

Homework 1 (Due: 2 weeks after book is available)

1. Protocols and Demultiplexing.

a) Use the Wireshark tool to examine the packet trace in the supplied file (on the web site). Your goal is to draw a “protocol tree” of the packets in the trace that shows which protocols are used at which layers. In this tree, each node stands for a protocol. A line from a lower node to a higher one means that the higher protocol is carried in packets on top of the lower protocol. There are more nodes at higher layers of the tree because multiple different protocols are used on top of a given protocol, e.g., both TCP and UDP are run over IP.

You will need to learn a little about the Wireshark tool to do this. There is information at the Wireshark site (<http://www.wireshark.org/>). However, you simply might proceed as follows:

- i. Launch Wireshark (on the CSE lab machines if you don't want to install it)
- ii. Open the trace file. The upper part of the window then lists one line per packet. The lower part lets you look at the selected packet in more detail (open the “+” areas).
- iii. Sort the packets by their highest layer protocol by clicking on the “Protocol” heading.
- iv. Go through the protocols, looking at one packet for each type of protocol, to see all of the lower layer protocols for the packet (e.g, a TCP packet will have IP below it).
- v. For fun, have a look at the different protocols and the various fields they use.
- vi. For each new high layer and lower layer protocol you find, add them to your single protocol tree diagram. Add a node with the name of the protocol, and a line showing the lower layer protocol on which it builds.

b) For the following protocols, look at a packet to see if you can determine what field is used as the “demultiplexing key” that determines the next higher layer: Ethernet II, IP, and UDP.

2. Error Difficulty.

There are different types of possible errors: bit errors, burst errors, erasure bit errors, and erasure bursts. Think about the difficulty of detecting or correcting each type of error (for a comparable rate of errors). Rank the errors in what are generally easiest to hardest to detect or correct. Justify your ranking with a very brief intuition (say a sentence for each ranking).

3. ARQ Details.

It is not only the data frames that need to be numbered for ARQ to be correct. The ACK frames need to be numbered too. Show that this is true by coming up with an example in the form of a time sequence diagram (time goes down the page, arrows show frames) for the stop-and-wait

protocol. Your example should cause the wrong data to be delivered if the frames are numbered but the ACKs are not.

4. Protocols and Layering

Read the paper “Opportunistic Routing in Multi-Hop Wireless Networks” (<http://portal.acm.org/citation.cfm?id=972387>). Consider two alternatives for sending information across multi-hop paths between two nodes in a group of wireless nodes. The first alternative is sending IP packets between two nodes along a chosen route of 802.11 links. The second alternative is sending IP packets between two nodes using ExOR.

- a) Draw the packet format “in the air” and protocol stack at a wireless node for each case.
- b) For each protocol in the stacks, indicate which protocols are processed at a node in the middle of the multi-hop path and which protocols are not touched by a middle node.
- c) For each header in the protocol formats, indicate which headers stay on the packet from the start to the finish node, and which headers are added/removed at middle nodes.

5. Textbook

Questions 1.16, 1.22, 2.16, 2.46, 3.10, 3.17

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