Fragmentation Considered Harmful

The paper by C. A. Kent and J. C. Mogul

• Advantages of fragmentation
  – Fragmentation allows high level protocols to be unconcerned with the characteristics of the transmission channel, and to send data in conveniently sized pieces.
  – Fragmentation allows the source host to deal with routes having different MTUs without having to know what path packets are taking.
  – Fragmentation allows protocols to optimize performance for high bandwidth connections.
  
  (determine the size as late as possible.)

Why harmful?

• Fragmentation causes inefficient resource usage.
  – Cost: routing decision, modify header, compute checksum
  – Example: sending TCP data

• Poor performance when fragments are lost

• Efficient reassembly is difficult
  – Size is hard to decide
  – How long to hold a fragment
  – Cannot fill in the holes of the previous datagram

Solutions

• Fragmentation avoidance without protocol changes
  – Always send tiny datagrams
  – Send 576 byte if the route goes via a gateway; use local MTU if local

• Fragmentation avoidance with protocol changes
  – Probe MINMTU with IP
  – Probe MINMTU with ICMP
  – Probe MINMTU by piggybacking on IP headers

Solutions (cont.)

• Recovery from fragmentation
  – Use of don’t fragment
    • ICMP, then change size
  – Passive detection of fragmentation by observing the retransmission rate
  – React to “time exceeded” ICMP
  – Fragmentation warning
  – Fragments received