Worksheet 1: Layering

Directions

Please form small groups and work out the answer to the question. The TA will walk around to help you, and at the end, they will discuss the correct answer. Doing this will help you prepare for the HW—a variant will be asked in the midterm.

Strict Layering

Recall that strict layering means that each layer only looks at its own header and only communicates with adjacent layers via an interface. In what follows below, assume that every packet in the Internet has a data link header (e.g. Ethernet), a routing header (e.g. IP header), and a transport header (e.g. TCP).

Assume that:

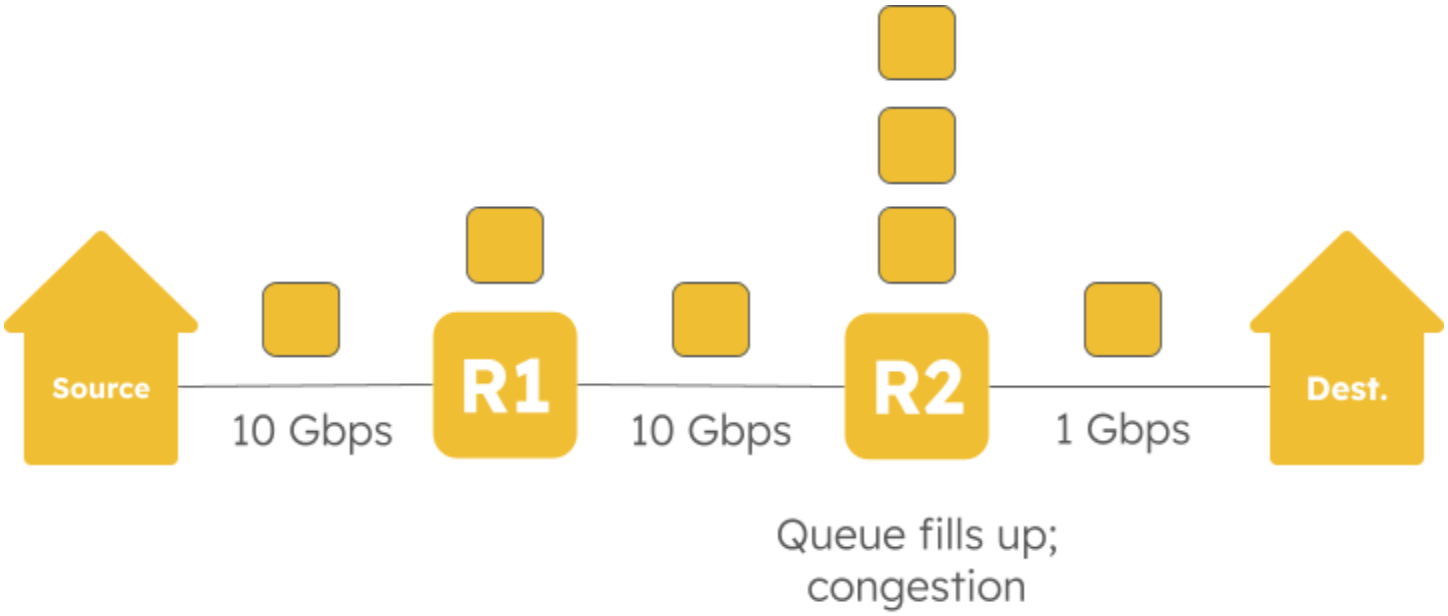
1. routers in the Internet look at the **destination address in the IP header** to decide where to forward packets,
2. the transport header has **sequence numbers** that it uses to number messages to check whether they arrive safely based on acknowledgements and to retransmit them if needed, and
3. the transport header also has something called **port numbers** which identify which application the packet is so that it can send it to the right application at the destination (e.g. 80 identifies Web traffic and 25 identifies email).

Firewalls

Firewalls are a special kind of router that look at the port numbers to decide whether certain application messages (e.g. SQL to stop SQL injection attacks) should be blocked. Is this a layer violation? Why or why not?

Congestion Control

The picture below shows a source trying to send a large amount of data to a destination across a path consisting of two routers R1 and R2. The link from the source to R1 and R1 to R2 is very fast (10 Gbps), but the link from R2 to D is much slower (1 Gbps). Thus, a queue builds up at R2. R2 can detect this and would like to signal the source to slow down. How can it do so and avoid a layer violation?



Questions

1. We could add a congestion bit to the header. Which header? IP or TCP? Or both. Read on to decide.
2. The “obvious way” to send congestion information back to the source is to send it backwards to R1 to the source. How might you do so? Unfortunately, it turns out that a large number of transfers on the Internet are asymmetrical. The path taken from the source to the destination is not the path taken from the destination to the source. What are the implications of this?
3. If you have the congestion bit forward to the destination and then back to the source, how would you do it? Think of which headers and which interfaces you would use.