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Computer Science
Computer Systems & Telematics
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Telematics – Exercises No. 12

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Exercise 1, The History of TCP:

The Transmission Control Protocol has gotten many modifications/improvements over time. Discuss when the following got added, list the relevant RFCs (if any), and briefly explain the extension/algorithm/feature:

1. Fast Retransmit
2. Fast Recovery
3. Congestion Control
4. Flow Control
5. Karn's Algorithm
6. Nagle' Algorithm
7. Selective Acknowledgements
8. TCP for networks with high bandwidth-delay product

List TCP variants that implement these features.

Exercise 2, Compatibility:

There are many TCP implementations/variants available and used in today's operating systems. Discuss if and why these variants are (not) fully compatible.

Exercise 3, Operating System Support:

Which TCP variants and features are supported by modern operating systems? Give examples.

How can you configure your TCP implementation?

Exercise 4, Basic and Advanced Congestion Avoidance:

Sketch a diagram depicting the behavior of a TCP implementation that detects congestion in the network (no ACKs are received for some segments). Assume three cases:

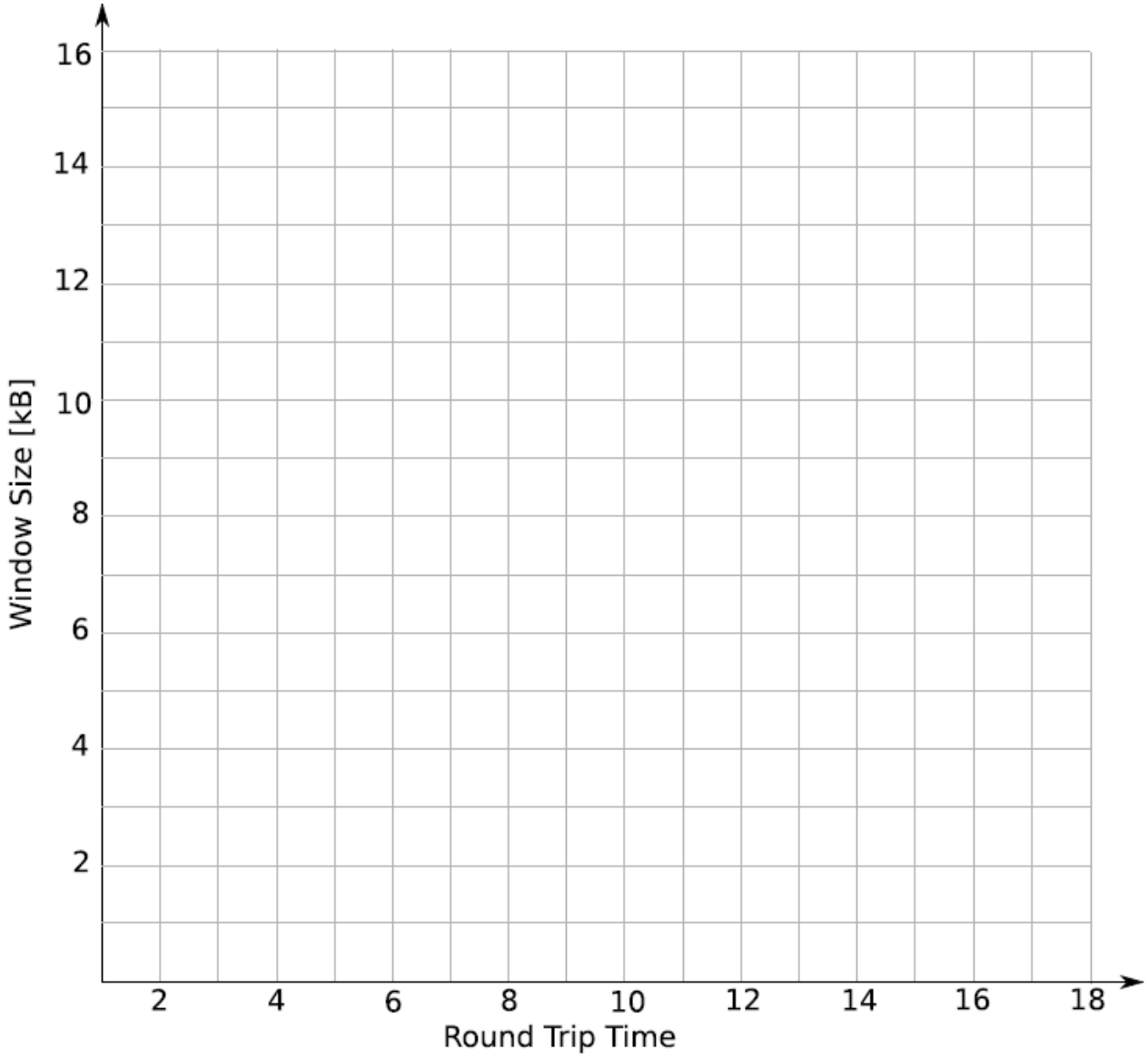
1. The TCP implementation does not support congestion avoidance.
2. The TCP implementation supports slow start and congestion avoidance.
3. The TCP implementation supports fast retransmit and fast recovery (implies slow start and congestion avoidance support).

Exercise 5, TCP Security:

Discuss attacks on the TCP protocol and how these can be detected or prevented.

Exercise 6, TCP Slowstart and Congestion Avoidance:

Consider a TCP implementation that uses an initial slow start threshold of 8 kbyte and a maximum segment size of 1 kbyte. A connection between hosts A and B is established and (unlimited) data is sent from A to B while B only acknowledges received segments and has no data to send. Assume that the receiver window of host B is always at 16 kbyte (Normally, the receiver window changes during the connection depending on the amount of data in the receive buffer.). Timeouts occur due to congestion after the 8^{th}, the 11^{th}, and the 17^{th} round trip time, respectively after A has sent the i-th round of TCP segments. For simplicity, assume that host A will always sent as many segments as possible, that B acknowledges all received segments at the same time, and that all segments experience the same delay in the network. Sketch the size of the congestion window and the slow start threshold in the following figure. Assume that the TCP implementation of host A does not support fast retransmit and fast recovery (or other improvements).



Exercise 7, TCP Limitations:

TCP is a reliable transport protocol but reliability can decrease throughput and increase delay.

1. The maximum payload size of a TCP segment is limited to 65495 Byte. Explain this value.
2. Consider a communication channel with a data rate of 1 Gbit/s and a delay of 10 ms. What is the maximum throughput a TCP connection can achieve? How effcient is the TCP connection?