CEN445 – Network Protocols and Algorithms
Chapter 6 – Transport Layer
6.6 Performance Issues

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Performance Issues

- Many strategies for getting good performance have been learned over time
  - Performance problems »
  - Measuring network performance »
  - Host design for fast networks »
  - Fast segment processing »
  - Header compression »
  - Protocols for “long fat” networks »

Performance Problems

- Unexpected loads often interact with protocols to cause performance problems
  - Need to find the situations and improve the protocols
- Examples:
  - Broadcast storm: one broadcast triggers another
  - Synchronization: a building of computers all contact the DHCP server together after a power failure
  - Tiny packets: some situations can cause TCP to send many small packets instead of few large ones

Measuring Network Performance

- Measurement is the key to understanding performance – but has its own pitfalls.
- Example pitfalls:
  - Caching: fetching Web pages will give surprisingly fast results if they are unexpectedly cached
  - Timing: clocks may over/underestimate fast events
  - Interference: there may be competing workloads

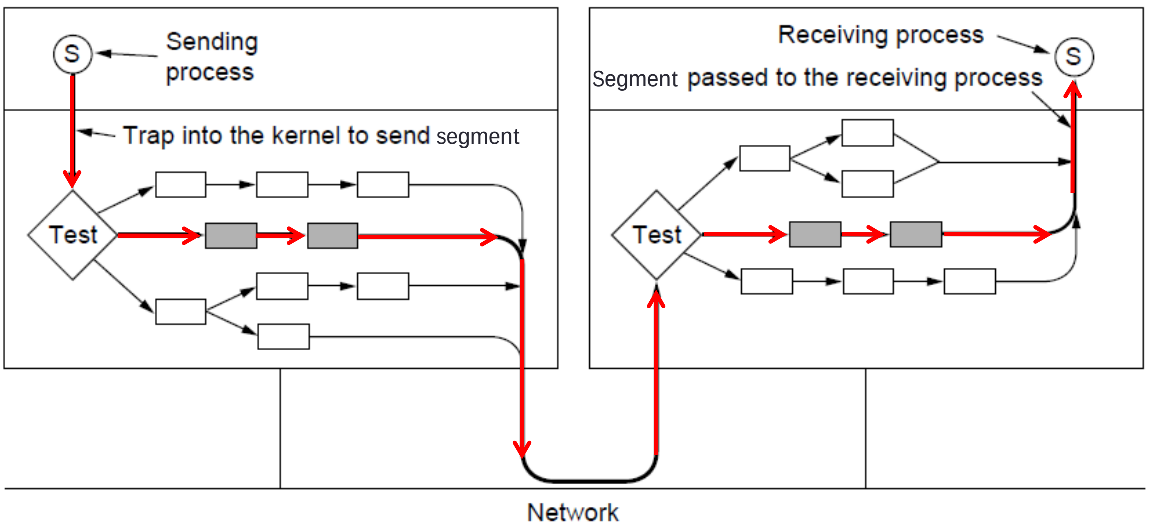
Host Design for Fast Networks

- Poor host software can greatly slow down networks.
- Rules of thumb for fast host software:
  - Host speed more important than network speed
  - Reduce packet count to reduce overhead
  - Minimize data touching
  - Minimize context switches
  - Avoiding congestion is better than recovering from it
  - Avoid timeouts

Fast Segment Processing

Speed up the common case with a fast path

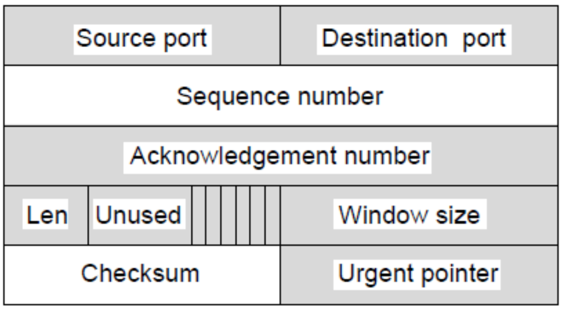
- Handles packets with expected header; OK for others to run slowly



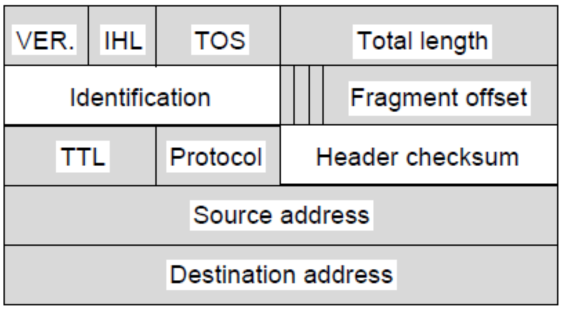
Fast Segment Processing

Header fields are often the same from one packet to the next for a flow;

copy/check them to speed up processing



TCP header fields that stay the same for a one-way flow (shaded)



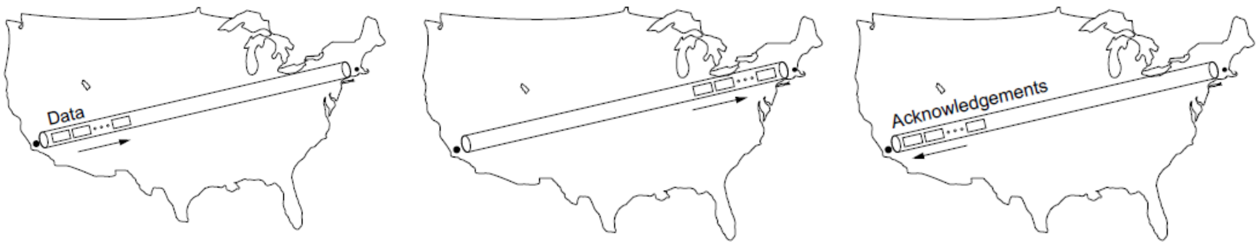
IP header fields that are often the same for a one-way flow (shaded)

Header Compression

- Overhead can be very large for small packets
  - 40 bytes of header for RTP/UDP/IP VoIP packet
  - Problematic for slow links, especially wireless
- Header compression mitigates this problem
  - Runs between Link and Network layer
  - Omits fields that don't change or change predictably
    - 40 byte TCP/IP header → 3 bytes of information
  - Gives simple high-layer headers and efficient links

Protocols for “Long Fat” Networks

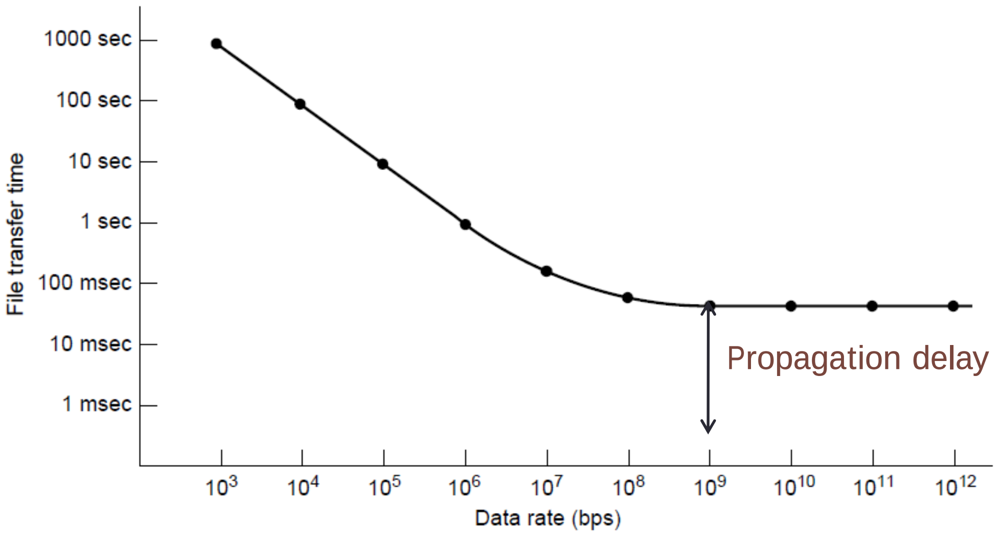
- Networks with high bandwidth (“Fat”) and high delay (“Long”) can store much information inside the network
  - Requires protocols with ample buffering and few RTTs, rather than reducing the bits on the wire



Starting to send 1 Mbit San Diego → Boston | 20ms after start | 40ms after start

Protocols for “Long Fat” Networks

- You can buy more bandwidth but not lower delay
  - Need to shift ends (e.g., into cloud) to lower further



Minimum time to send and ACK a 1-Mbit file over a 4000-km line