

Chapter 3 Transport Layer

A S M Touhidul Hasan, Ph.D.
Assistant Professor,
Department of CSE, UAP



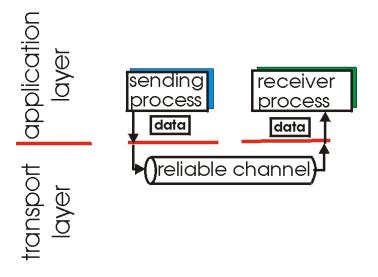
Chapter 3 Outline of Lecture 7

- 3.4 principles of reliable data transfer
 - ☐Principles of reliable data transfer
 - Reliable data transfer: getting started
 - □rdt1.0: reliable transfer over a reliable channel
 - rdt2.0: channel with bit errors
 - □rdt2.1: sender, handles garbled ACK/NAKs



Principles of reliable data transfer

- important in application, transport, link layers
 - top-10 list of important networking topics!

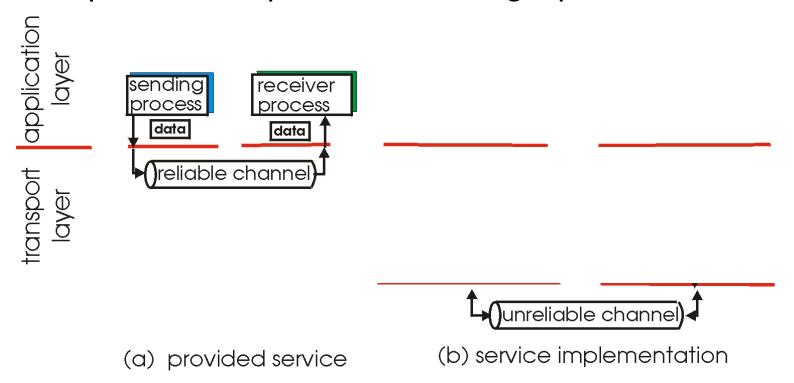


- (a) provided service
- characteristics of unreliable channel will determine complexity of reliable data transfer protocol (rdt)



Principles of reliable data transfer

- important in application, transport, link layers
 - top-10 list of important networking topics!

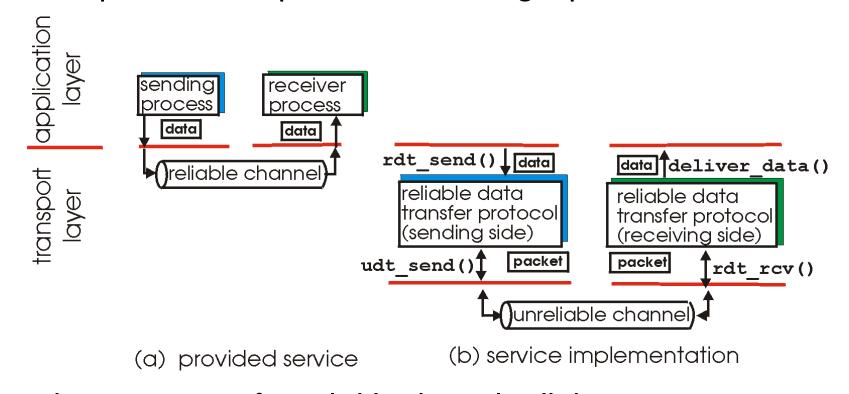


 characteristics of unreliable channel will determine complexity of reliable data transfer protocol (rdt)



Principles of reliable data transfer

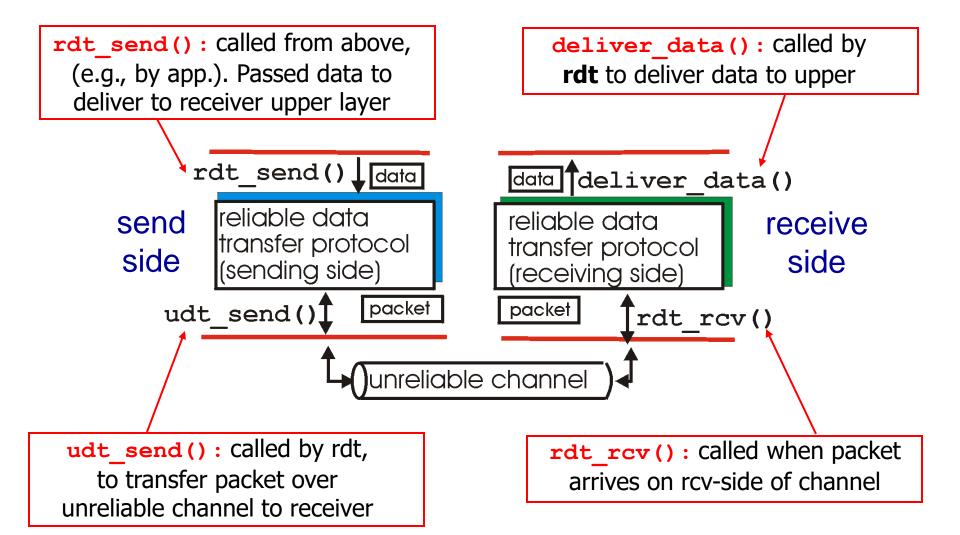
- important in application, transport, link layers
 - top-10 list of important networking topics!



 characteristics of unreliable channel will determine complexity of reliable data transfer protocol (rdt)



Reliable data transfer: getting started





Reliable data transfer: getting started

we'll:

- incrementally develop sender, receiver sides of reliable data transfer protocol (rdt)
- consider only unidirectional data transfer
 - but control info will flow on both directions!
- use finite state machines (FSM) to specify sender, receiver

state: when in this "state" next state uniquely determined by next event state actions

event causing state transition

actions taken on state transition

state

event

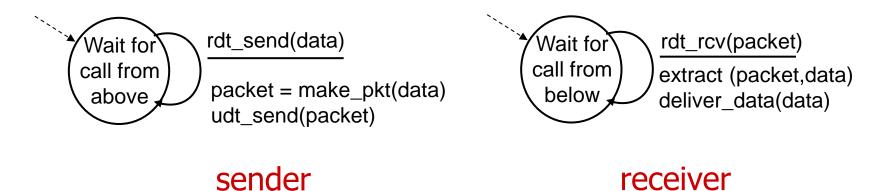
event

actions



rdt I.O: reliable transfer over a reliable channel

- underlying channel perfectly reliable
 - no bit errors
 - no loss of packets
- separate FSMs for sender, receiver:
 - sender sends data into underlying channel
 - receiver reads data from underlying channel





rdt2.0: channel with bit errors

- underlying channel may flip bits in packet
 - checksum to detect bit errors
- the question: how to recover from errors:

How do humans recover from "errors" during conversation?



rdt2.0: channel with bit errors

- underlying channel may flip bits in packet
 - checksum to detect bit errors
- the question: how to recover from errors:
 - acknowledgements (ACKs): receiver explicitly tells sender that pkt received OK
 - negative acknowledgements (NAKs): receiver explicitly tells sender that pkt had errors
 - sender retransmits pkt on receipt of NAK
- new mechanisms in rdt2.0 (beyond rdt1.0):
 - error detection
 - feedback: control msgs (ACK,NAK) from receiver to sender

rdt2.0: FSM specification

rdt_send(data)
sndpkt = make_pkt(data, checksum)
udt_send(sndpkt)

Wait for call from above

rdt_rcv(rcvpkt) && isNAK(rcvpkt)

ACK or NAK

rdt_send(sndpkt)

rdt_send(sndpkt)

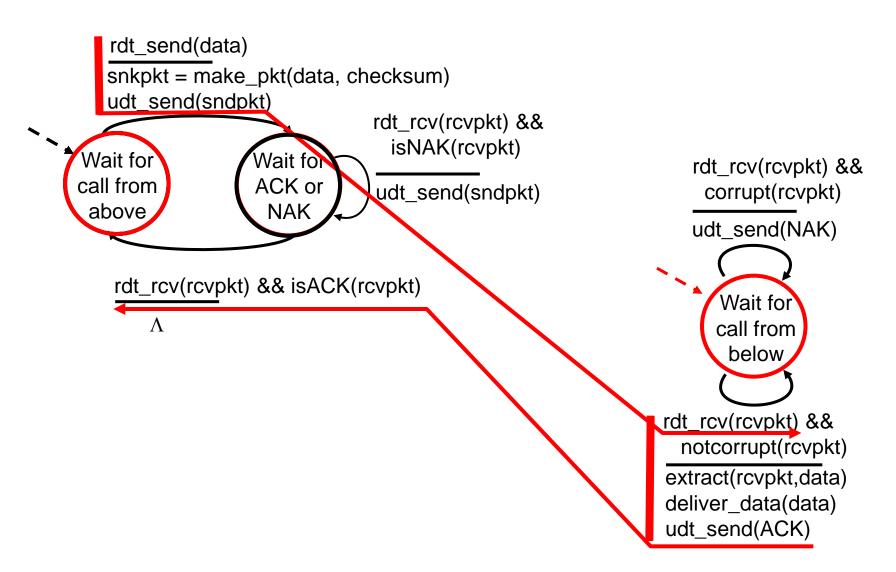
rdt_send(sndpkt)

sender

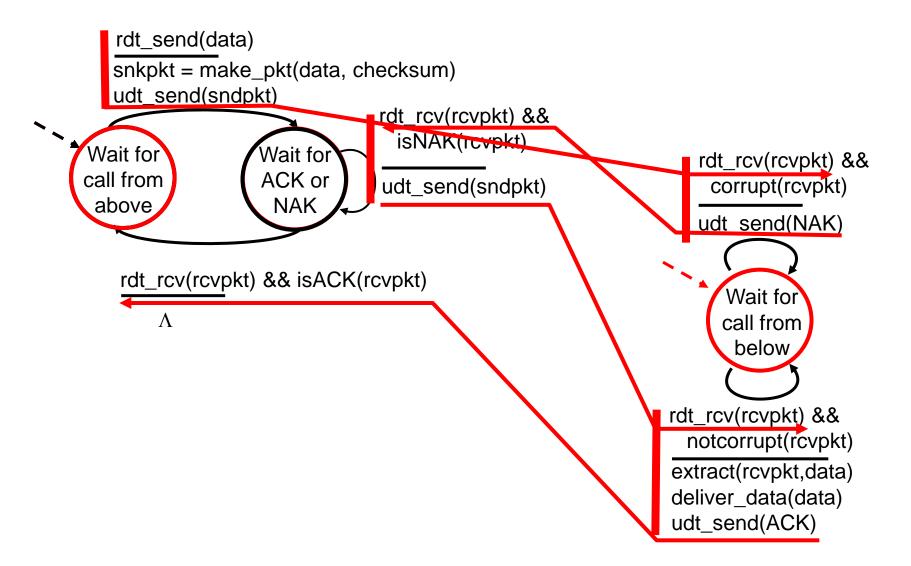
receiver

rdt_rcv(rcvpkt) && corrupt(rcvpkt) udt send(NAK) Wait for call from below rdt_rcv(rcvpkt) && notcorrupt(rcvpkt) extract(rcvpkt,data) deliver_data(data) udt_send(ACK)

rdt2.0: operation with no errors



rdt2.0: error scenario







what happens if ACK/NAK corrupted?

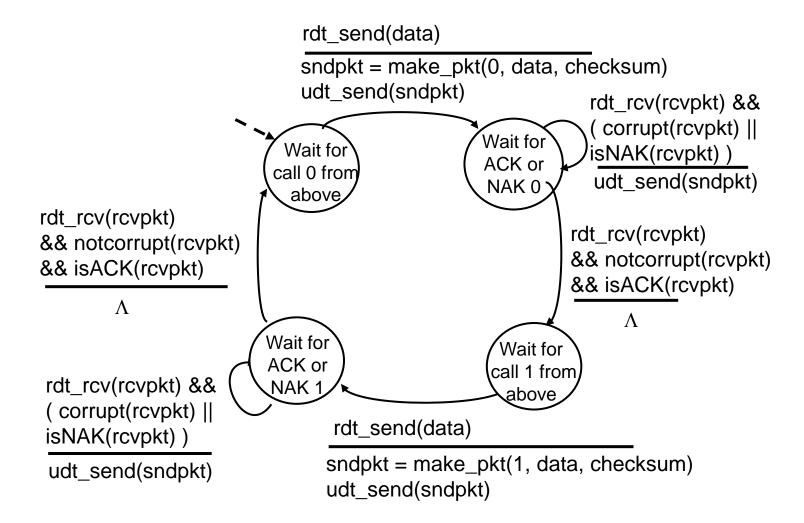
- sender doesn't know what happened at receiver!
- can't just retransmit: possible duplicate

handling duplicates:

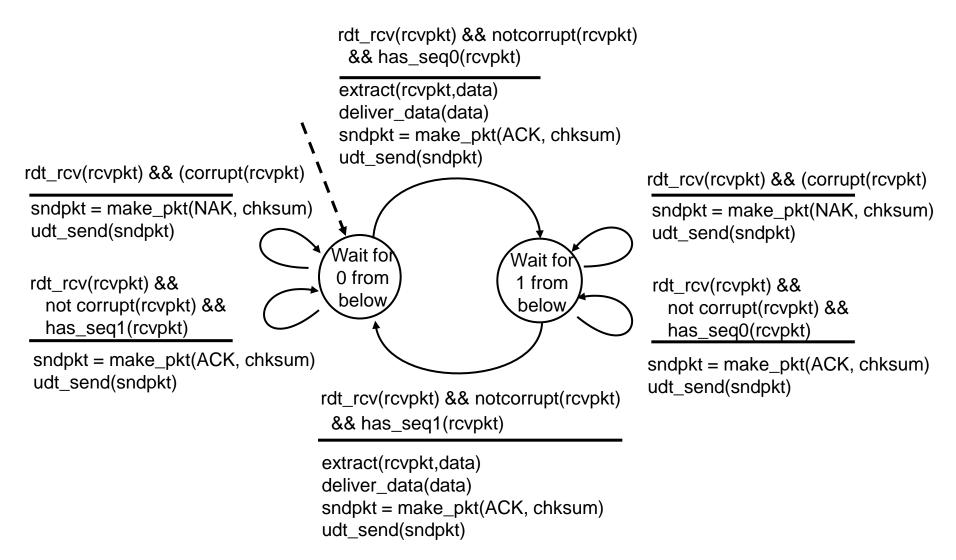
- sender retransmits current pkt if ACK/NAK corrupted
- sender adds sequence number to each pkt
- receiver discards (doesn't deliver up) duplicate pkt

stop and wait sender sends one packet, then waits for receiver response

rdt2.1: sender, handles garbled ACK/NAKs



rdt2.1: receiver, handles garbled ACK/NAKs





rdt2.1: discussion

sender:

- seq # added to pkt
- two seq. #'s (0,1) will suffice. Why?
- must check if received ACK/NAK corrupted
- twice as many states
 - state must
 "remember" whether
 "expected" pkt should
 have seq # of 0 or I

receiver:

- must check if received packet is duplicate
 - state indicates whether0 or I is expected pktseq #
- note: receiver can not know if its last ACK/NAK received OK at sender