Discussion Section

Oct 18, 2013

Agenda

- CRC calculation and Endianness
- Review Sliding Window Protocol
- Some debugging techniques

What is Endianness?

- Ordering of bytes within a data structure
  - 4 byte int, 0x01020304 can be stored in memory as
    - |01|02|03|04| -> MSByte first (“Biggest” byte first - big endian)

      --- OR ---

    - |04|03|02|01| -> LSByte first (“Littlest” byte first - little endian)

Why do we care about Endianness?

- Are these operations equivalent?
  a. uint16_t x = ((uint16_t*) char_buf)[0];

  b. uint16_t x = char_buf[0] << 8 + char_buf[1];

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- Part of CRC initialization steps.

Sliding Window Protocol

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- Improve link usage by not waiting for RTT between 2 packets.

Sender Window

- Contains un-ACKd frames.

- ← ACKd
  ← Sent but not ACKd
  ← Not sent yet
- ACKs are cumulative.
  ACK[4] implies ACK[3], ACK[2], ACK[1].

Sender Window

- Contains un-ACKd frames.

- ← (Outside window) ACKd
  ← (Inside window) Sent but not ACKd
  ← (Inside window) Not sent yet
  ← (Outside window) Not sent yet
- ACKs are cumulative.

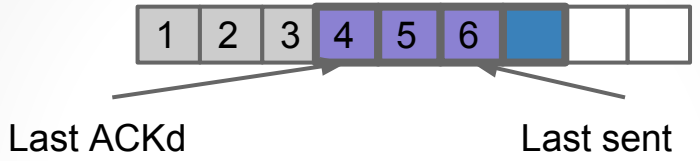
Receiver Window

- Contains frames received out-of-order

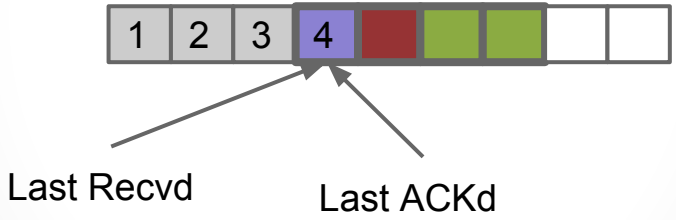
- ←Received (and next packet received)
  ←Received (next packet not received)
  ←Not received
  ←Will be accepted
  ←Will not be accepted

Example - Initial step

Sender

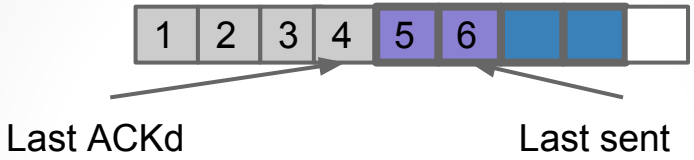


Receiver

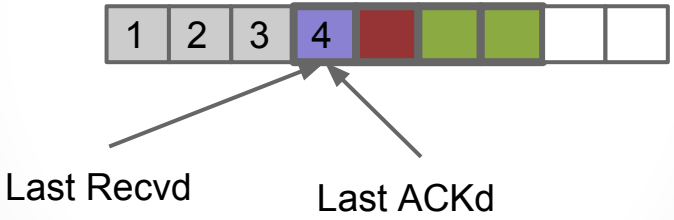


Example - Initial step (corrected)

Sender

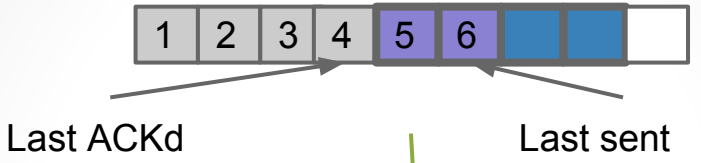


Receiver

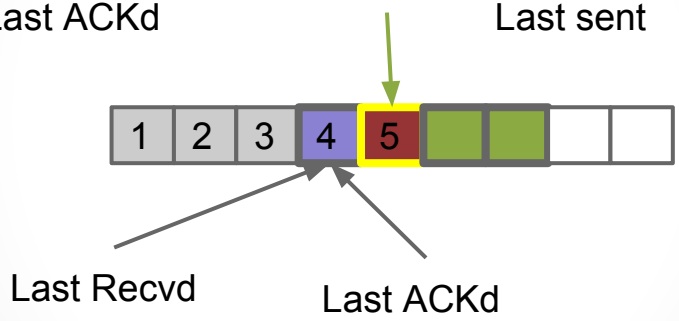


Step 1 - Receiver gets #5

Sender

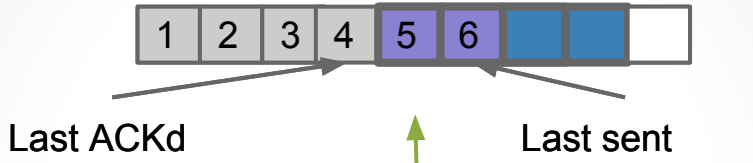


Receiver

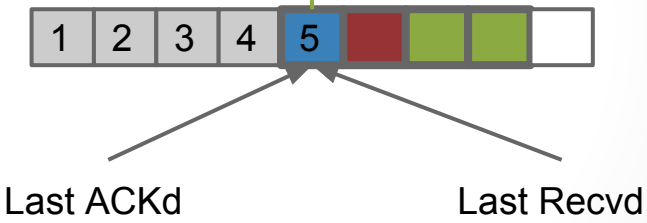


Step 1 - Receiver gets #5 - outcome

Sender



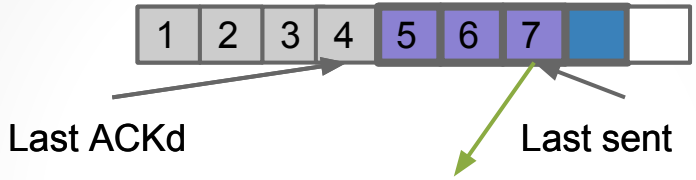
Receiver



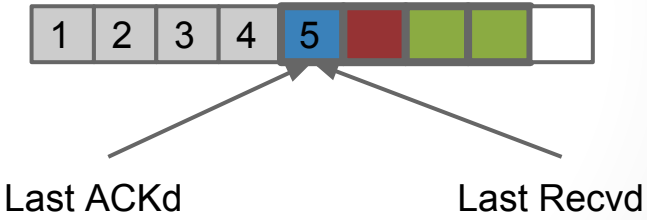
Receiver sends ACK for #5

Step 2 - Sender sends #7

Sender

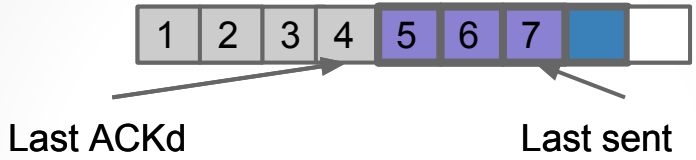


Receiver

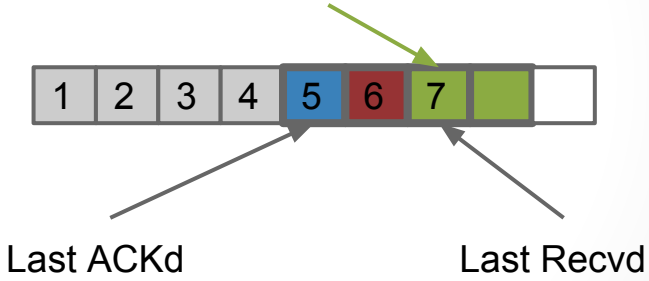


Step 2 - Receiver gets #7

Sender

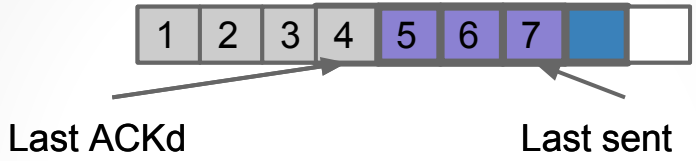


Receiver

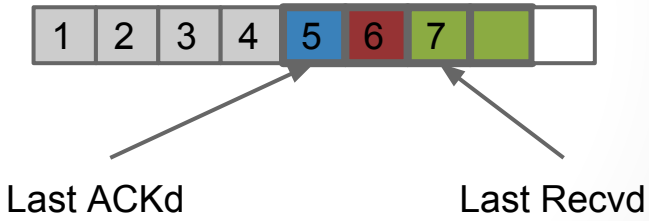


Step 2 - Receiver gets #7 - outcome

Sender



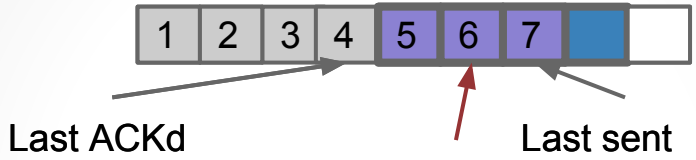
Receiver



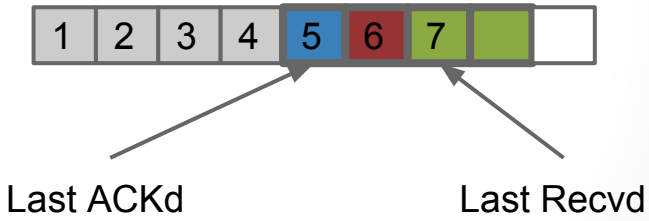
Send Duplicate ACK[6]

Step 3 - Sender gets DupACK[6]

Sender

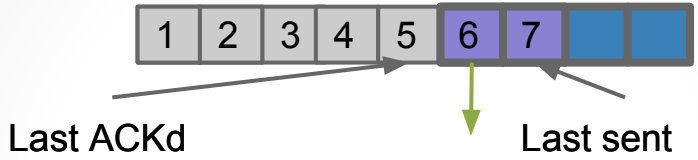


Receiver

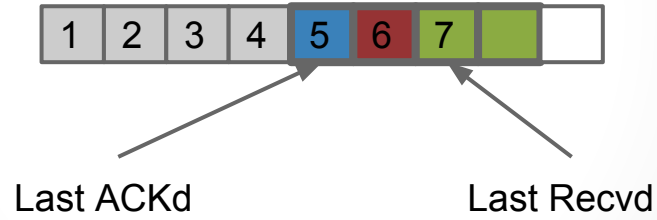


Step 3 - Sender gets DupACK[6]

Sender



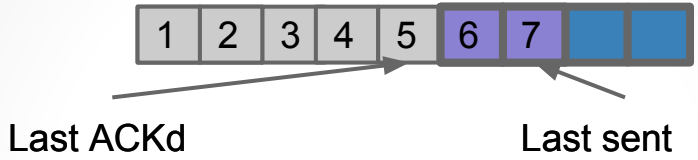
Receiver



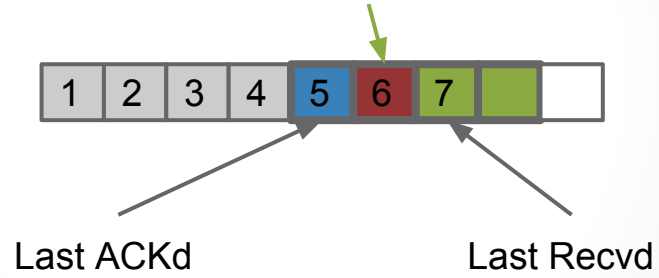
Resend packet 6

Step 4 - Receiver gets #6

Sender



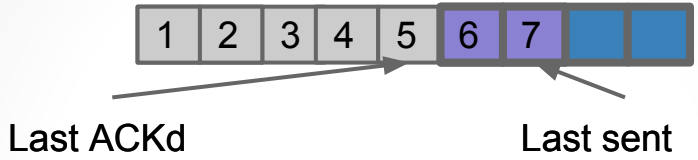
Receiver



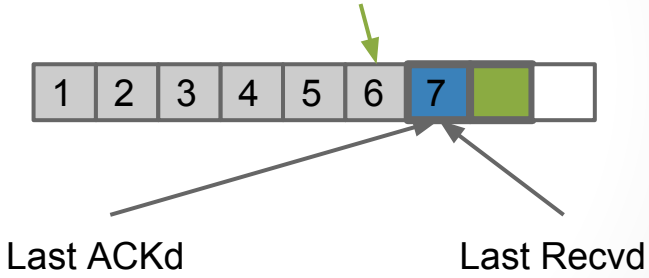
Resend packet 6

Step 4 - Receiver gets #6 - outcome

Sender



Receiver



Resend packet 6

Debugging hands on

Q & A