



IIT KHARAGPUR



NPTEL ONLINE
CERTIFICATION COURSES

COMPUTER NETWORKS AND INTERNET PROTOCOLS

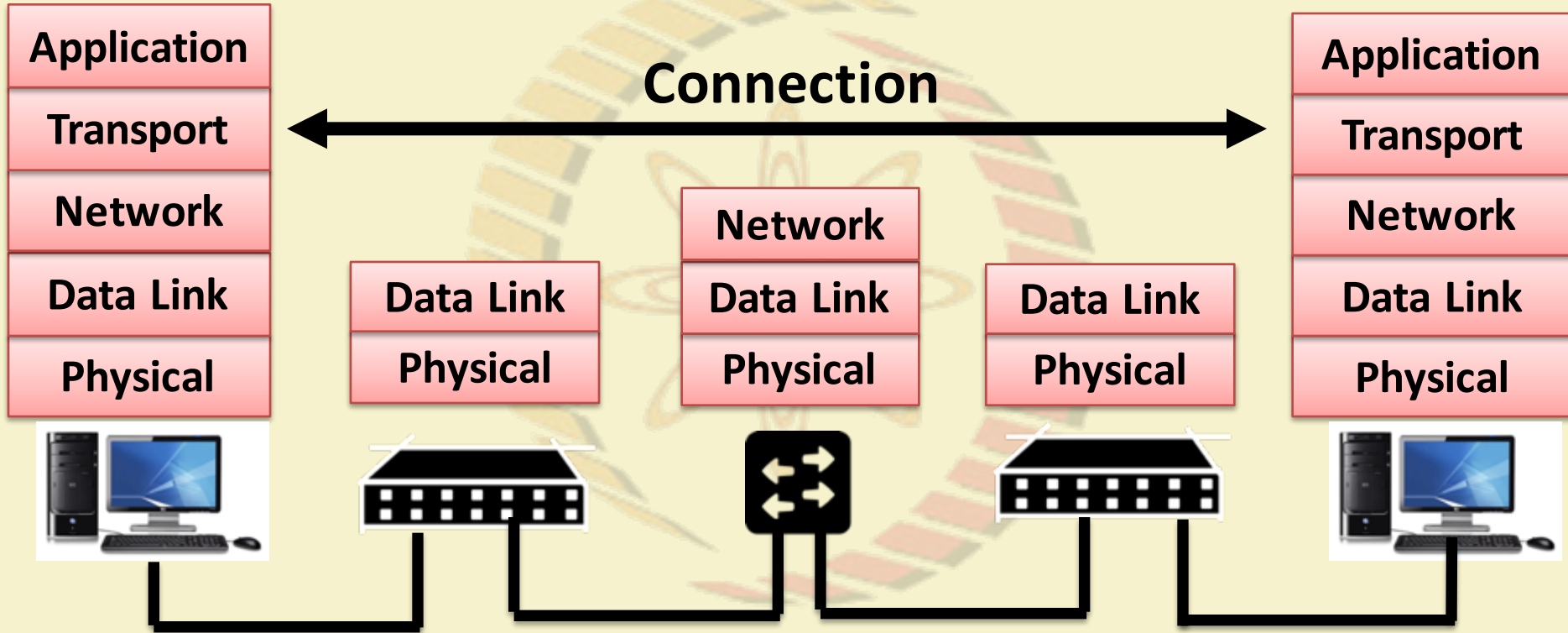
SOUMYA K GHOSH

COMPUTER SCIENCE AND ENGINEERING,
IIT KHARAGPUR

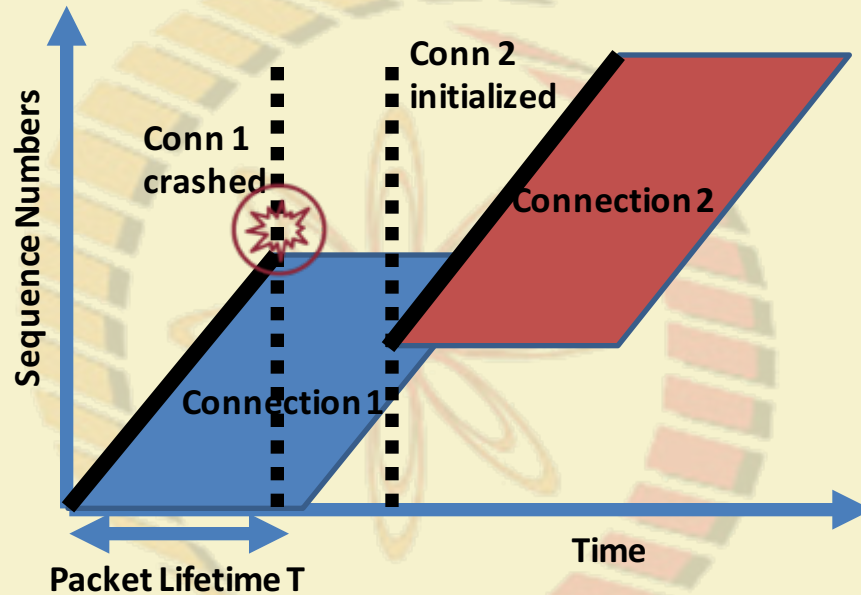
SANDIP CHAKRABORTY

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Transport Layer - III (Connection II)

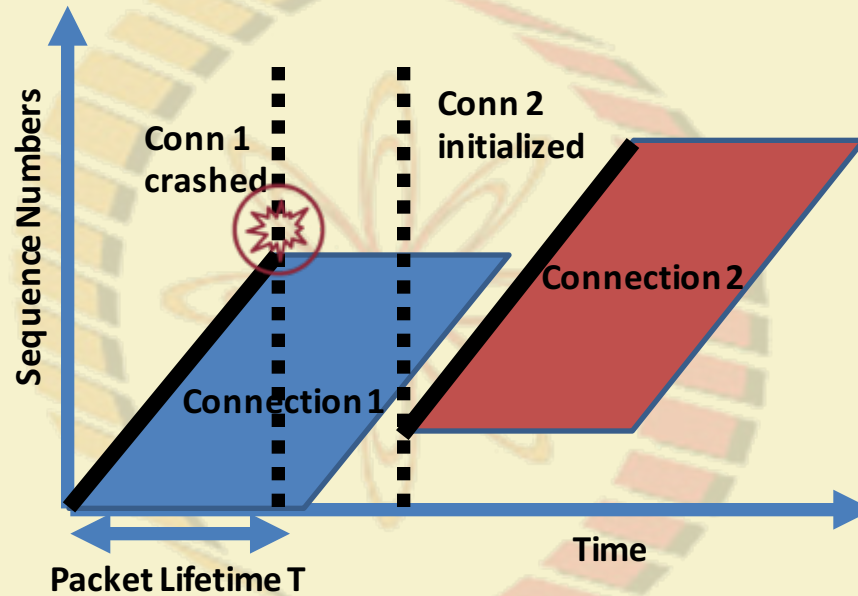


Initial Sequence Number during Connection Establishment

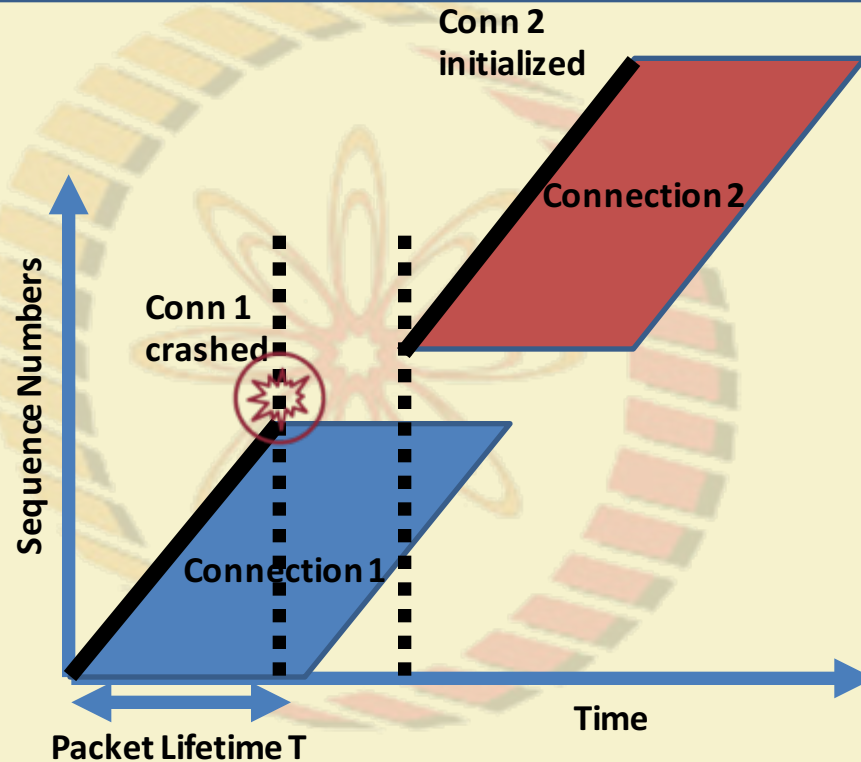


- A Delayed duplicate packet of connection 1 can create a confusion for connection 2

What We Ideally Want? Either ...

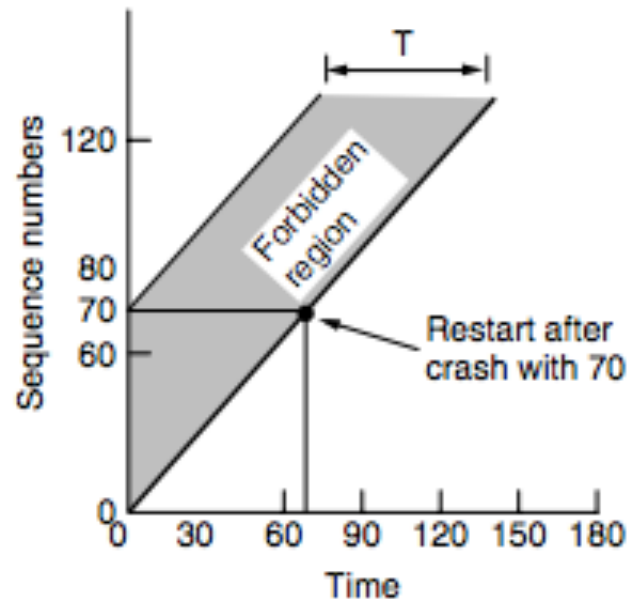


What We Ideally Want? Or ...



Connection Establishment – Handling Delayed Duplicates

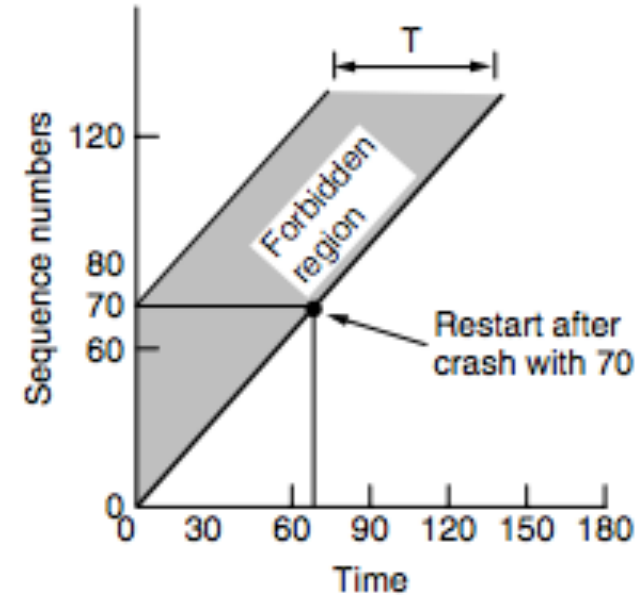
- Receiver receives two segments having the same sequence number within a duration T
 - One packet must be the duplicate
 - The receiver discards the duplicate packets.



Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

Connection Establishment – Handling Delayed Duplicates

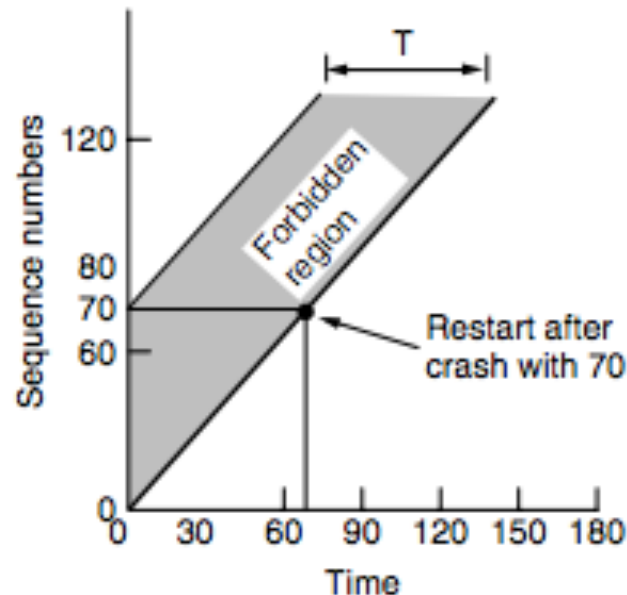
- For a crashed device, the transport entity remains idle for a duration T after recovery, to ensure that all packets from the previous connection are dead – **not a good solution**



Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

Connection Establishment – Handling Delayed Duplicates

- **Adjust the initial sequence numbers properly** - A host does not restart with a sequence number in the forbidden region, based on the sequence number it used before crash and the time duration T .

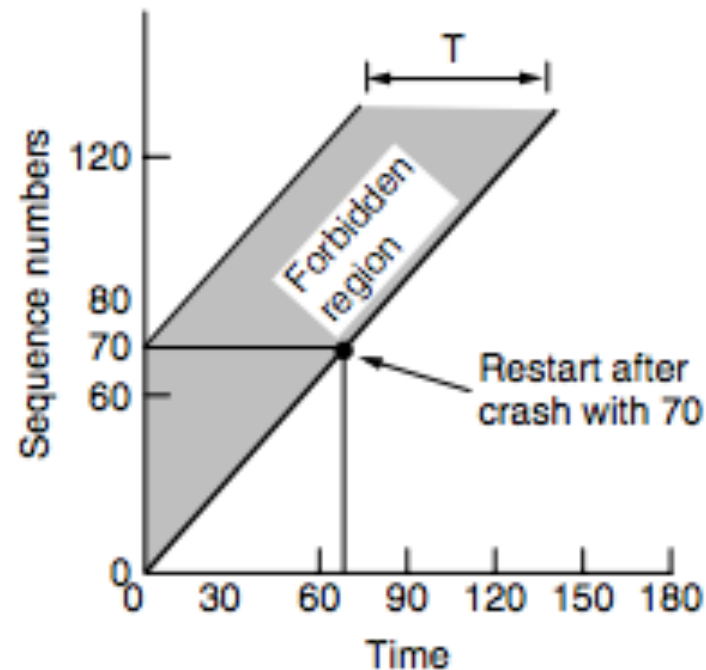


Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

Packet Sequence Numbers are Out of the Forbidden Region

Two possible source of problems

1. A host sends too much data too fast on a newly opened connection

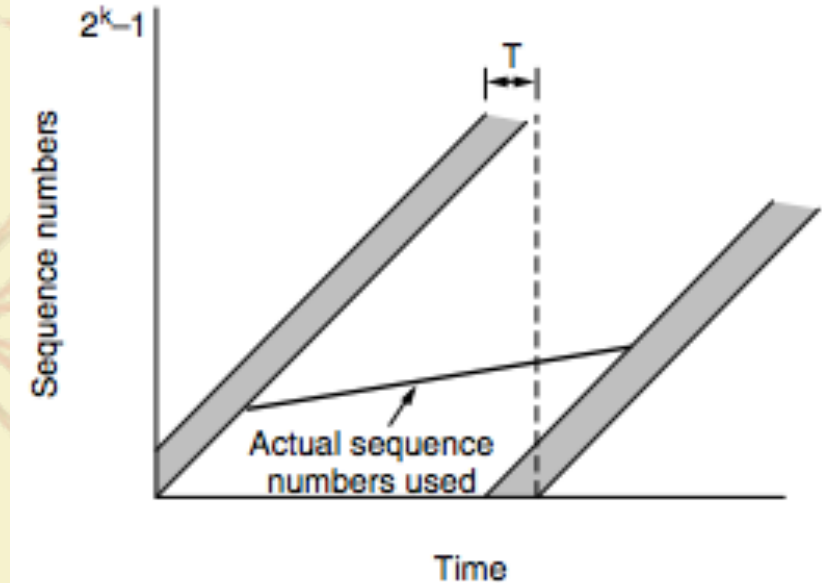


Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

Packet Sequence Numbers are Out of the Forbidden Region

Two possible source of problems

2. The data rate is too slow that the sequence number for a previous connection enters the forbidden region for the next connection



Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

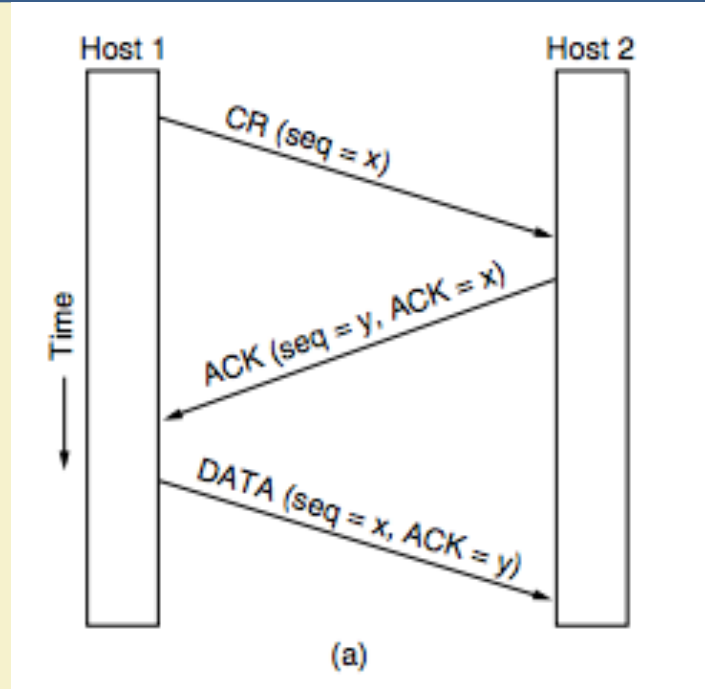
Adjusting the Sending Rate based on Sequence Numbers

- The maximum data rate on any connection is one segment per clock tick
 - Clock ticks (inter-packet transmission duration) is adjusted based on the sequences acknowledged – **ensure that no two packets are there in the network with same sequence number**
 - **We call this mechanism as self-clocking (used in TCP)**
 - Ensures that the sequence numbers do not warp around too quickly (RFC 1323)

Adjusting the Sending Rate based on Sequence Numbers

- **We do not remember sequence number at the receiver:** Use a **three way handshake** to ensure that the connection request is not a repetition of an old connection request
 - The individual peers validate their own sequence number by looking at the acknowledgement (ACK)
 - **Positive synchronization among the sender and the receiver**

Three Way Handshake

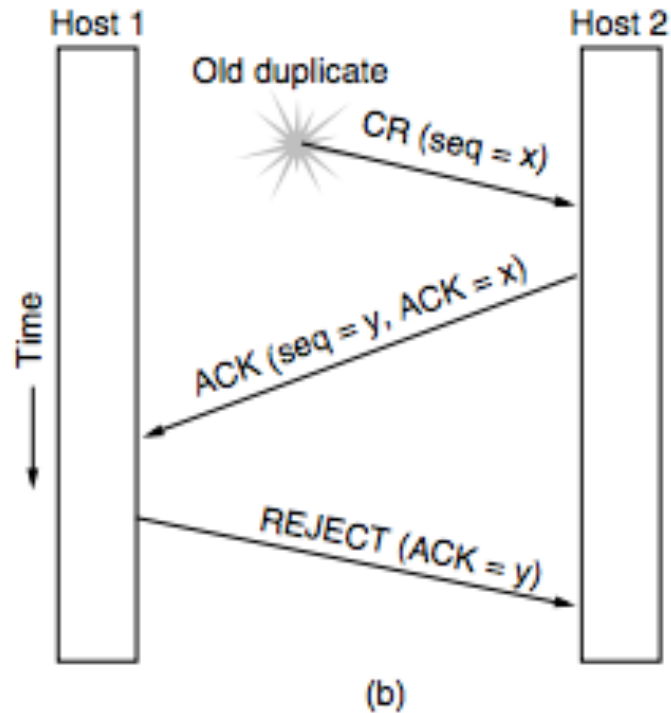


- By looking at the ACK, Host 1 ensures that Sequence number x does not belong to the forbidden region of any previously established connection
- By looking at the ACK in DATA, Host 2 ensures that sequence number y does not belong to the forbidden region of any previously established connection

Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

CONNECTION REQUEST is a Delayed Duplicate

Source: Computer
Networks (5th Edition) by
Tanenbaum, Wetherell



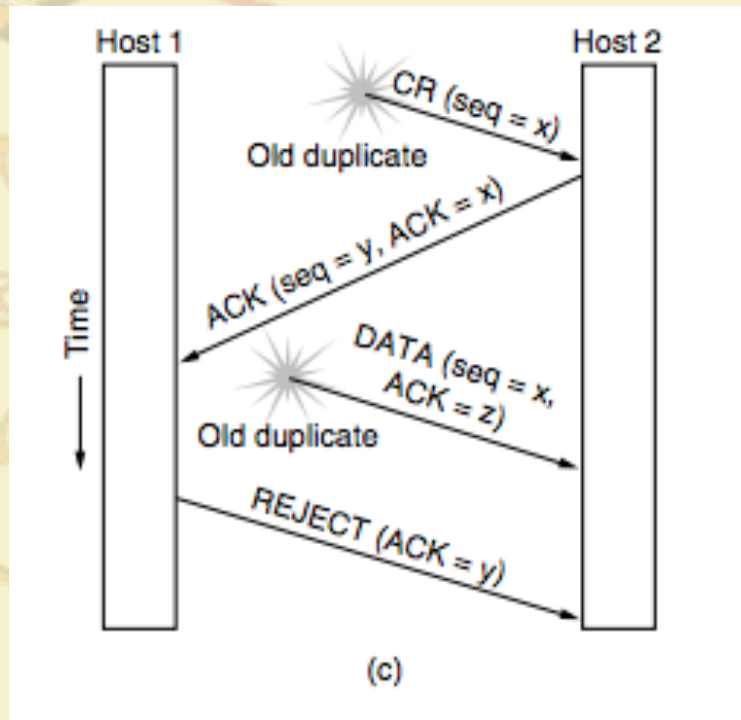
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CONNECTION REQUEST and ACK both are Delayed Duplicates

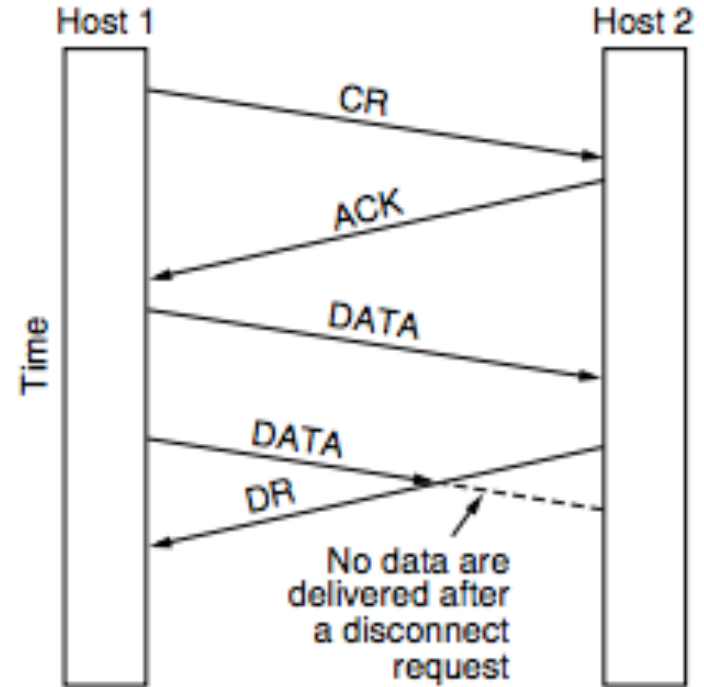
Source: Computer Networks
(5th Edition) by Tanenbaum,
Wetherell



Connection Release – Asymmetric Release

- When one party hangs up, the connection is broken
- This may results in data loss

Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

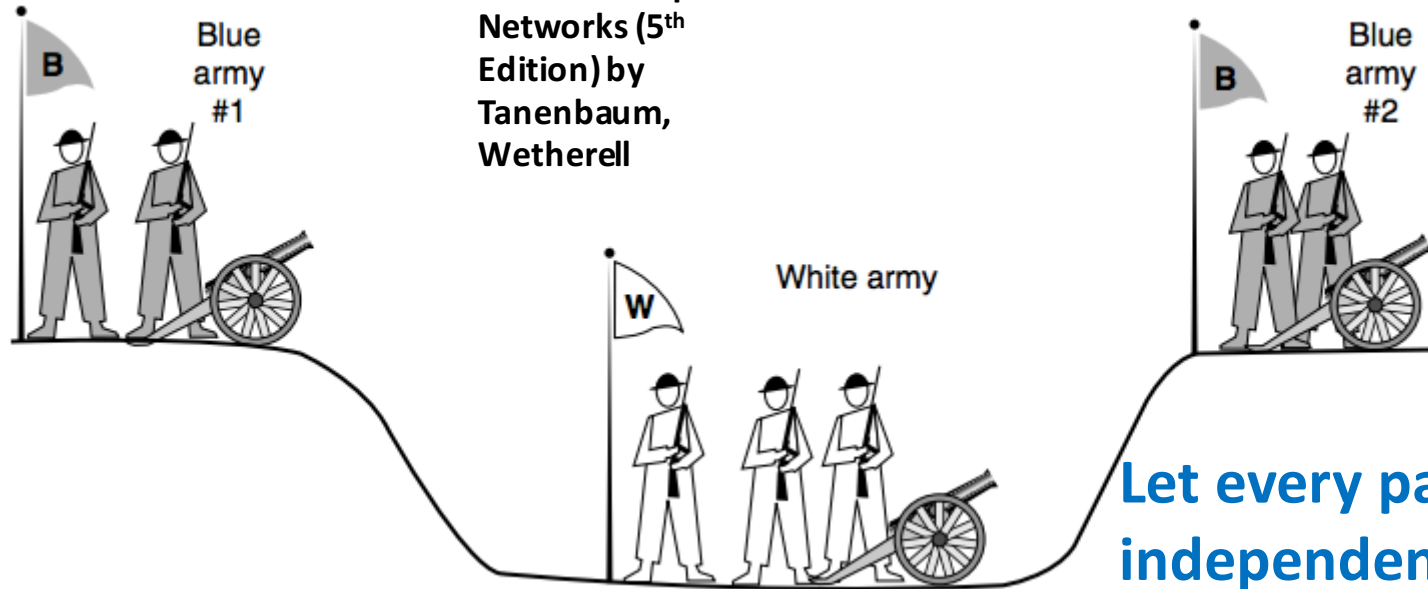


Connection Release – Symmetric Release

- Treats the connection as two separate unidirectional connections and requires each one to be released separately
- Does the job when each process has a fixed amount of data to send and clearly knows when it has sent it.
- What can be a protocol for this?
 - **Host 1: “I am done”**
 - **Host 2: ”I am done too”**
- **Does this protocol work good always?**

The Two Army Problem

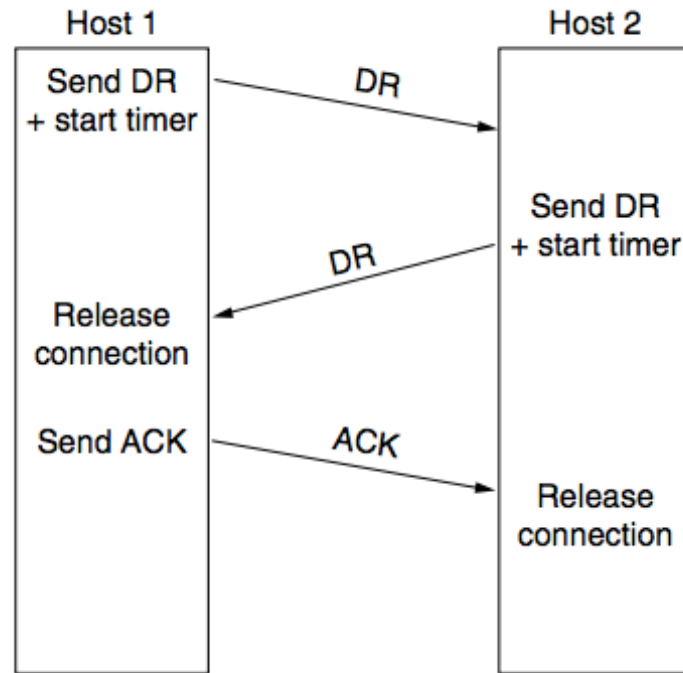
Source: Computer
Networks (5th
Edition) by
Tanenbaum,
Wetherell



No protocol exists to solve this

Let every party take
independent
decisions

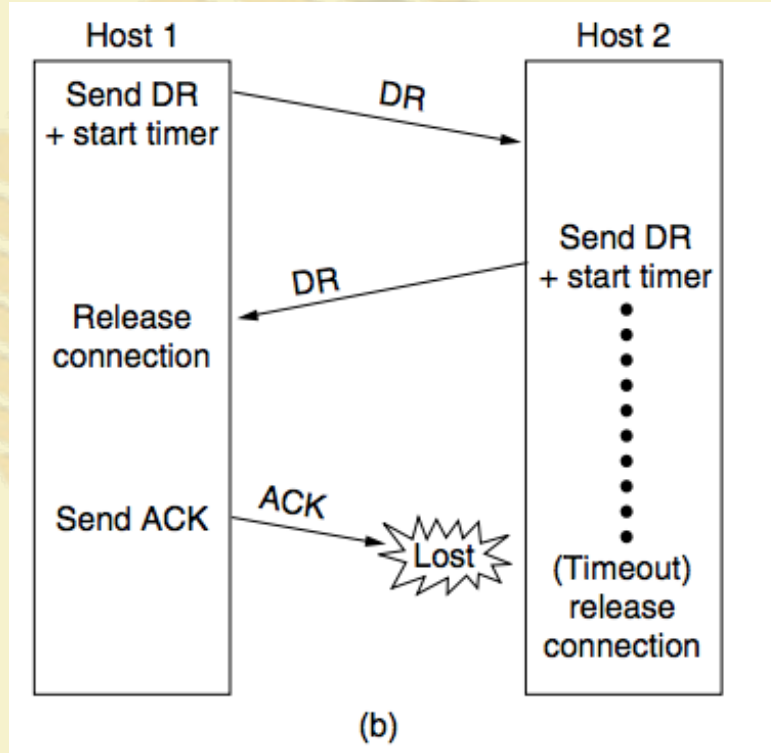
Connection Release



(a)

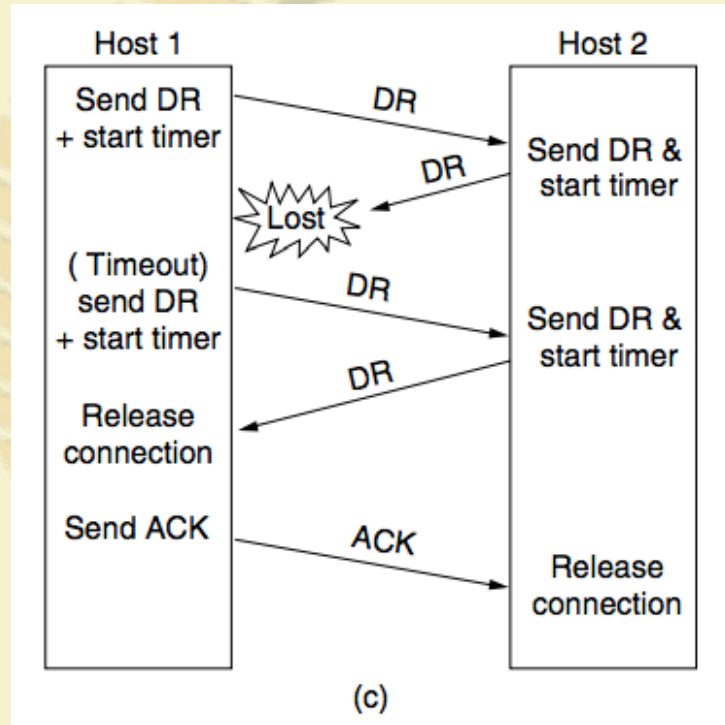
Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

Connection Release – Final ACK Lost



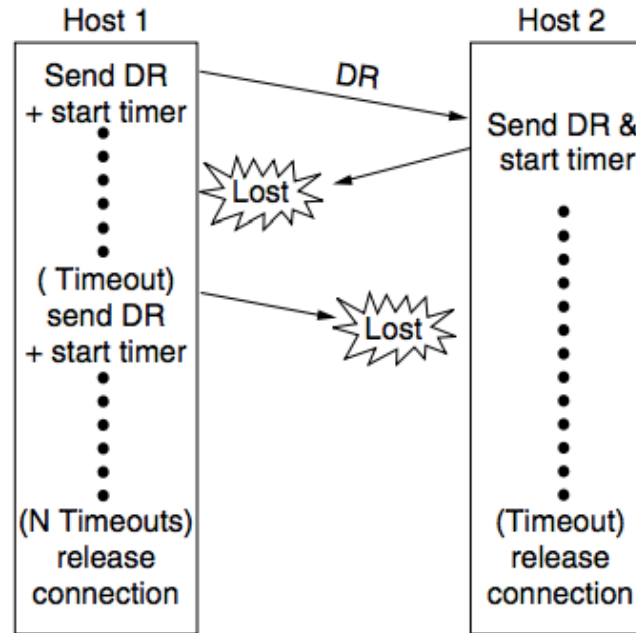
Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

Connection Release – Response Lost



Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell

Connection Release – Response Lost and Subsequent DRs Lost



(d)

Source: Computer Networks (5th Edition) by Tanenbaum, Wetherell



thank you!

