

Lesson 11: Packets and Making a Reliable Internet



Goals: We will be able to...



- Explain why protocols are necessary to overcome the underlying unreliability of the Internet
- Justify the need for acknowledgements and packet numbering in TCP
- Develop a protocol for reliable communication on the Internet

Warm-Up:



- Your friend sent you a message on the Internet, but you never received it. Based on what you already know about routers and the physical Internet, list what reasons might explain this fact.

Packets Unplugged Activity



- You cannot move from your location
- You need to send a message
 - With one word on each sheet
 - With the address you are sending to on each sheet

The Need for Packets



- When we communicate on the Internet, we are not just sending short text messages as we did yesterday.
 - We also exchange docs, videos, music, and data, and these files can easily grow to enormous size.
- All of this would not be a problem if the Internet were perfectly reliable, but in reality some errors sometimes occur (wires cut, routers overwhelmed, interference).
- The response to this problem is to **split large messages into smaller pieces of info called packets**

More on Packets



- It turns out that splitting up a message into packets provides many benefits.
 - If a faster route opens up halfway through transmitting a large file, it is easy to reroute later packets in the transmission through that route
- Splitting up a message into smaller chunks doesn't solve all the problems of unreliability on the Internet
 - Packets can still be dropped or arrive out of order
- Today's challenge is to develop a protocol to reliably send messages even though the network itself is unreliable...

Internet Simulator – Packets and Unreliability



- **A few changes:**
 - You will only be allowed to send packets containing 8 characters of text
 - Anything larger than 8 characters will be cut off...
 - However, you may construct multiple packets prior to sending them, by clicking “Add packet,” and then sending them all with one click of the “send” button.
 - Every message has a small chance of being dropped on each “hop” it makes between routers.

Activity Guide: Packets and Making a Reliable Internet



- Work in groups of 2-4
- Log in to Code Studio – Internet Simulator Stage 11
- Add at least 4 routers
- Join a DIFFERENT router from your groupmates

Develop a Protocol



- Develop a communication protocol that allows you to overcome the unreliability of the network so that a message can be sent and both sender and receiver can be confident the full message was received.
 - There should be a way to confirm receipt of a packet/message
 - There should be a way to define the ordering of packets
- Your message could look something like this:

```
@@@@          v
@  @         .-, |
@@@@        ((.))/
@  @        /  \
@@@@        /___\
           _/  |_
```

Guidelines for Protocol:



- All communication can only be done through the Internet Simulator
- The full message sent will be at least 80 characters long – broken into at least 10 packets – and might be entirely random (i.e. there's no way to use human intuition to reconstruct the message)
 - The message is not known beforehand
- The sender and receiver must be confident the full message was successfully transmitted and reconstructed.

Test Protocol



- You'll send a message of my choosing

How your protocol may look like TCP:



- Every once in a while TCP sends back a “cumulative acknowledgement” of how many in-order packets it has received. For example in an 8-packet message if you received packets:
 - 1 2 _ 4 5 6 _ 8
- Then you would send back a message like:
 - ack 2 or maybe ack 3 in order to have packet 3 re-sent

Wrap-Up:



- Video: The Internet: Packets, Routing, and Reliability: <https://youtu.be/AYdF7b3nMto>

Activity and TCP



- The challenges we encountered in today's activity very closely mirror those that exist on the actual Internet
- The response was the development of a protocol called the **Transmission Control Protocol, or more simply, TCP.**
- TCP divides larger messages into smaller packets which have ordering information added to their header.
- When a packet arrives at a destination computer, an acknowledgment is sent to the sender, letting them know they don't need to resend that packet.
- Once all the packets have arrived, the ordering information in the headers of the packets allows them to be reordered to create the original message.

Vocabulary:



- Packets – Small chunks of information that have been carefully formed from larger chunks of information
- TCP – Transmission Control Protocol – provides reliable, ordered, and error-checked delivery of a stream of packets on the internet. TCP is tightly linked with IP and usually seen as TCP/IP in writing.

More on packets



- <https://www.youtube.com/watch?v=TbaaMQVYMYQ>