = 750 s; Rtt = ~~375 s~~ = 2 · T_p = 2 · 750 s = 1500 s

13. Explain the most important properties of the following code:



Consult the P&D textbook

14. What circumstances may prevent the traceroute utility from composing the full path to some destination?

Lost or filtered probe packets; lost or filtered response packets

15. Interpret the following tcpdump trace
    a. What's the Ethernet multiplexing key value?
    0842
    b. What's the Ethernet destination MAC address?
    0x1234 56ab cdef
    c. What's the Ethernet source MAC address?
    0x8416 f903 c504
    d. What's the meaning of the tcpdump options used in the command line?

Capture trace from interface enp3s0
Printout the ethernet header
Hex
Verbose
Limit trace to ethertype value 0x0842

e. What's the probable effect derived from the destination host receiving this frame?
The frame's payload sends ffff ffff ffff and 16 copies of a MAC: probably it is a Magic Packet.

f. Does the frame contain an IP packet?
No, ethertype value is not 0x0800 and payload can't be mapped to a correct IP packet

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# tcpdump -i enp3s0 -e -XX -vvv ether proto 0x0842
tcpdump: listening on enp3s0, link-type EN10MB (Ethernet), capture size 262144 bytes
19:40:55.935038 84:16:f9:03:c5:04 (oui Unknown) > 12:34:56:ab:cd:ef (oui Unknown), ethertype Unknown
(0x0842), length 116:
  0x0000:  1234 56ab cdef 8416 f903 c504 0842 ffff  .4V..........B..
  0x0010:  ffff ffff 1234 56ab cdef 1234 56ab cdef  .....4V....4V...
  0x0020:  1234 56ab cdef 1234 56ab cdef 1234 56ab  .4V....4V....4V.
  0x0030:  cdef 1234 56ab cdef 1234 56ab cdef 1234  ...4V....4V....4
  0x0040:  56ab cdef 1234 56ab cdef 1234 56ab cdef  V....4V....4V...
  0x0050:  1234 56ab cdef 1234 56ab cdef 1234 56ab  .4V....4V....4V.
  0x0060:  cdef 1234 56ab cdef 1234 56ab cdef 1234  ...4V....4V....4
  0x0070:  56ab cdef                                V...
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