Transport Layer
Part 2

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EECS 325/425
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"Well, we busted outa class, had to get away from those fools,
We learned more from a three minute record than we ever learned in school."

These slides are more-or-less directly from the slide set developed by Jim Kurose and Keith Ross for their book "Computer Networking: A Top Down Approach, 5th edition".

The slides have been lightly adapted for Mark Allman's EECS 325/425 Computer Networks class at Case Western Reserve University.

Connectionless demultiplexing

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- when host receives UDP segment:
  - checks destination port number in segment
  - directs UDP segment to socket with that port number
- IP datagrams with different source IP addresses and/or source port numbers directed to same socket
  - i.e., demuxing based on destination port only

Connectionless demux (cont)

```
DatagramSocket serverSocket = new DatagramSocket(6428);
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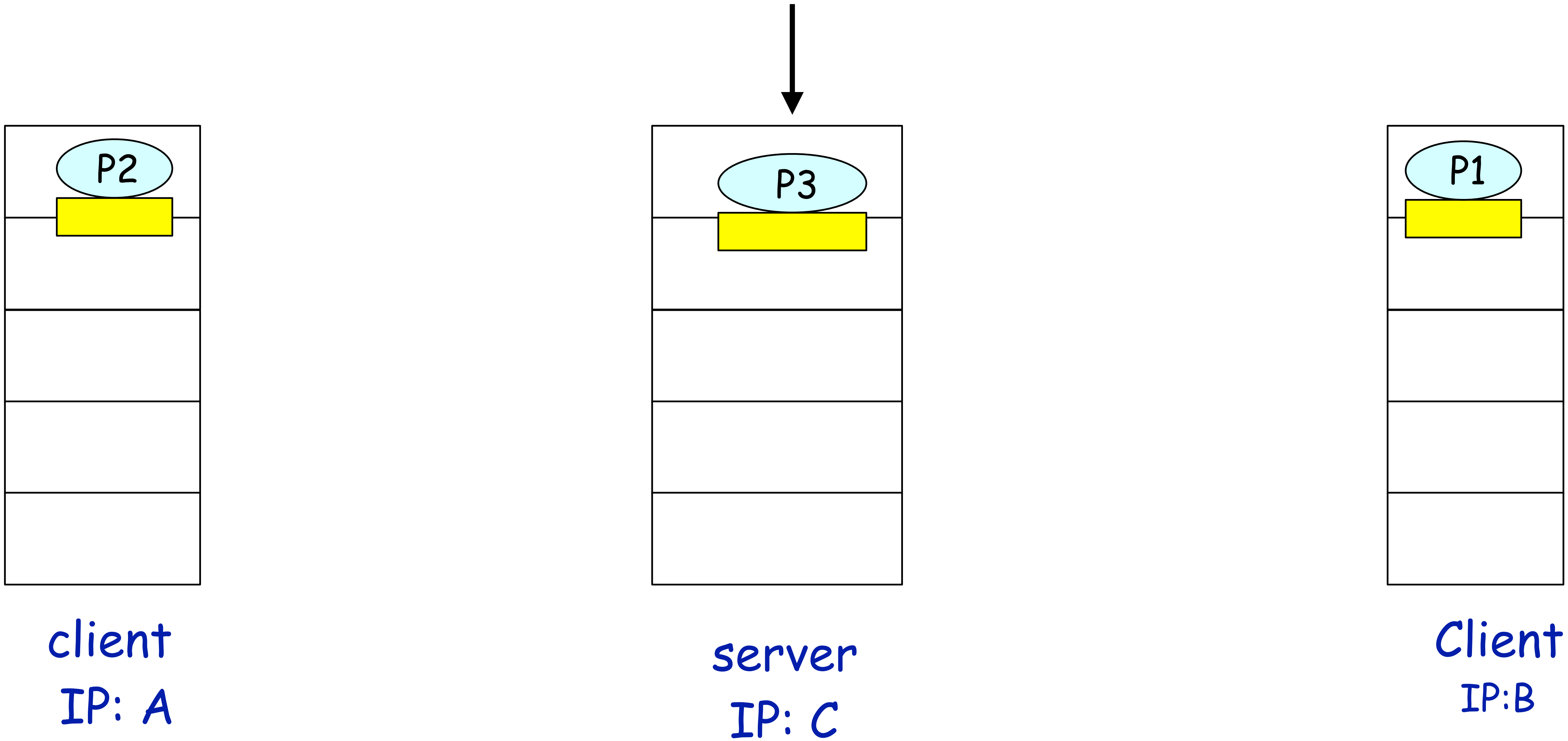

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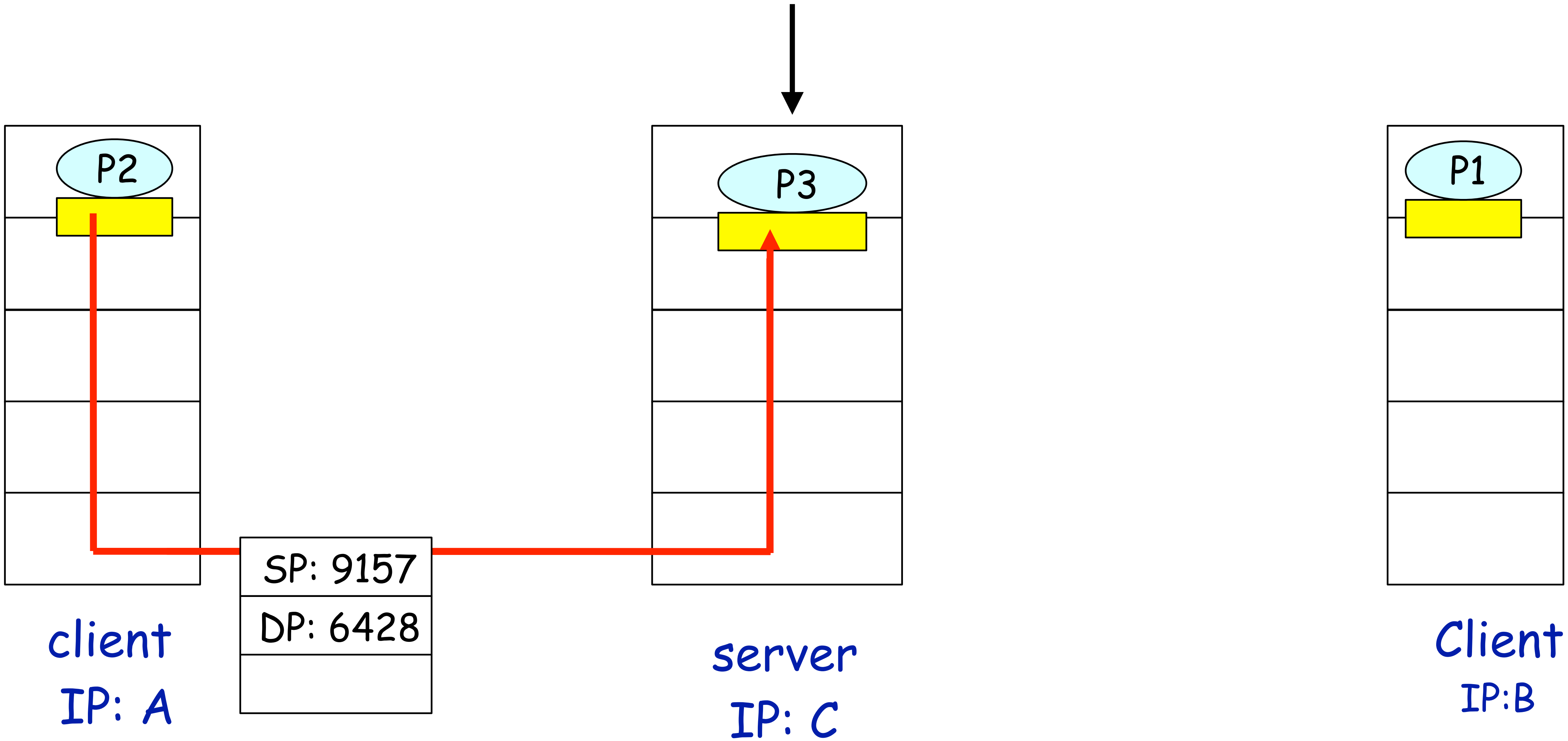

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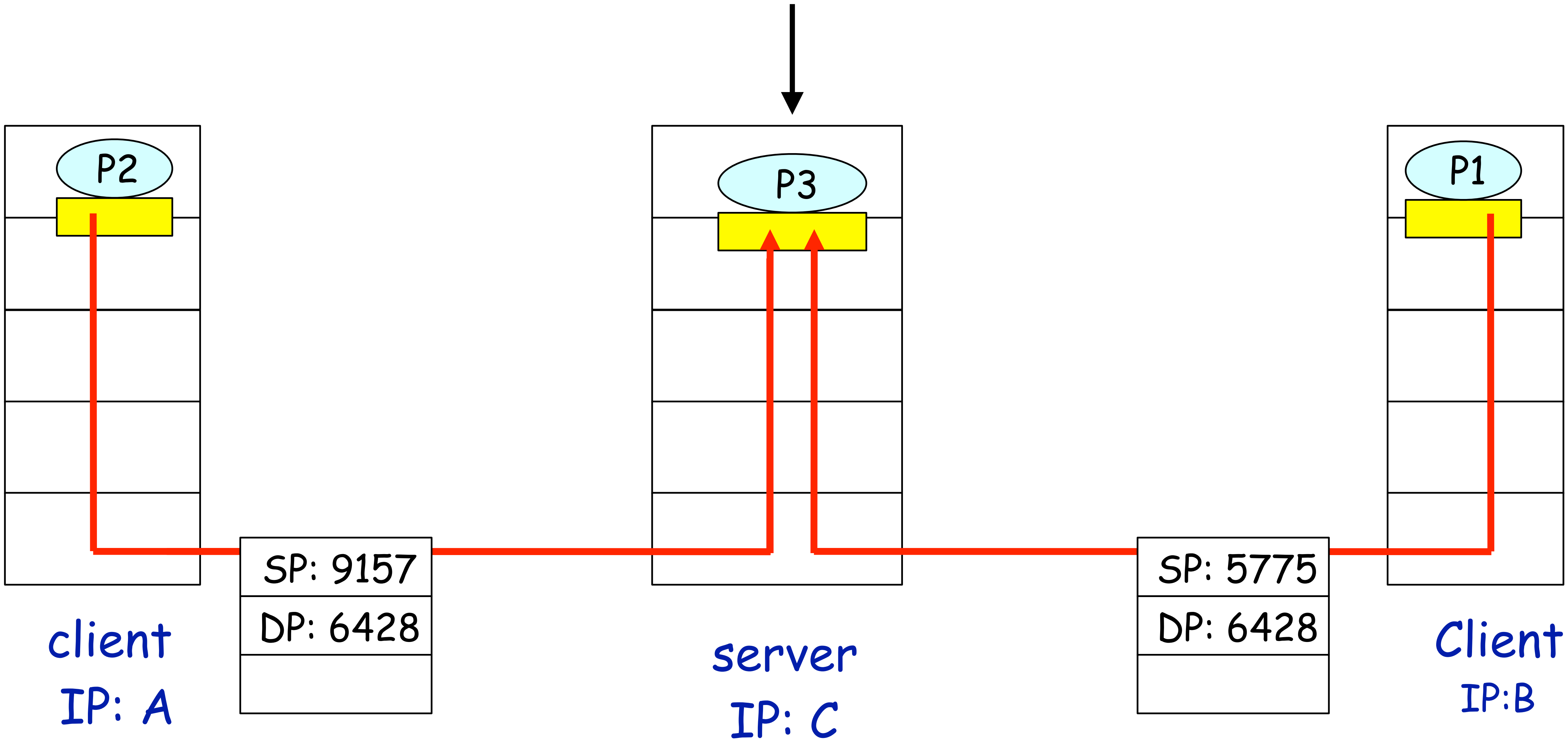

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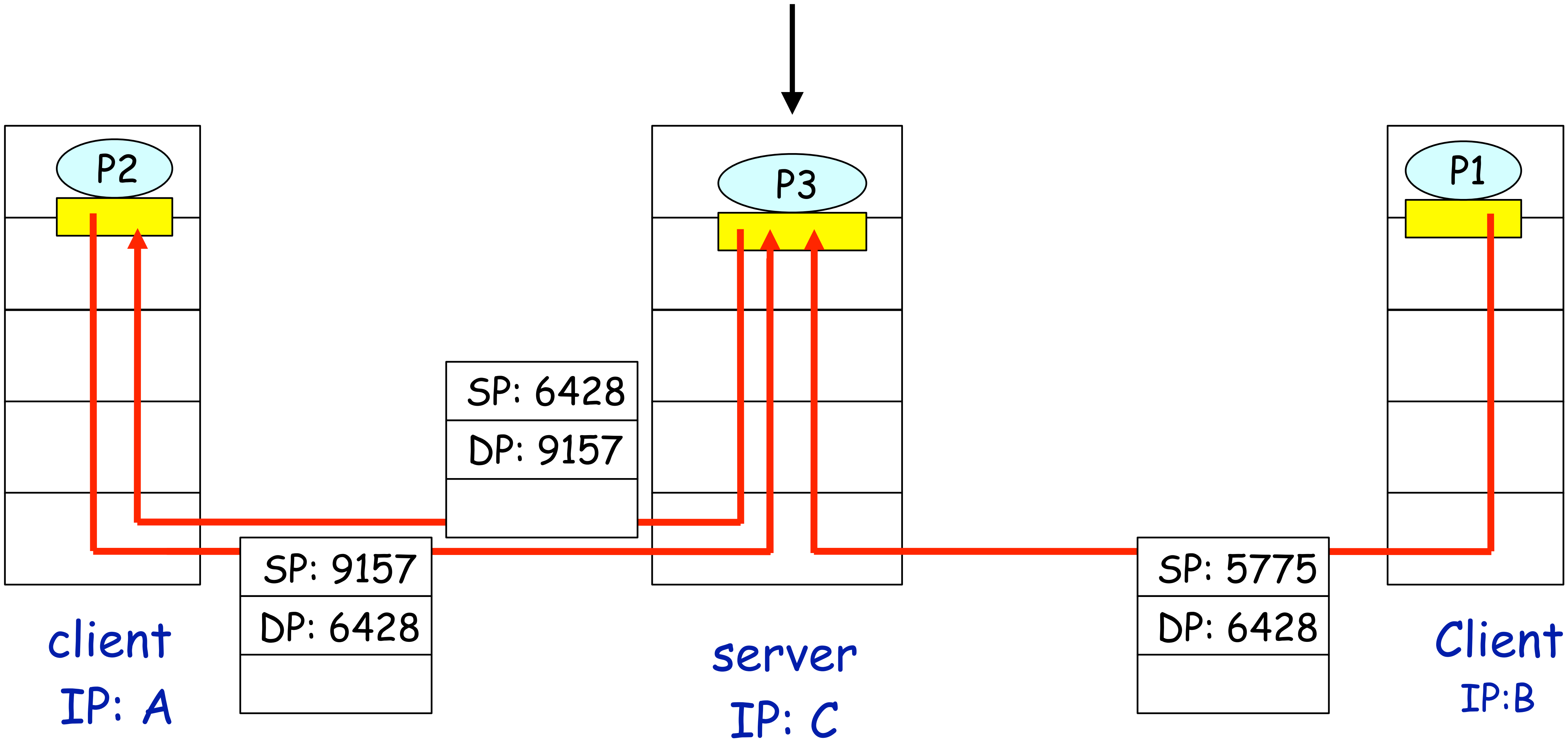

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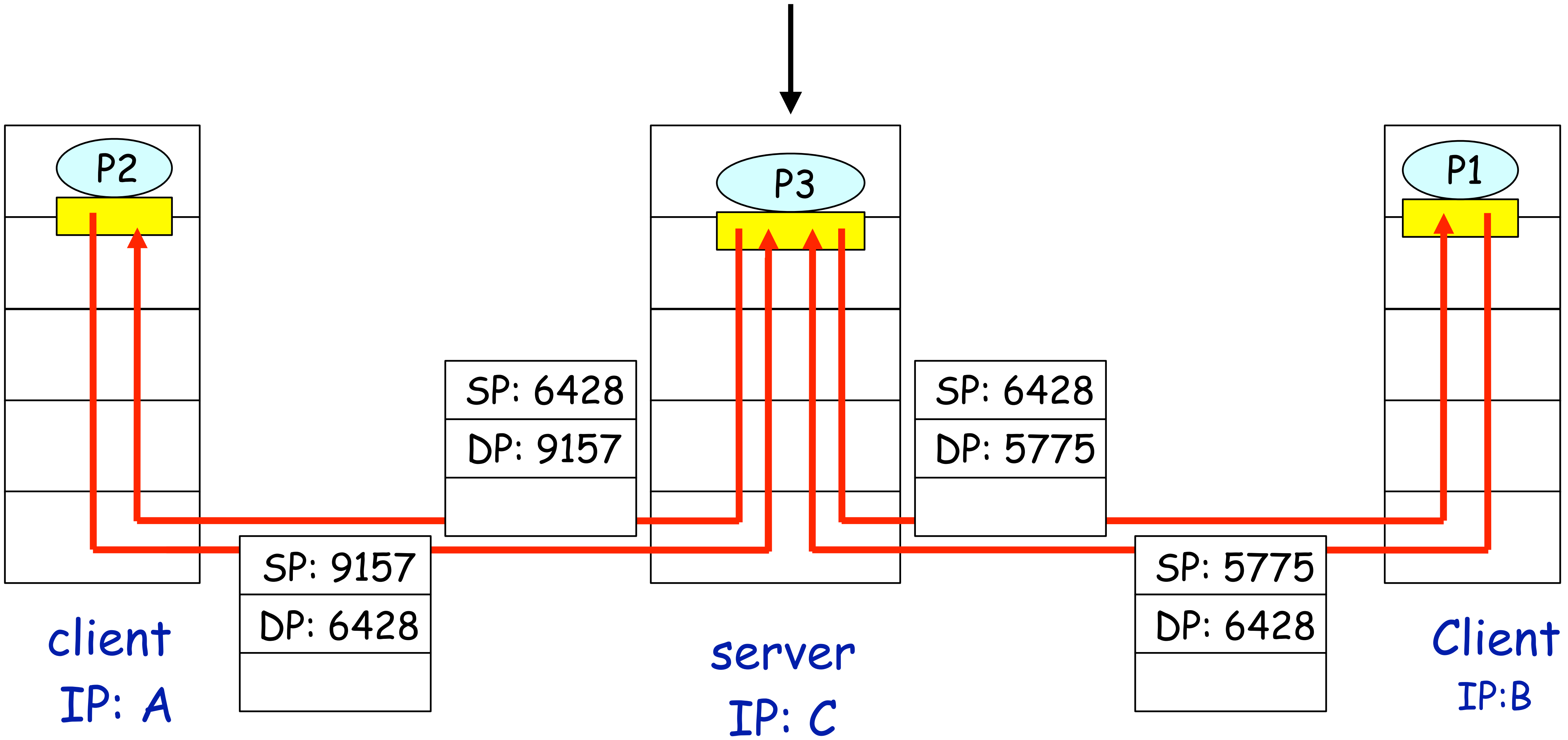

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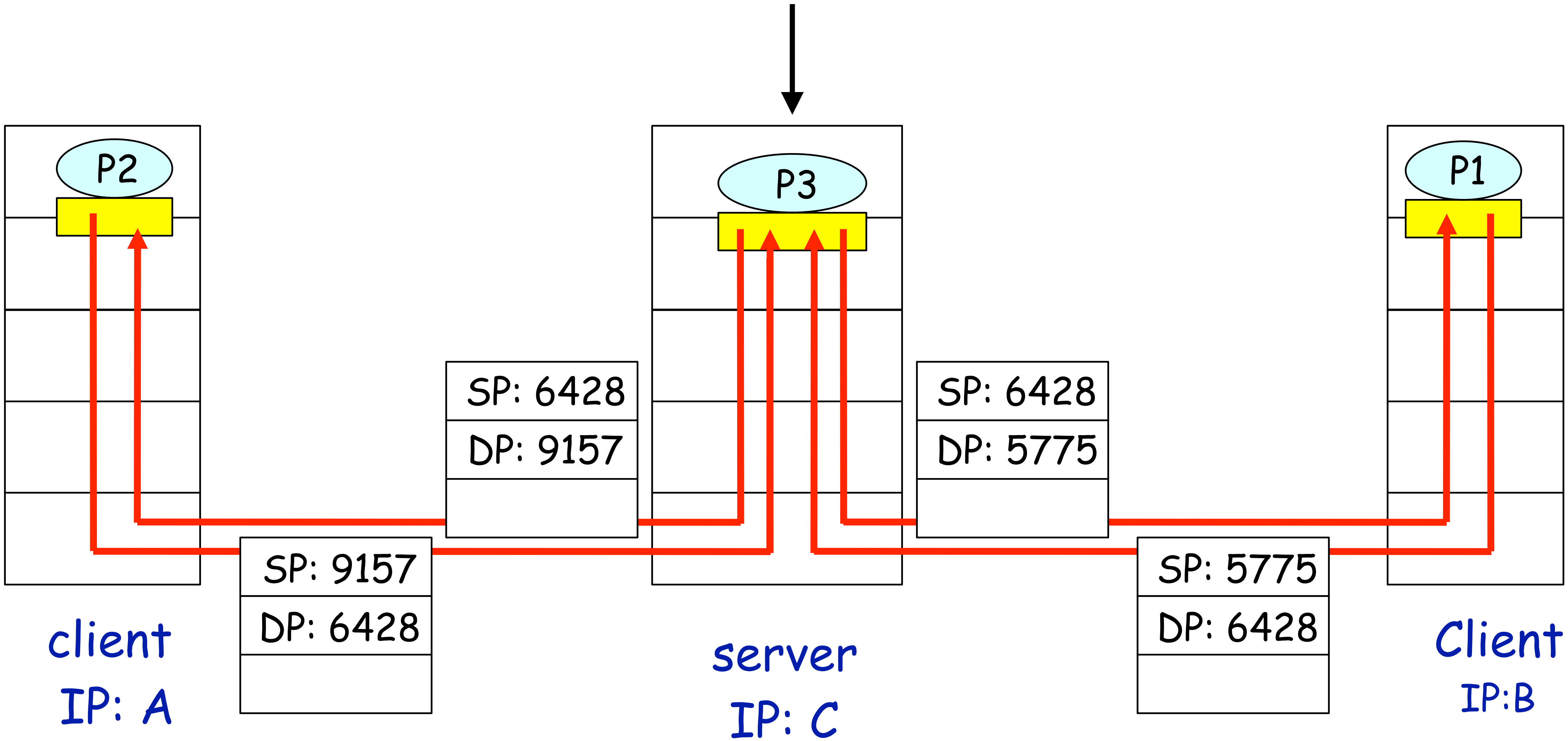
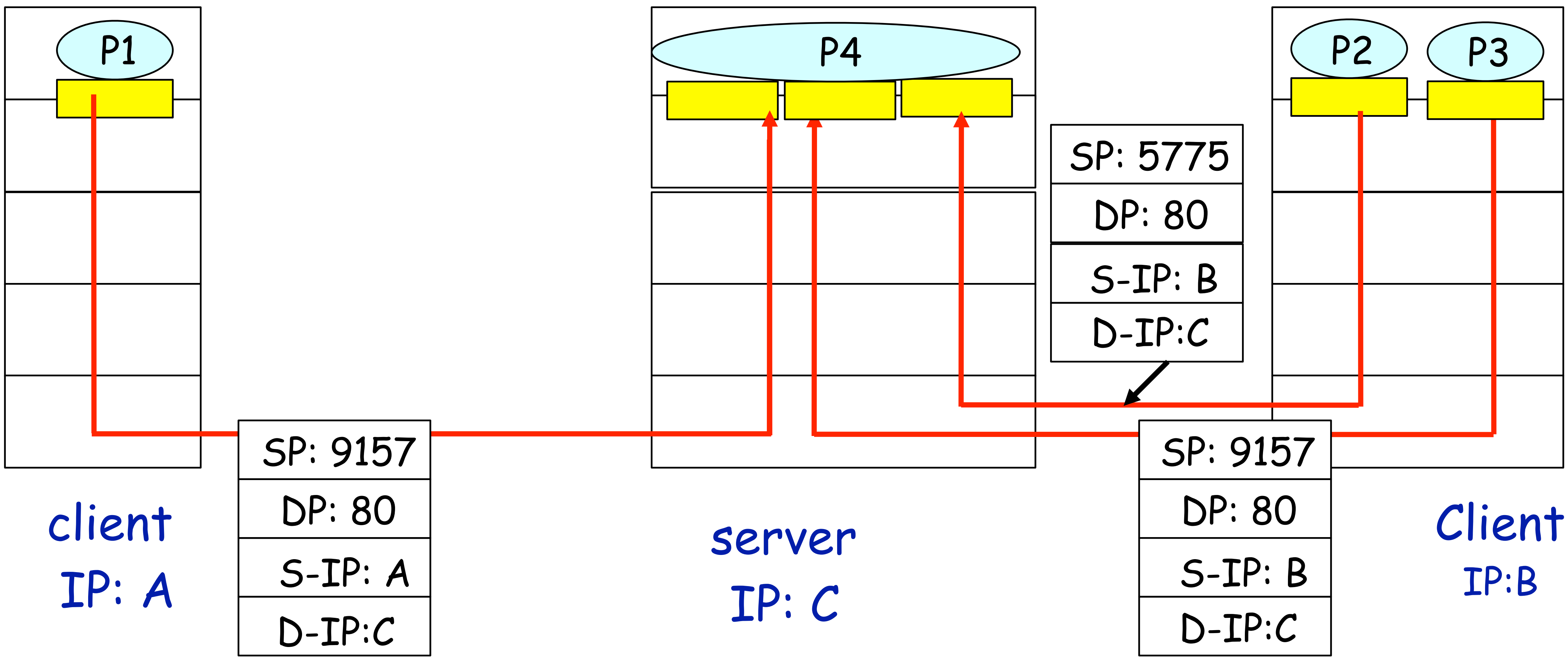


SP provides "return address"

More Complex Demux-ing



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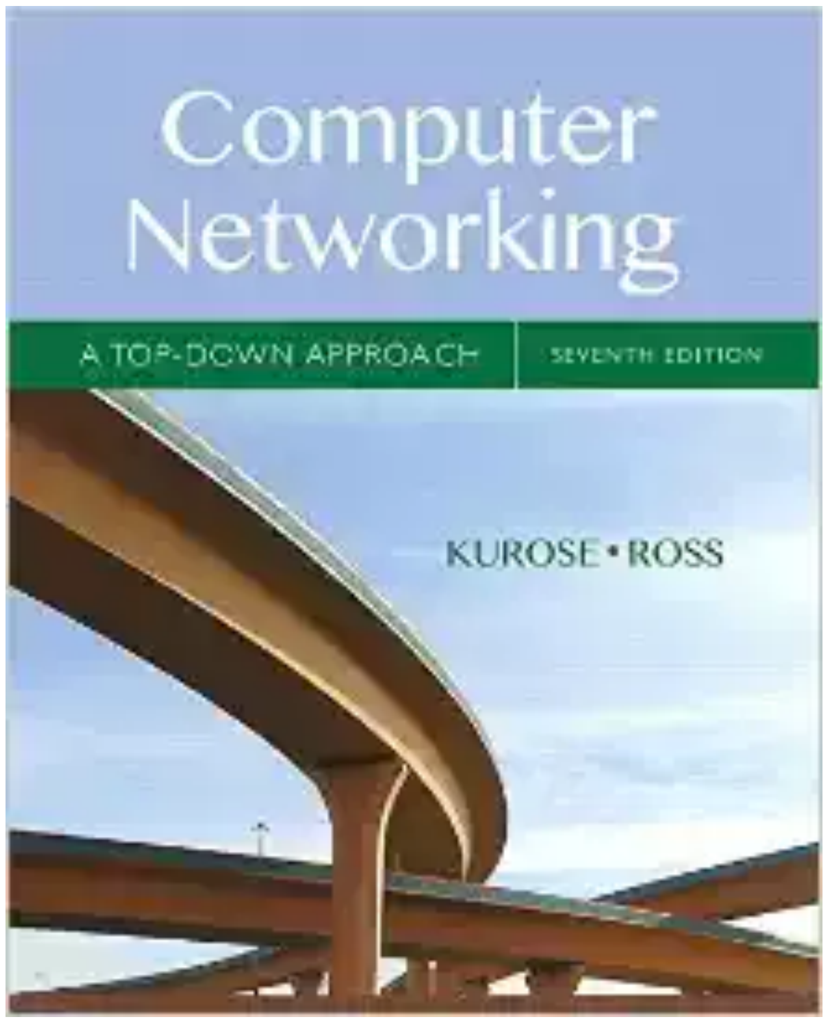

- 3.3: Connectionless Transport: UDP

UDP: User Datagram Protocol [RFC 768]

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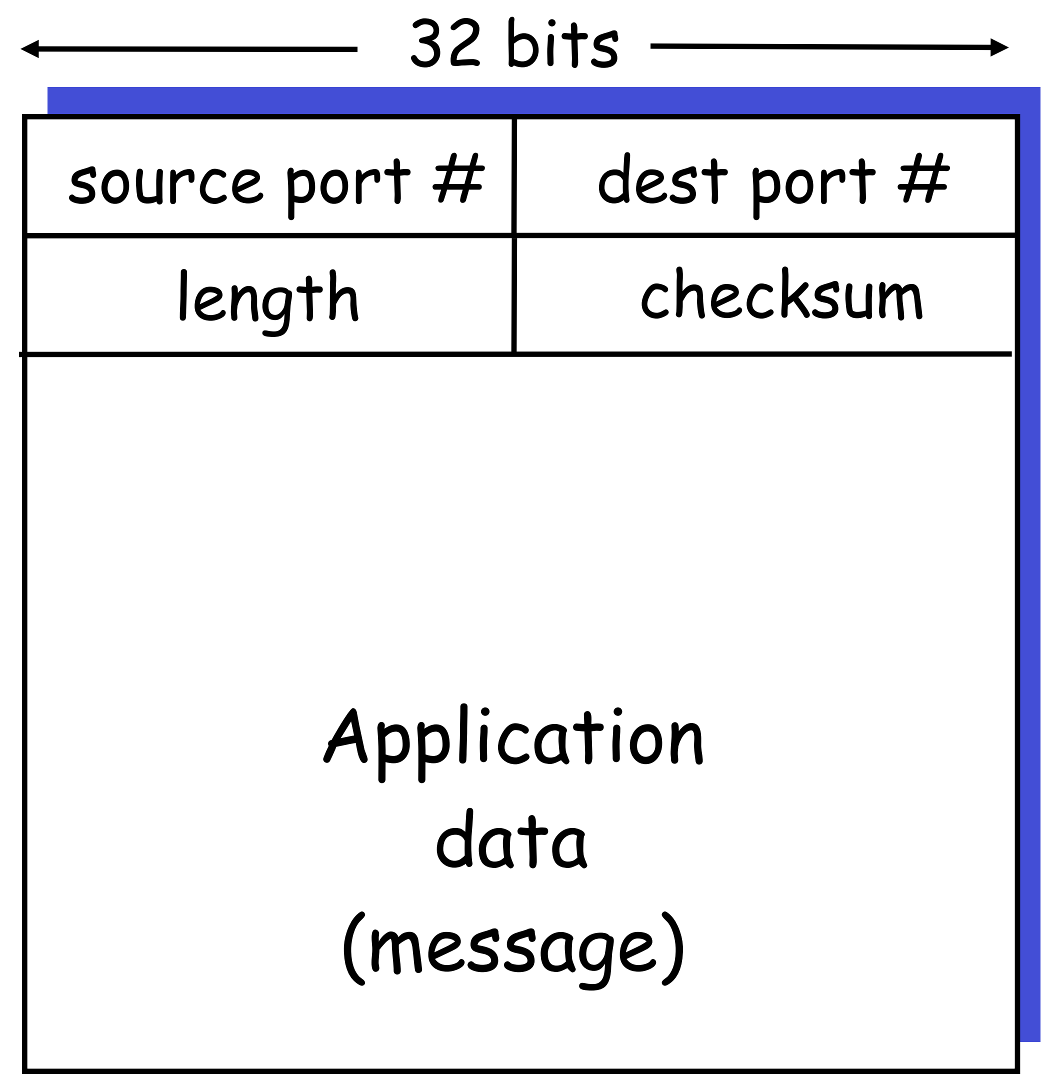
Why is there a UDP?

- no connection establishment (which can add delay)
- simple: no connection state at sender, receiver
- small segment header
- no congestion control: UDP can blast away as fast as desired

UDP

- often used for streaming multimedia apps
  - loss tolerant
  - rate controllable
- other UDP uses
  - DNS
  - SNMP
- reliable transfer over UDP: add reliability at application layer
  - application-specific error recovery!



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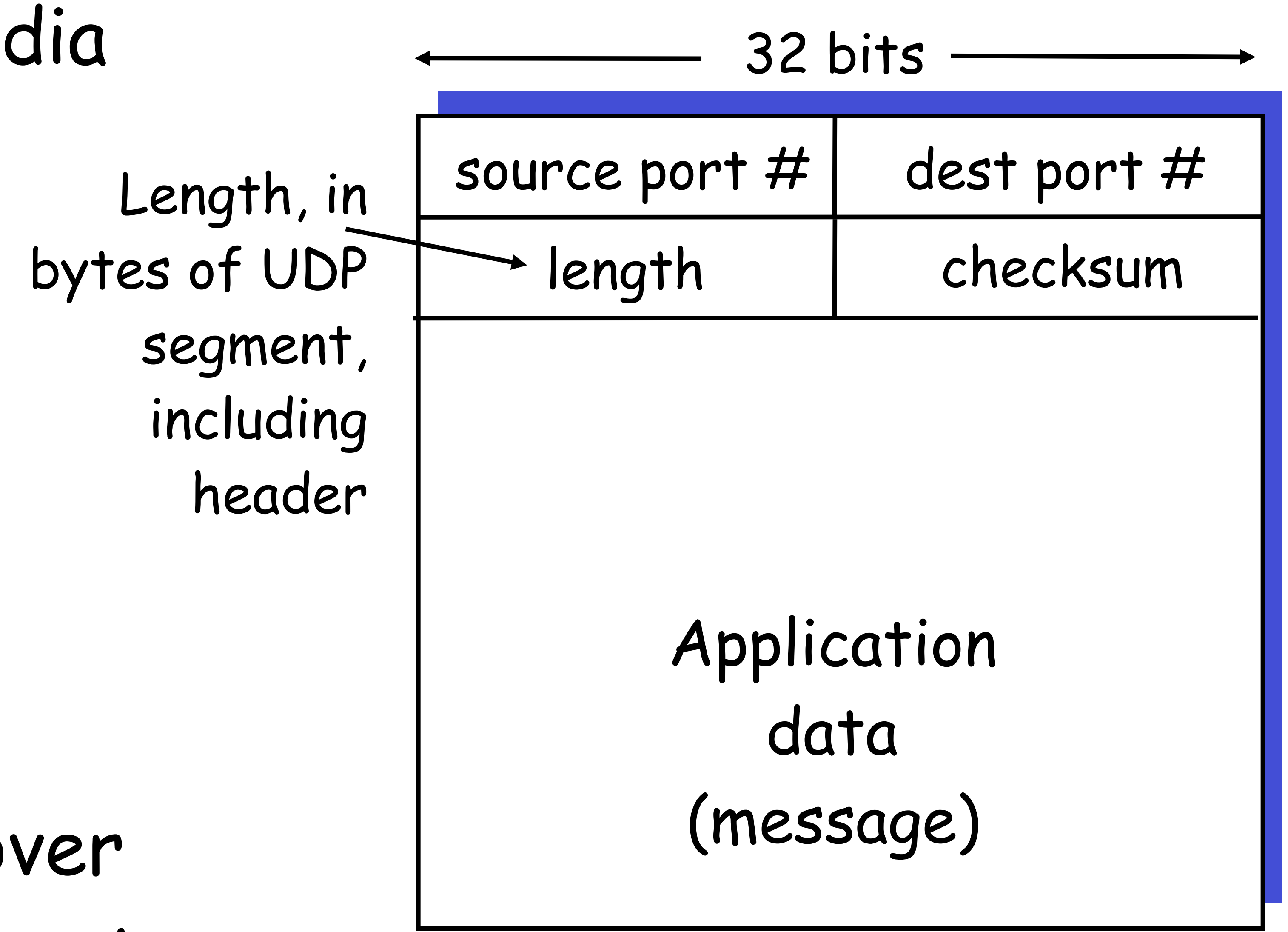

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  - NO - error detected
  - YES - no error detected.
    - But maybe errors nonetheless?

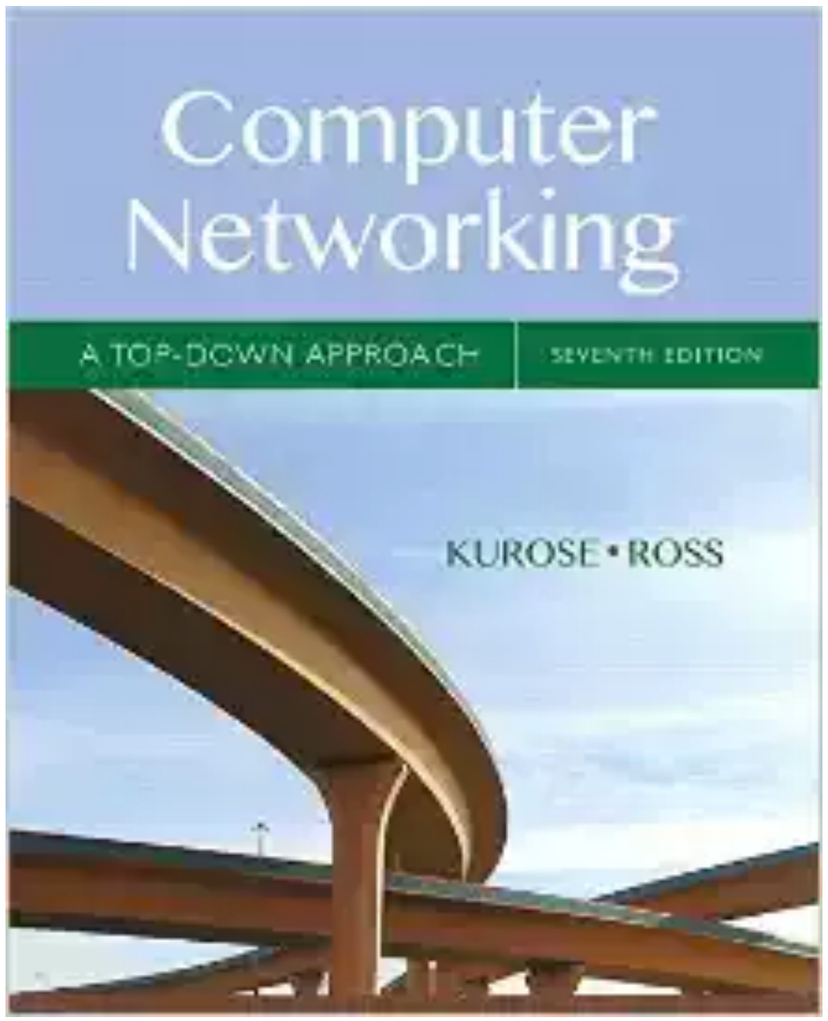
UDP Packet Header

0 ... 15	16 ... 31
Source Port Number(16 bits)	Destination Port Number(16 bits)
Length(UDP Header + Data)16 bits	UDP Checksum(16 bits)
Application Data (Message)	

A Tangent...

- Binary number: 0111

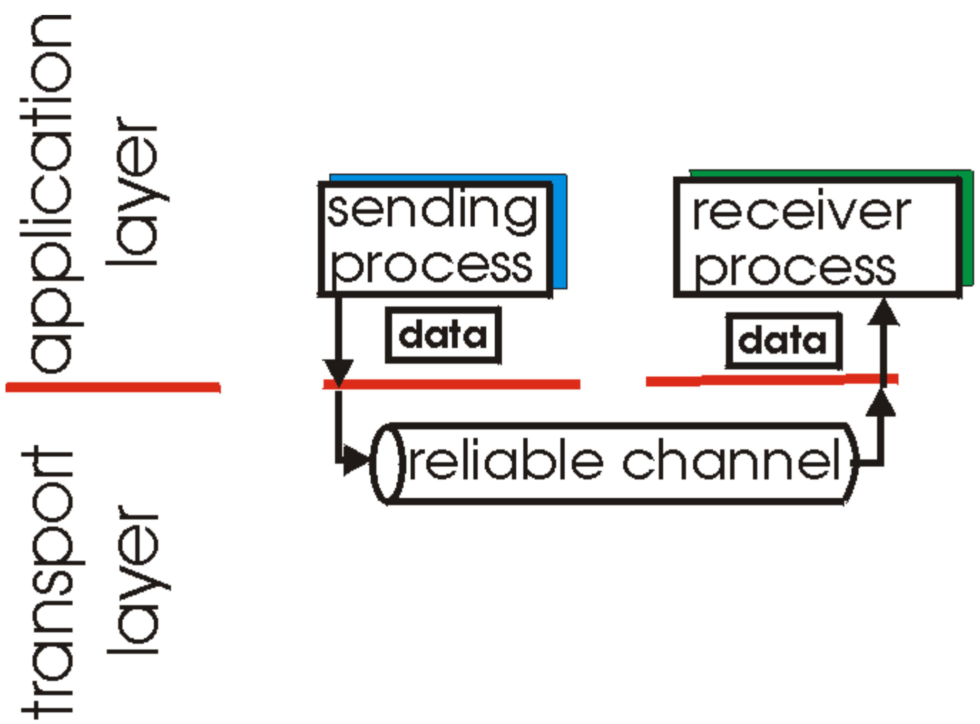
Reading Along ...



- 3.4: Principles of reliable data transfer

Principles of Reliable data transfer

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



(a) provided service

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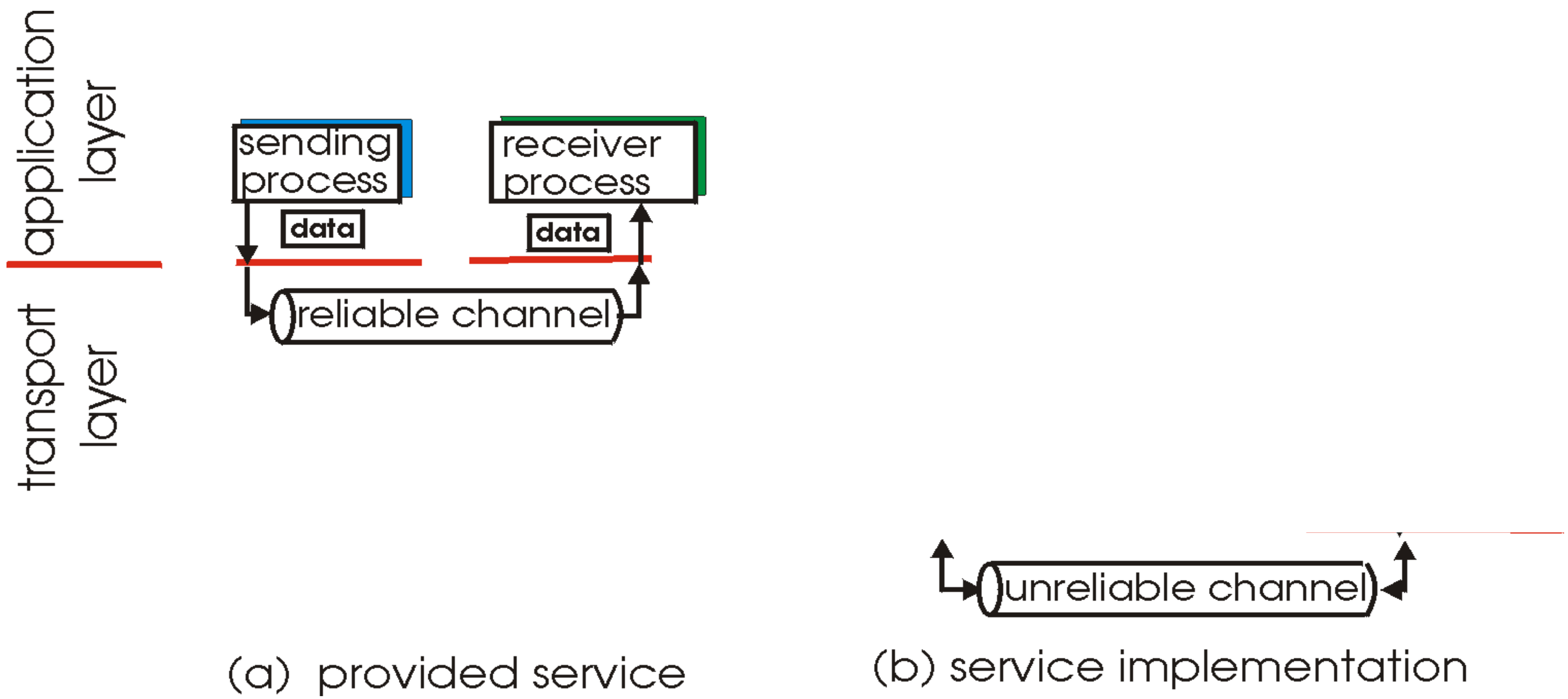

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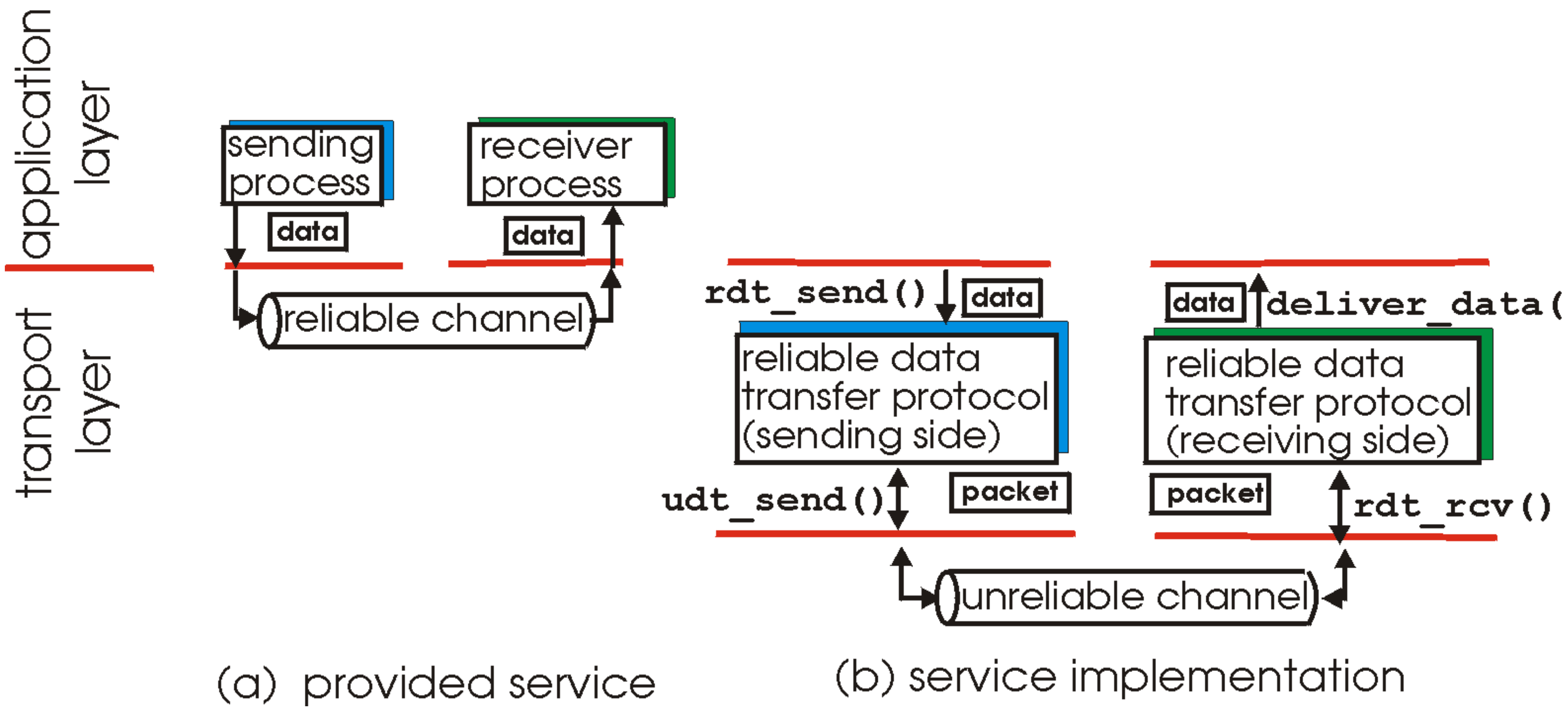
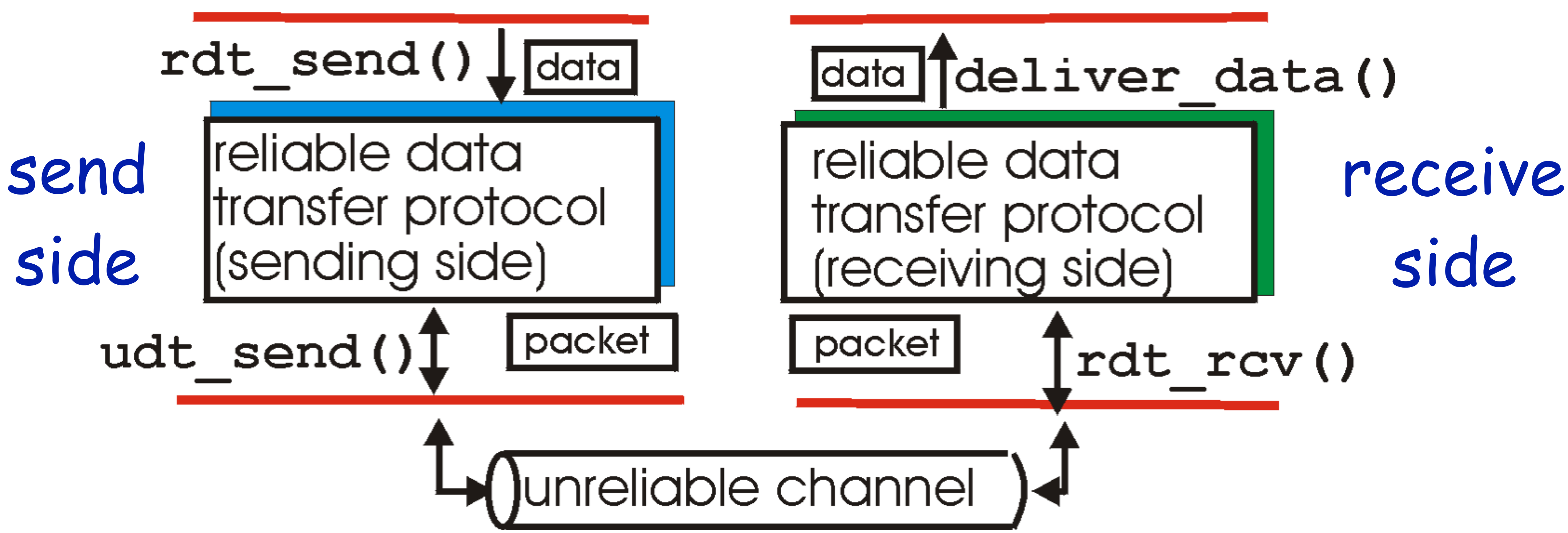


Reliable data transfer: getting started



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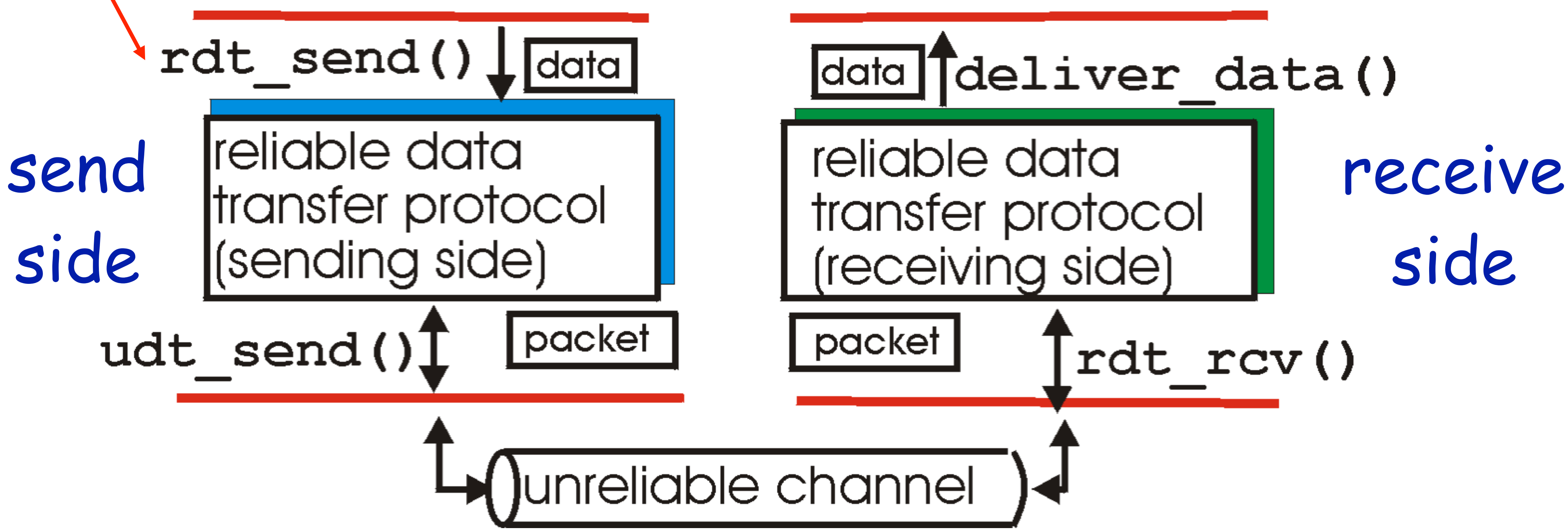
rdt_send(): called from above, (e.g., by app.). Passed data to deliver to receiver upper layer



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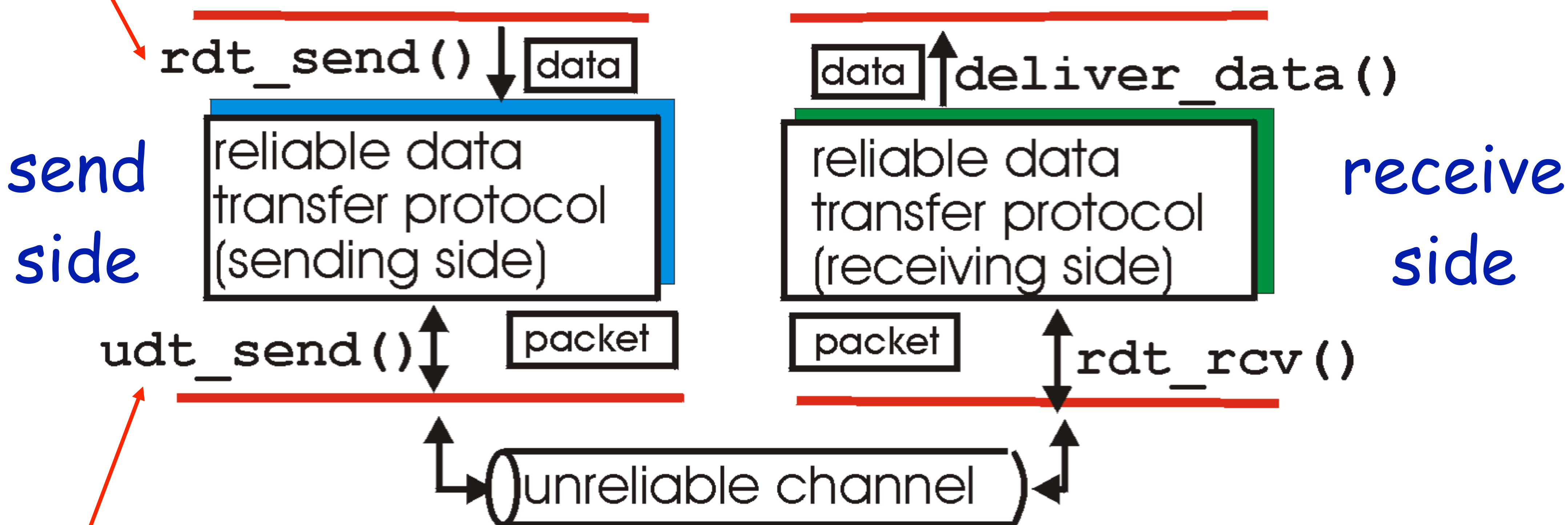

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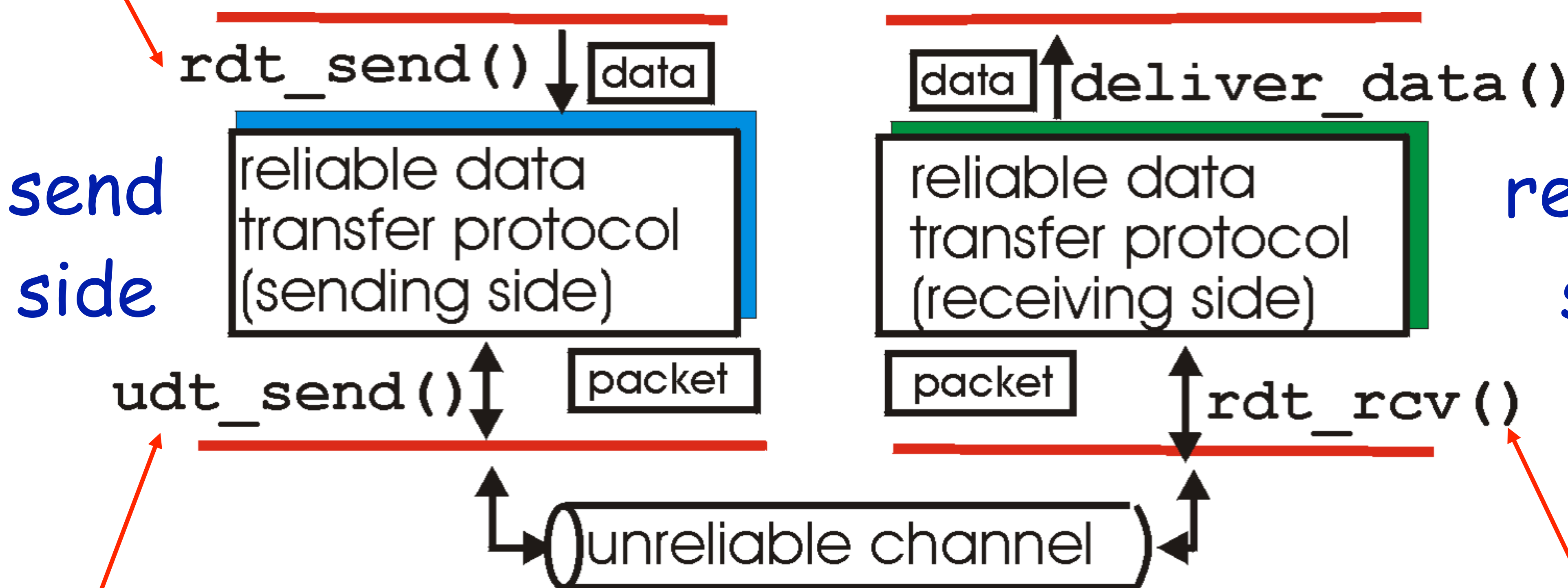

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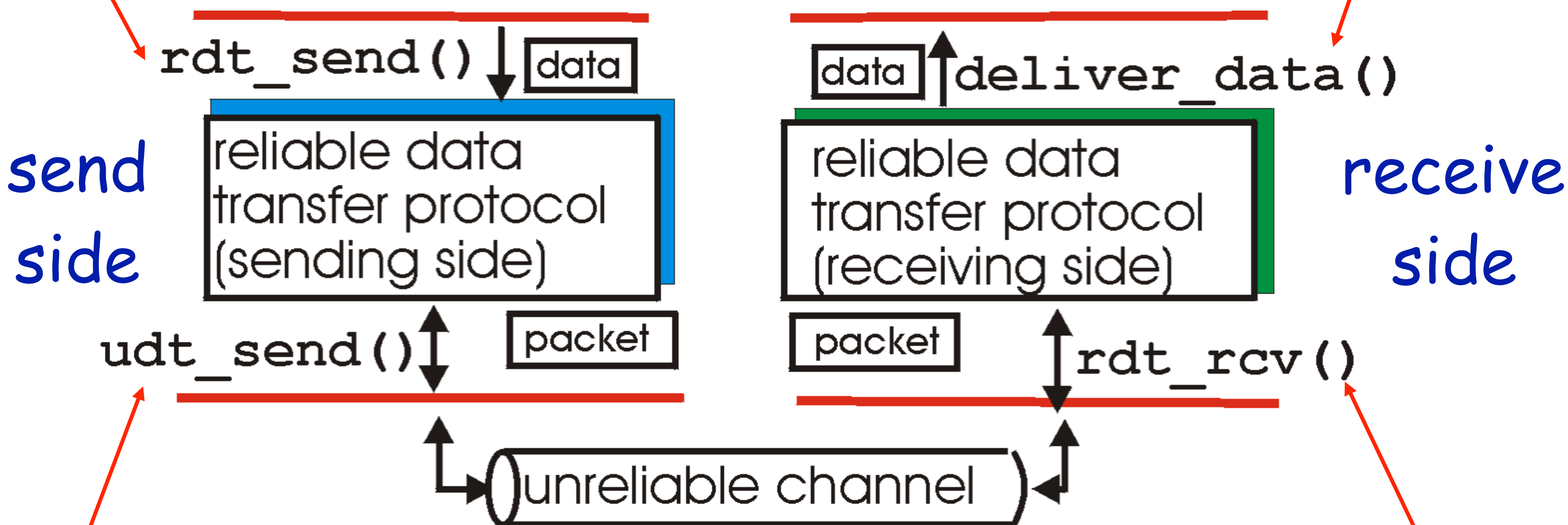
`deliver_data()`: called by `rdt` to deliver data to upper



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

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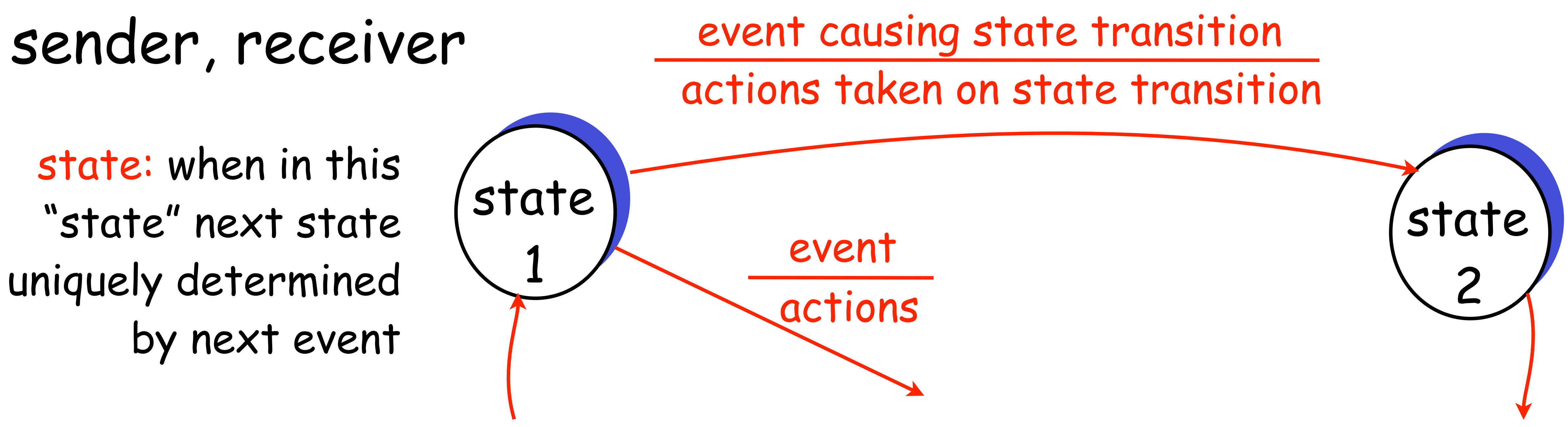

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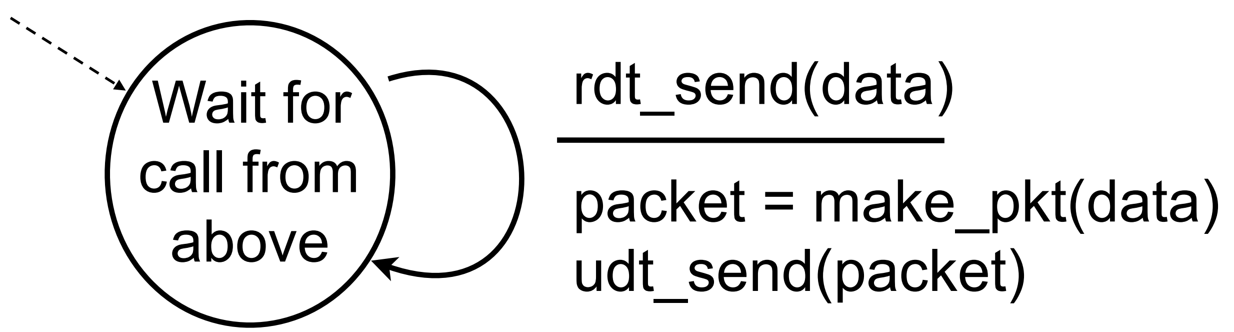

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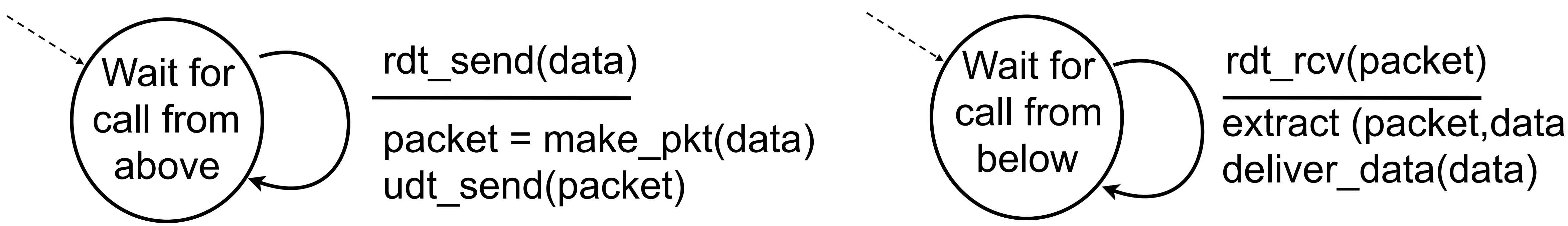

sender　　　　receiver

Rdt 1.0

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- Obviously unrealistic assumptions!
- If that was all there was to it, there'd be little reason to even bring it up!

Rdt2.0: channel with bit errors

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How do humans recover
from "errors"
during conversation?

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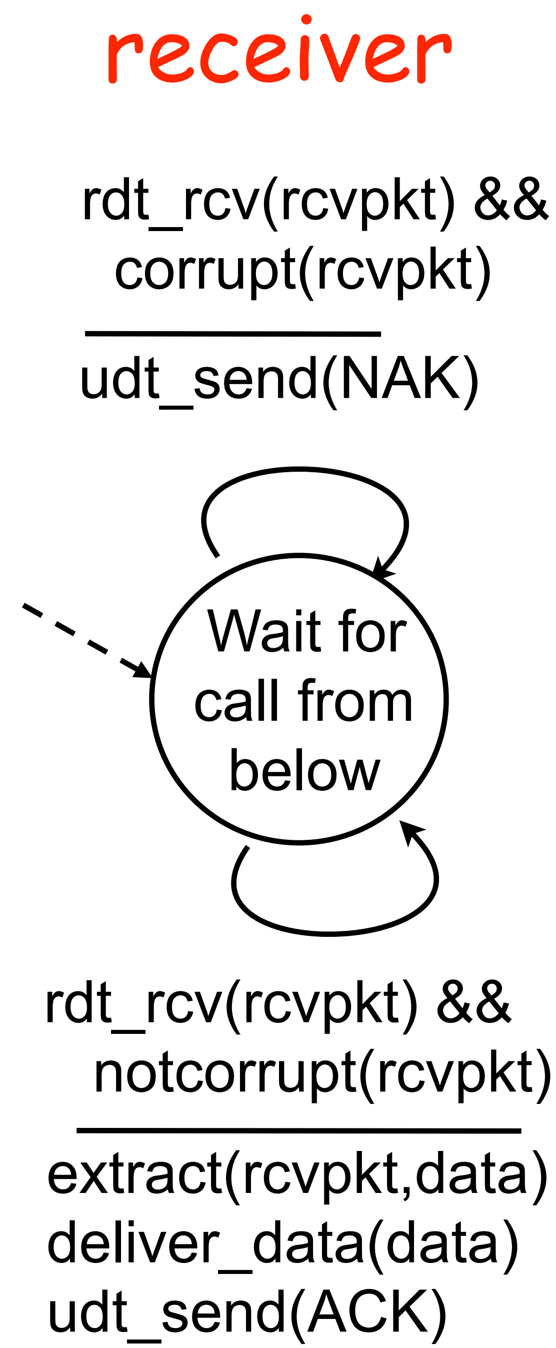
- new mechanisms in `rdt2.0` (beyond `rdt1.0`):
  - error detection
  - receiver feedback: control msgs (ACK,NAK) rcvr->sender

rdt2.0: FSM specification



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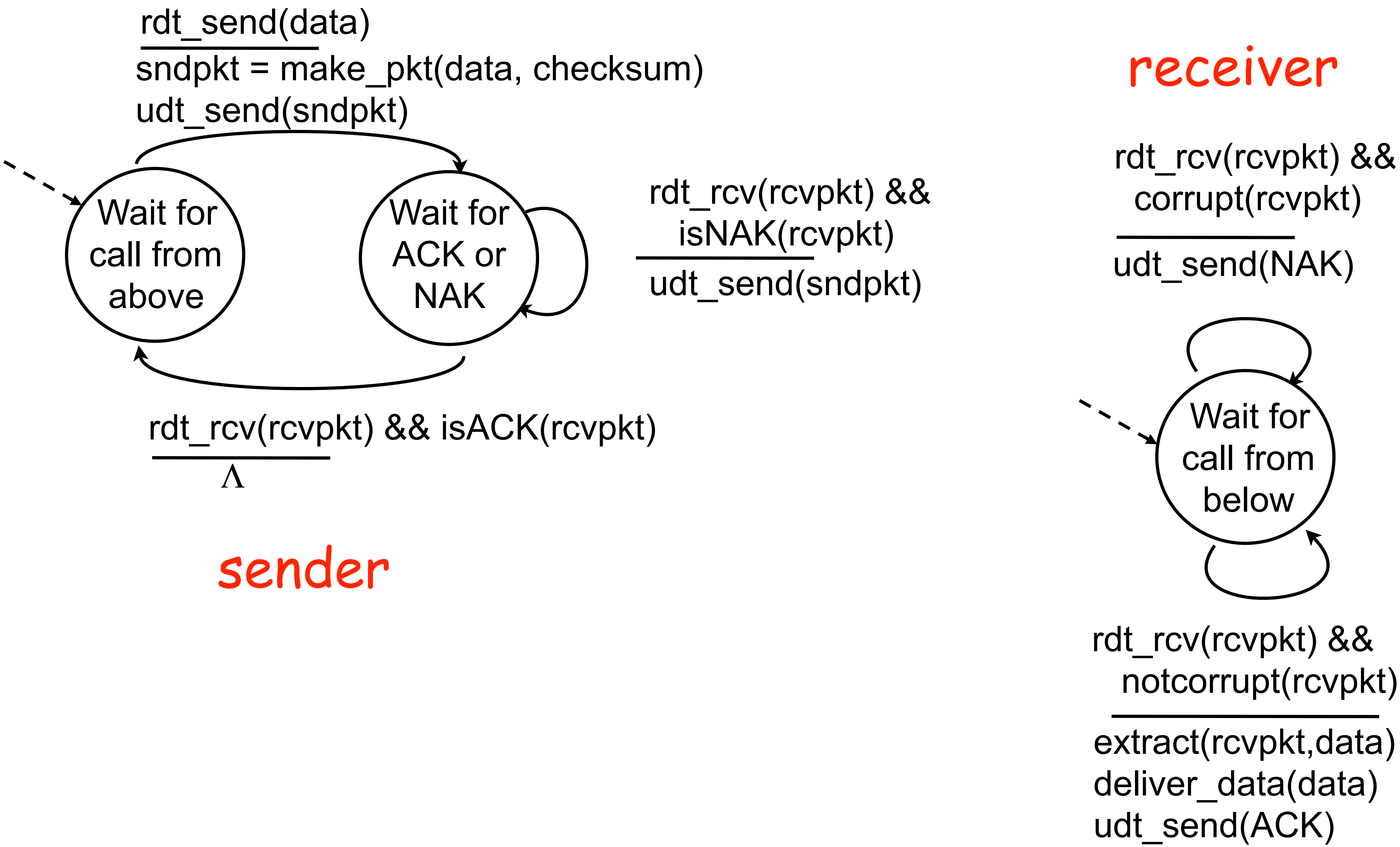

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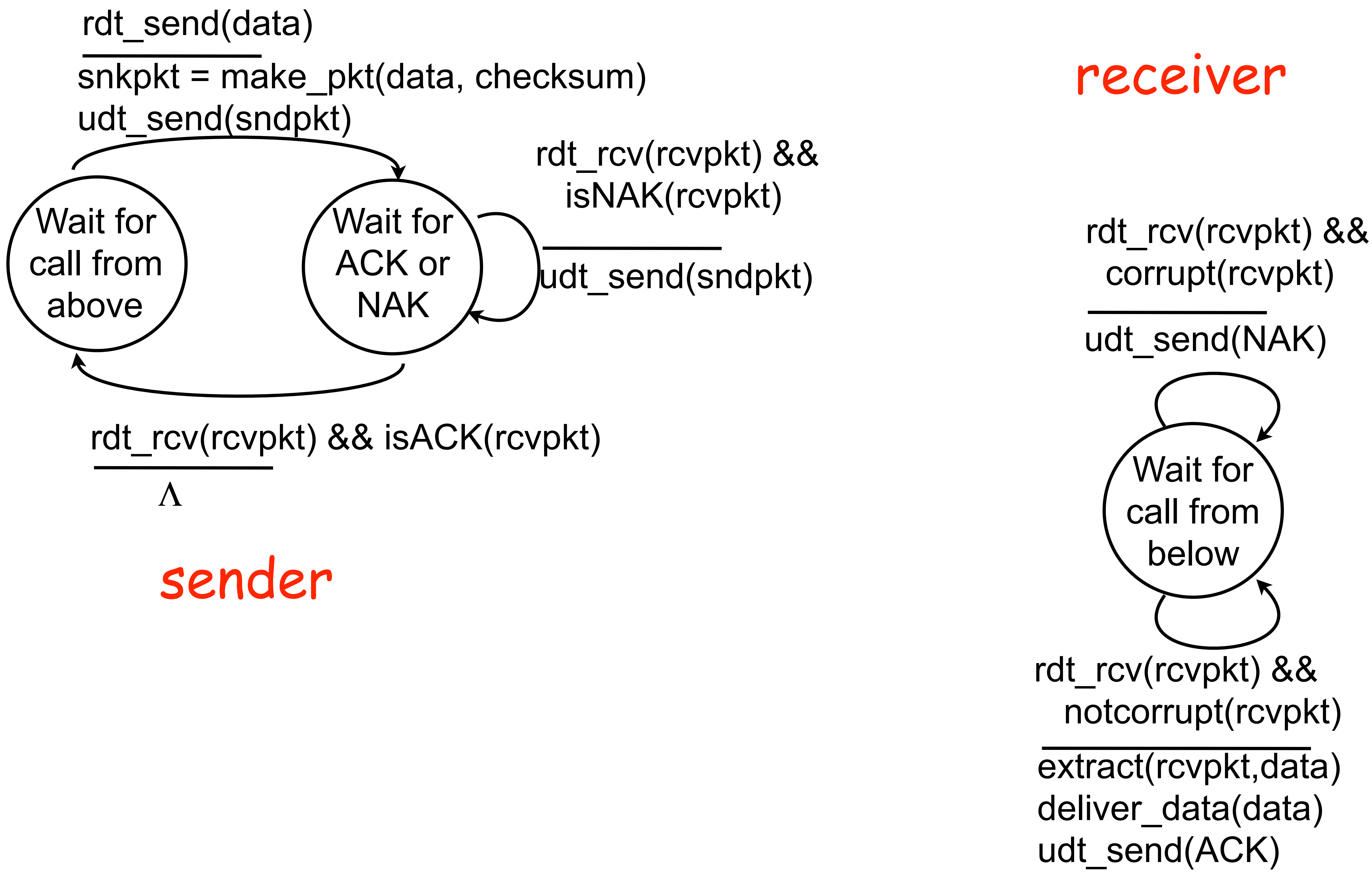

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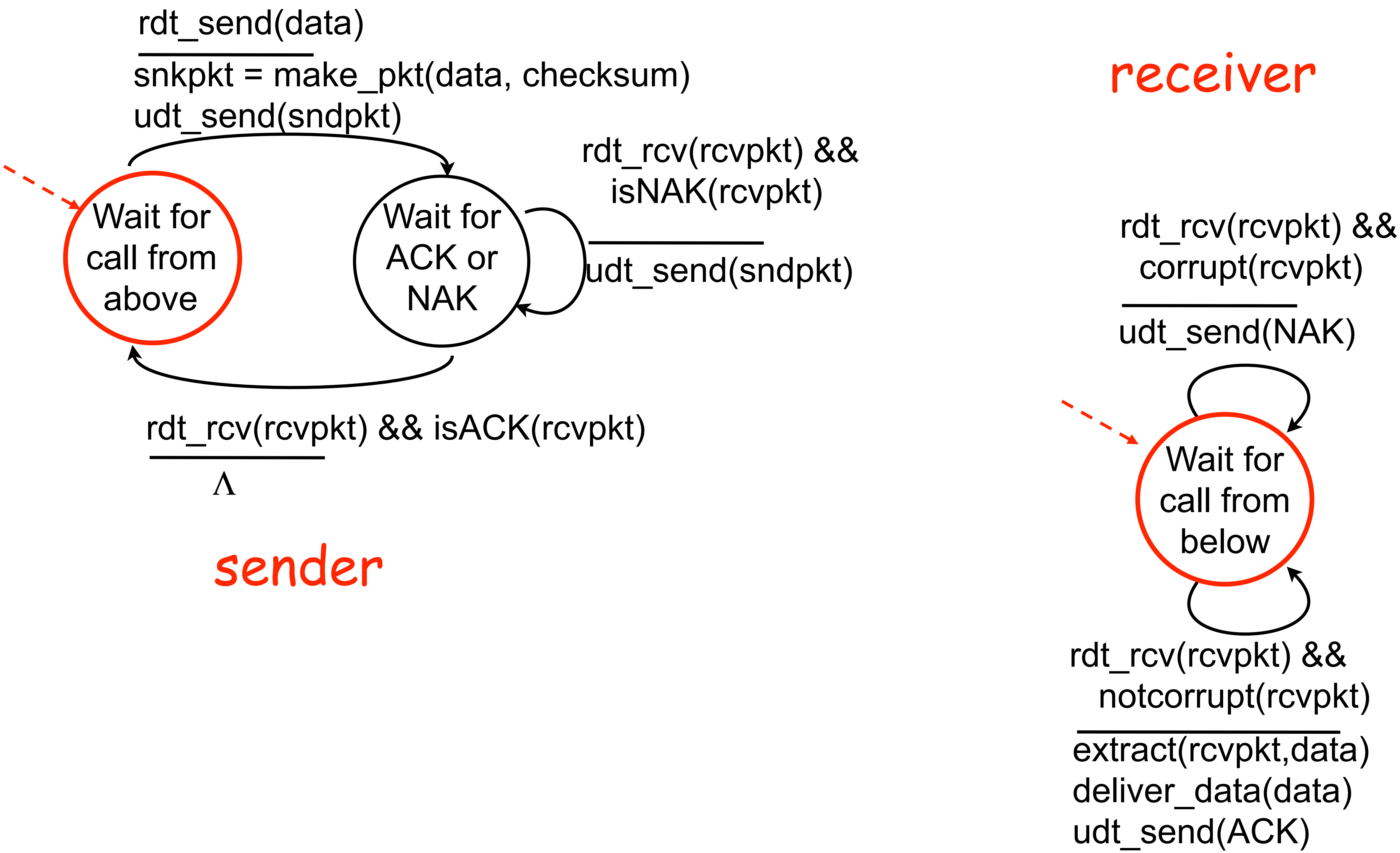

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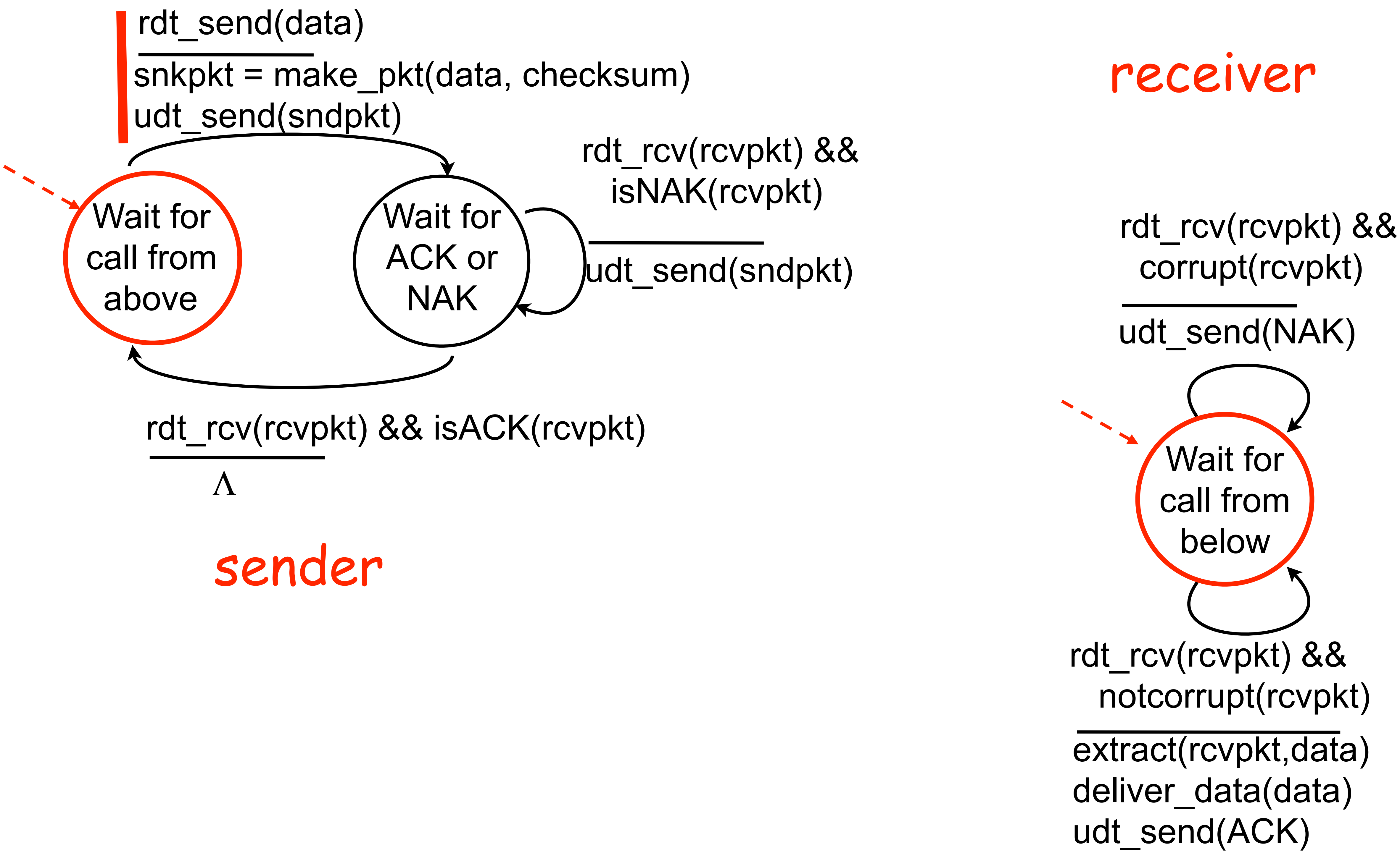

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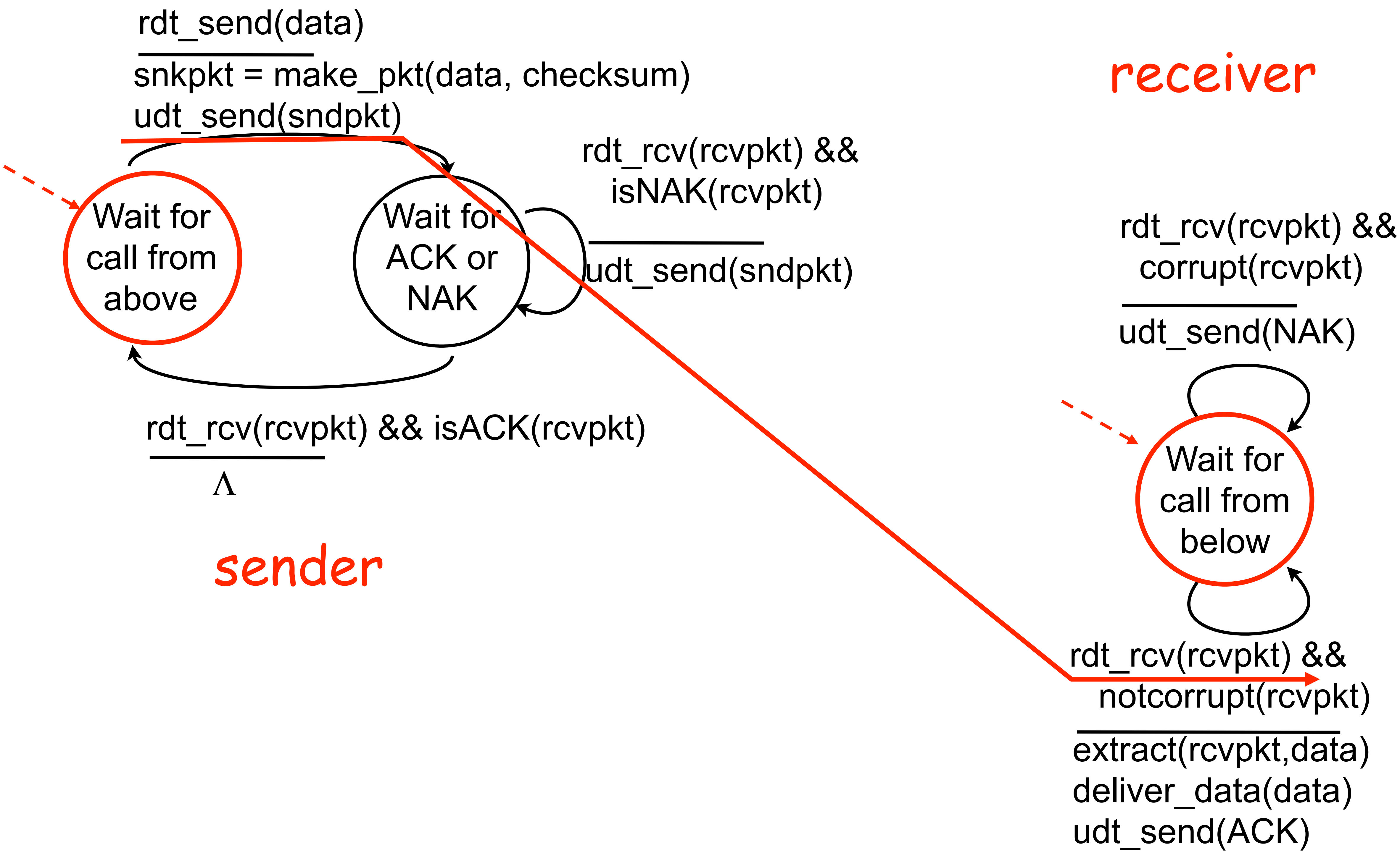

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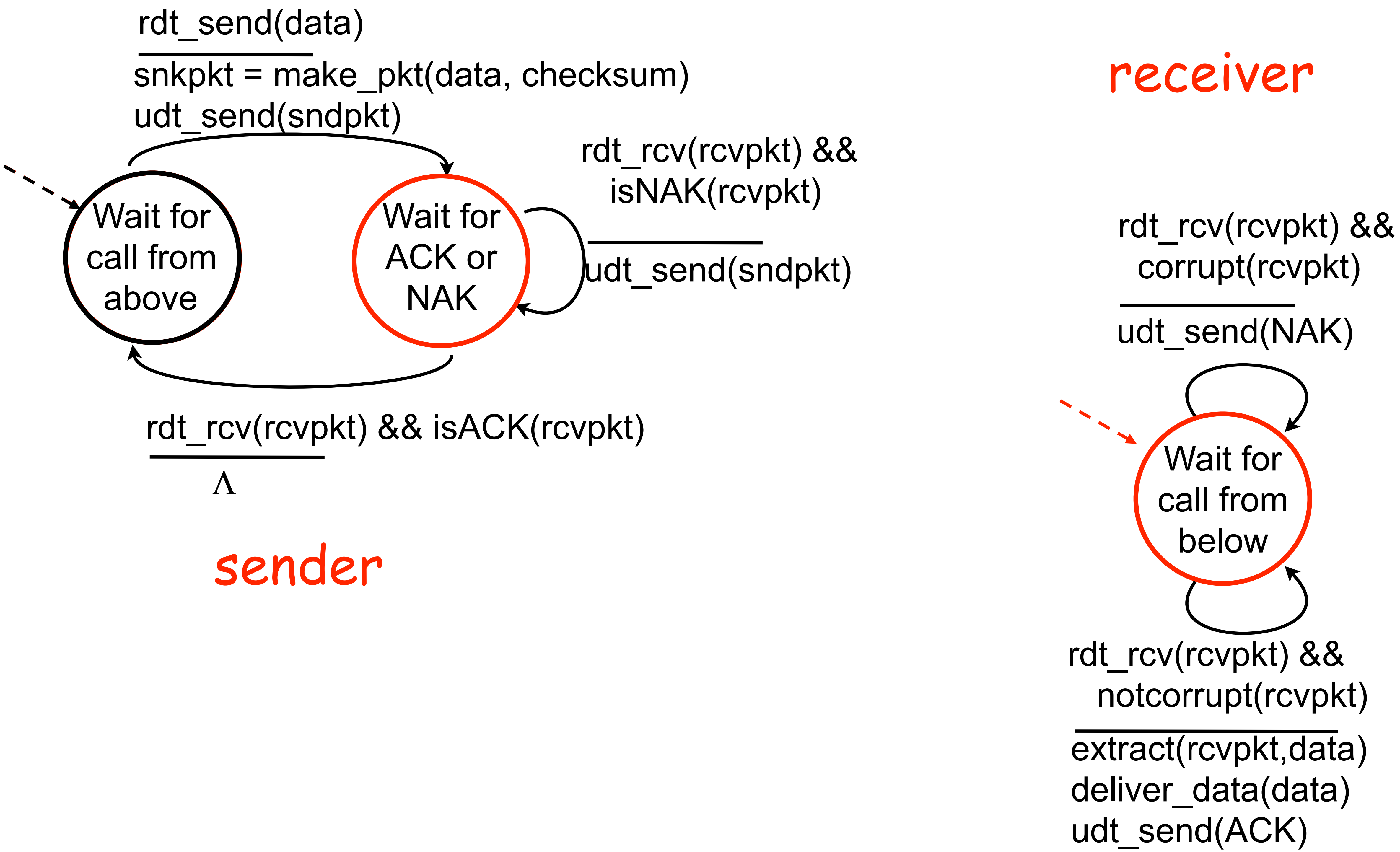

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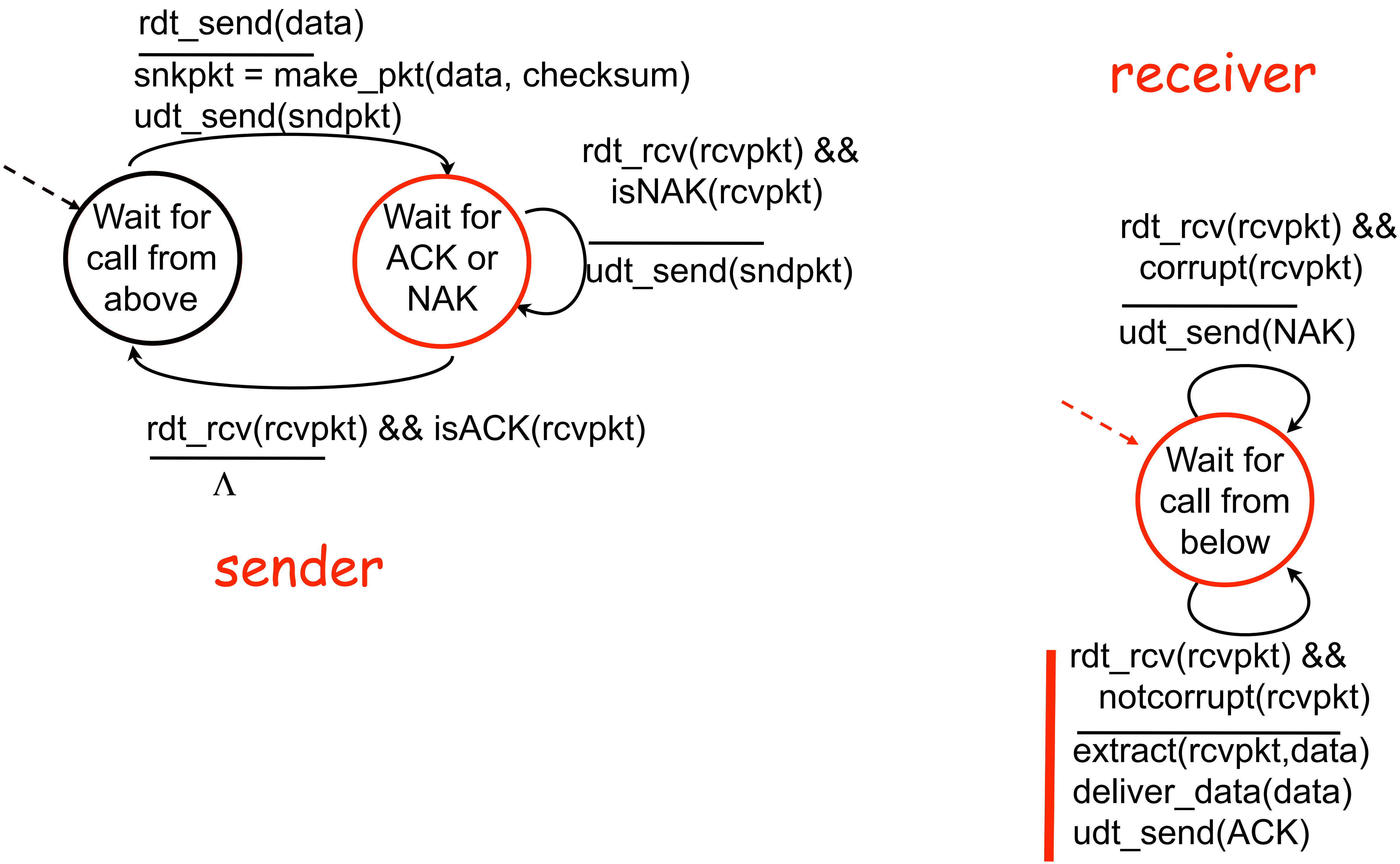

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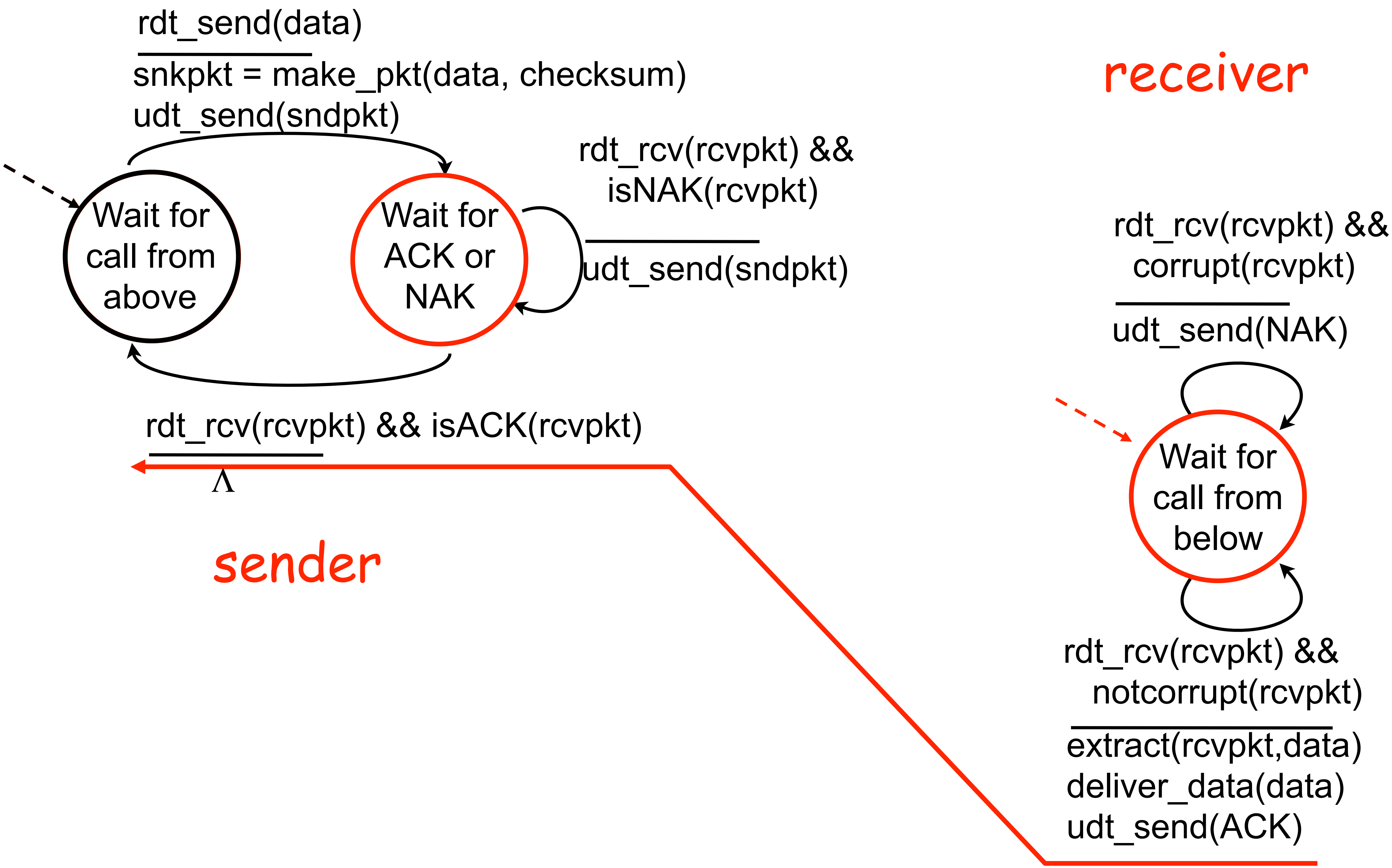

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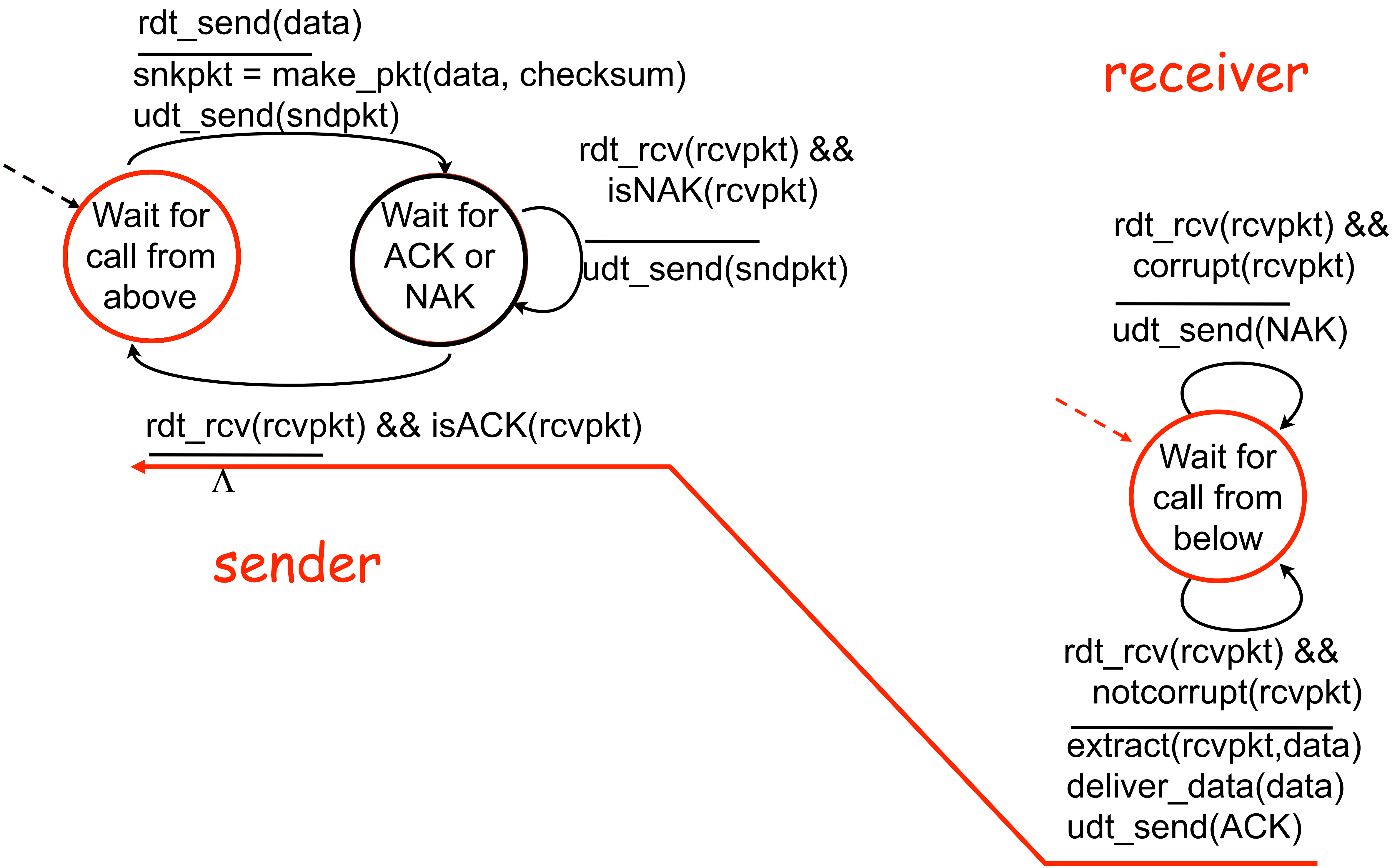

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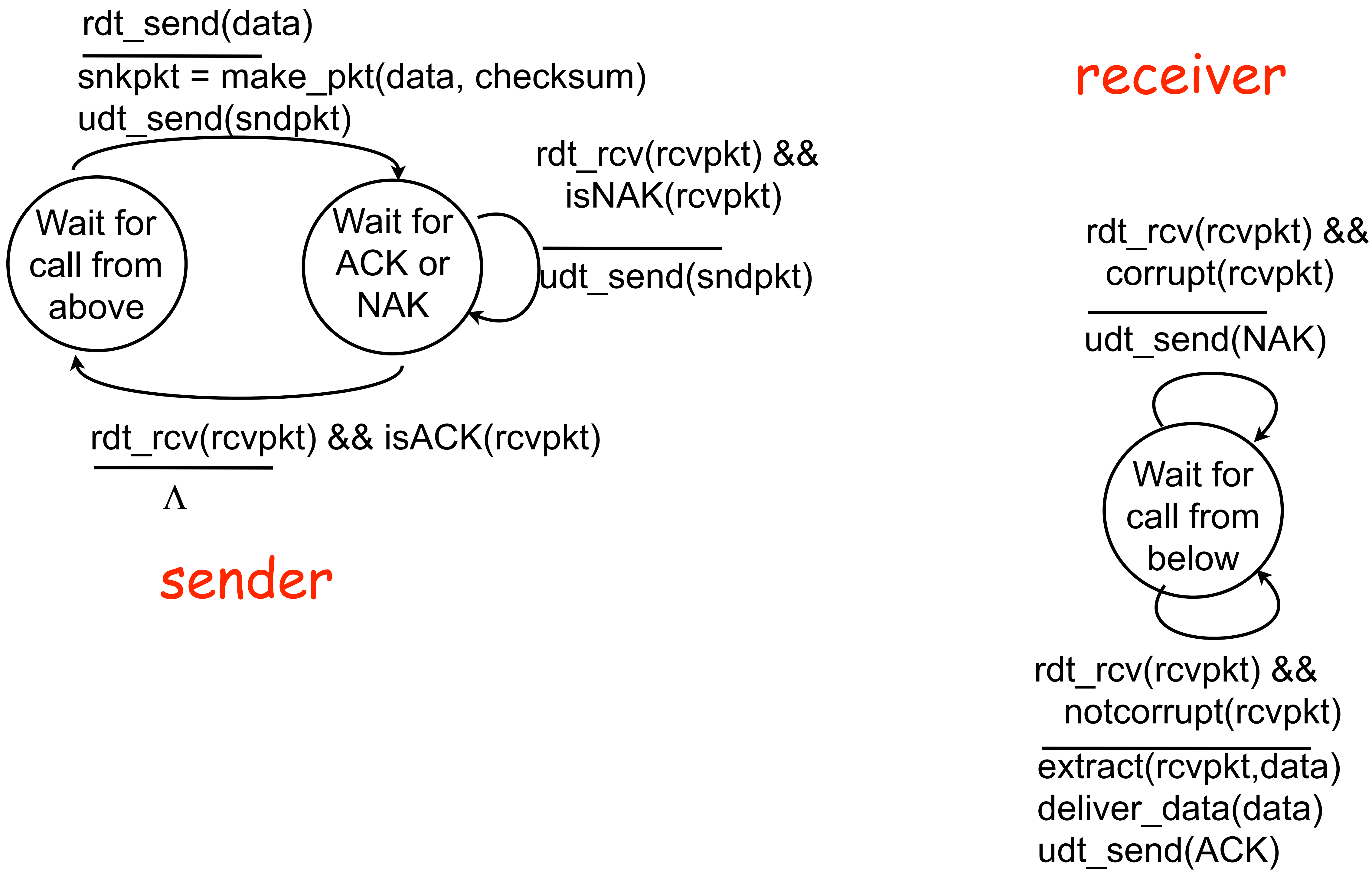

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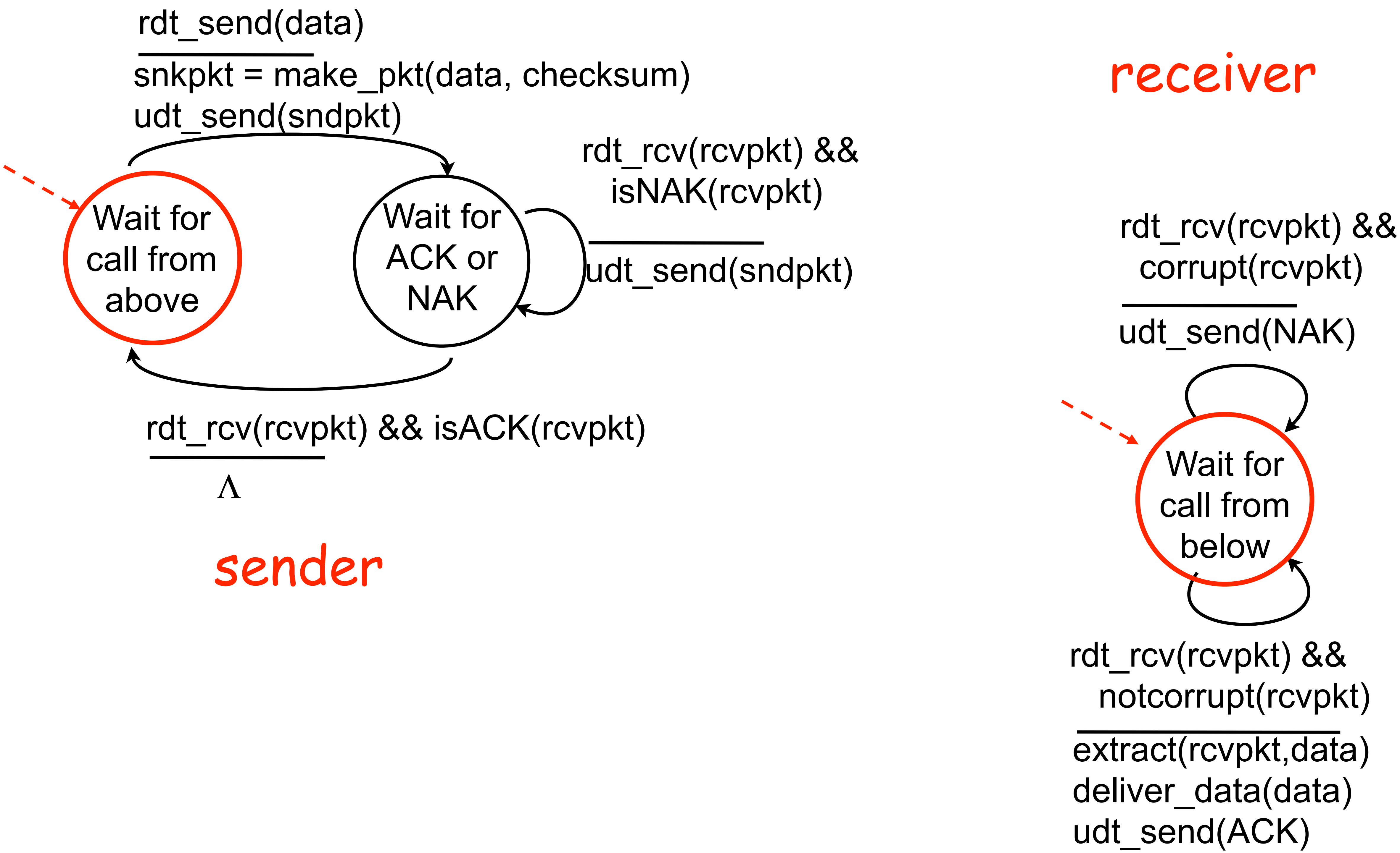

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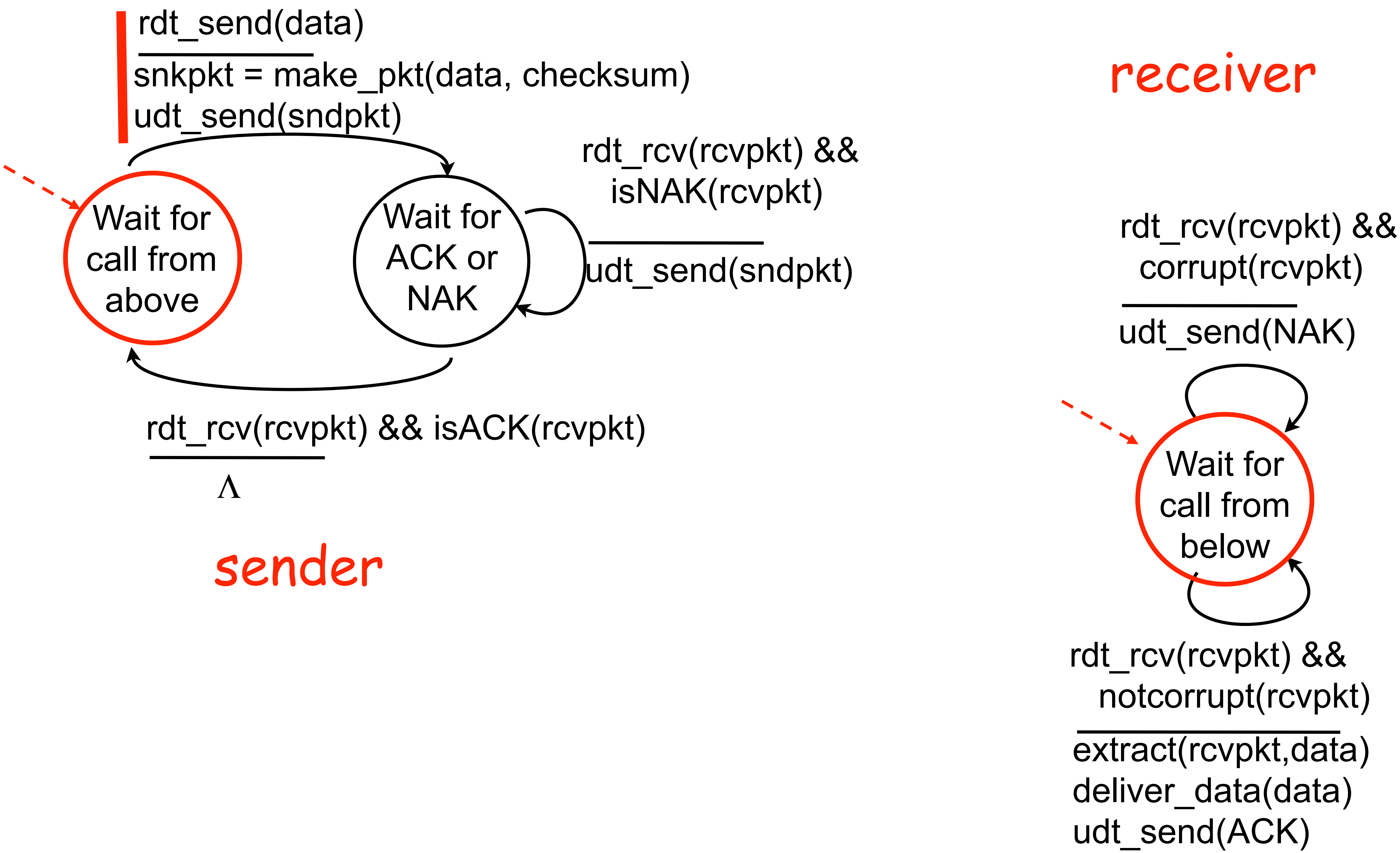

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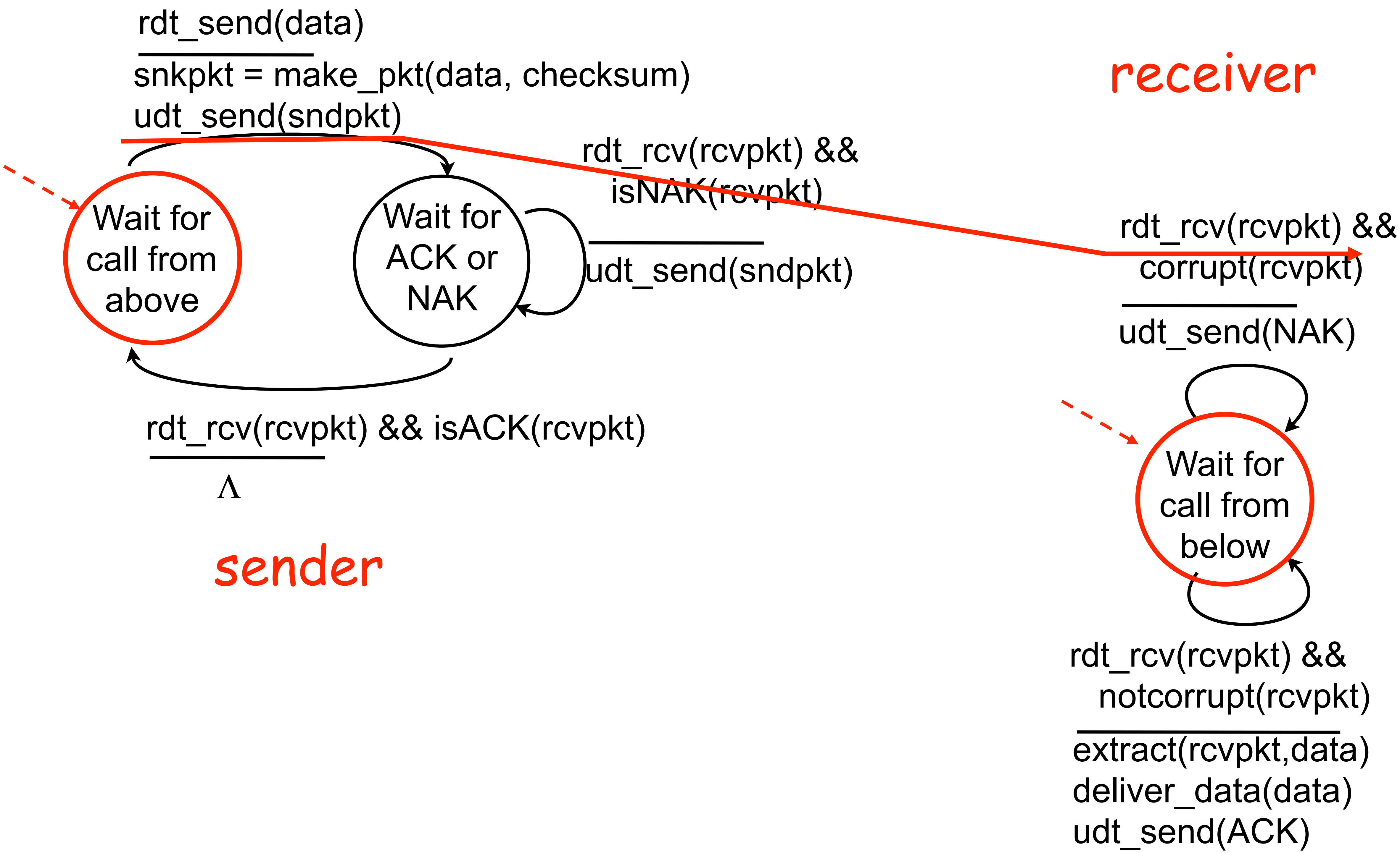

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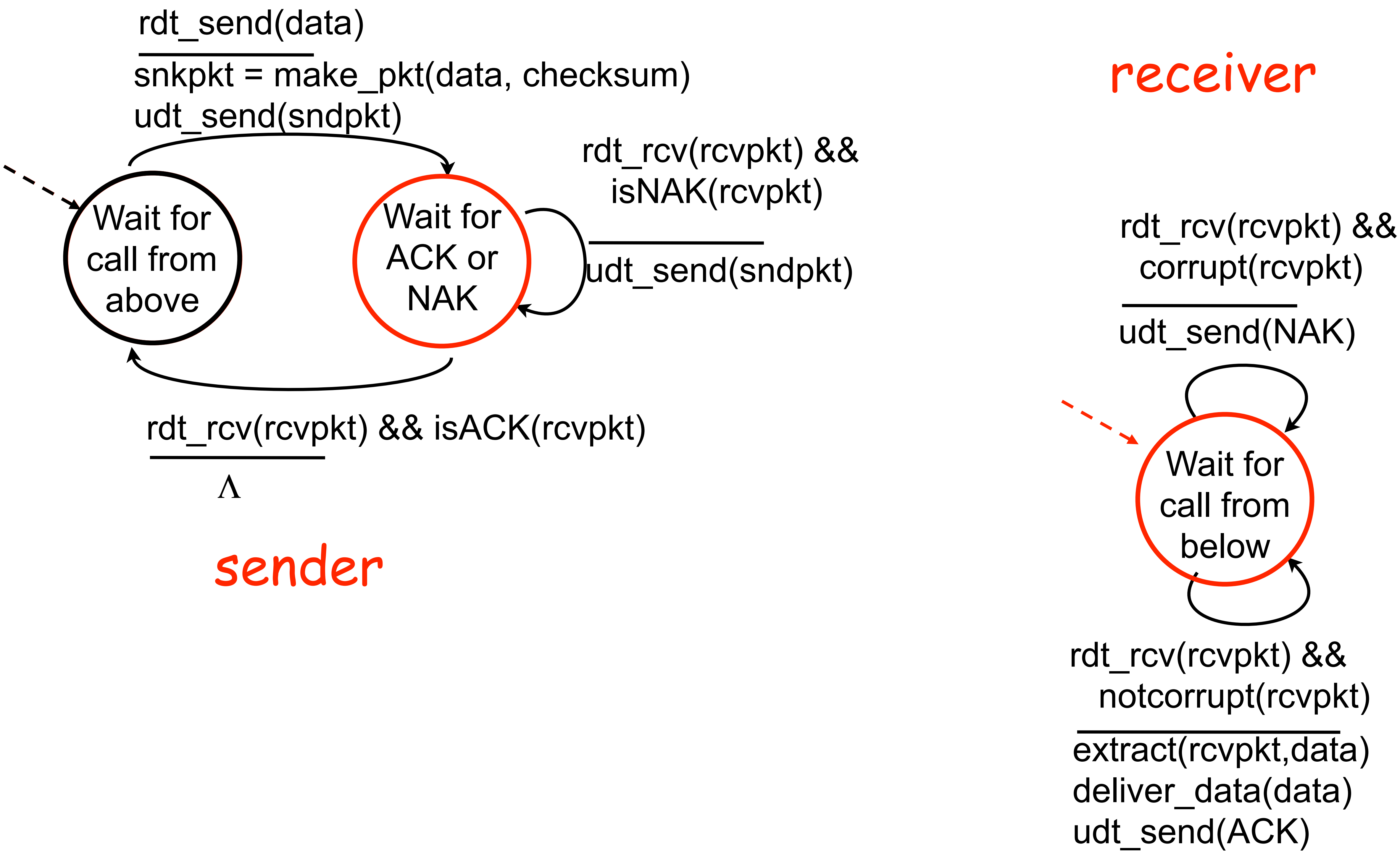

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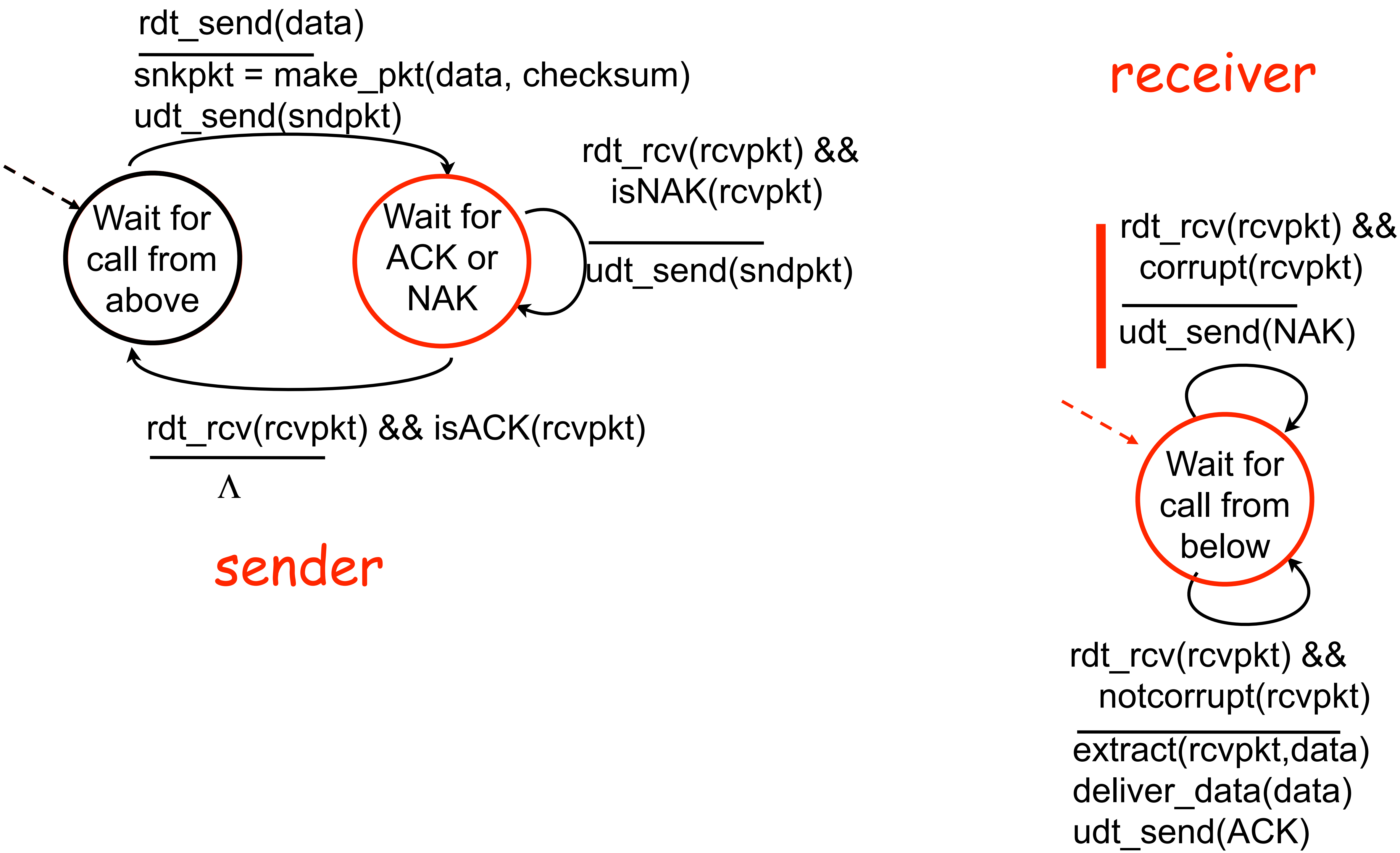

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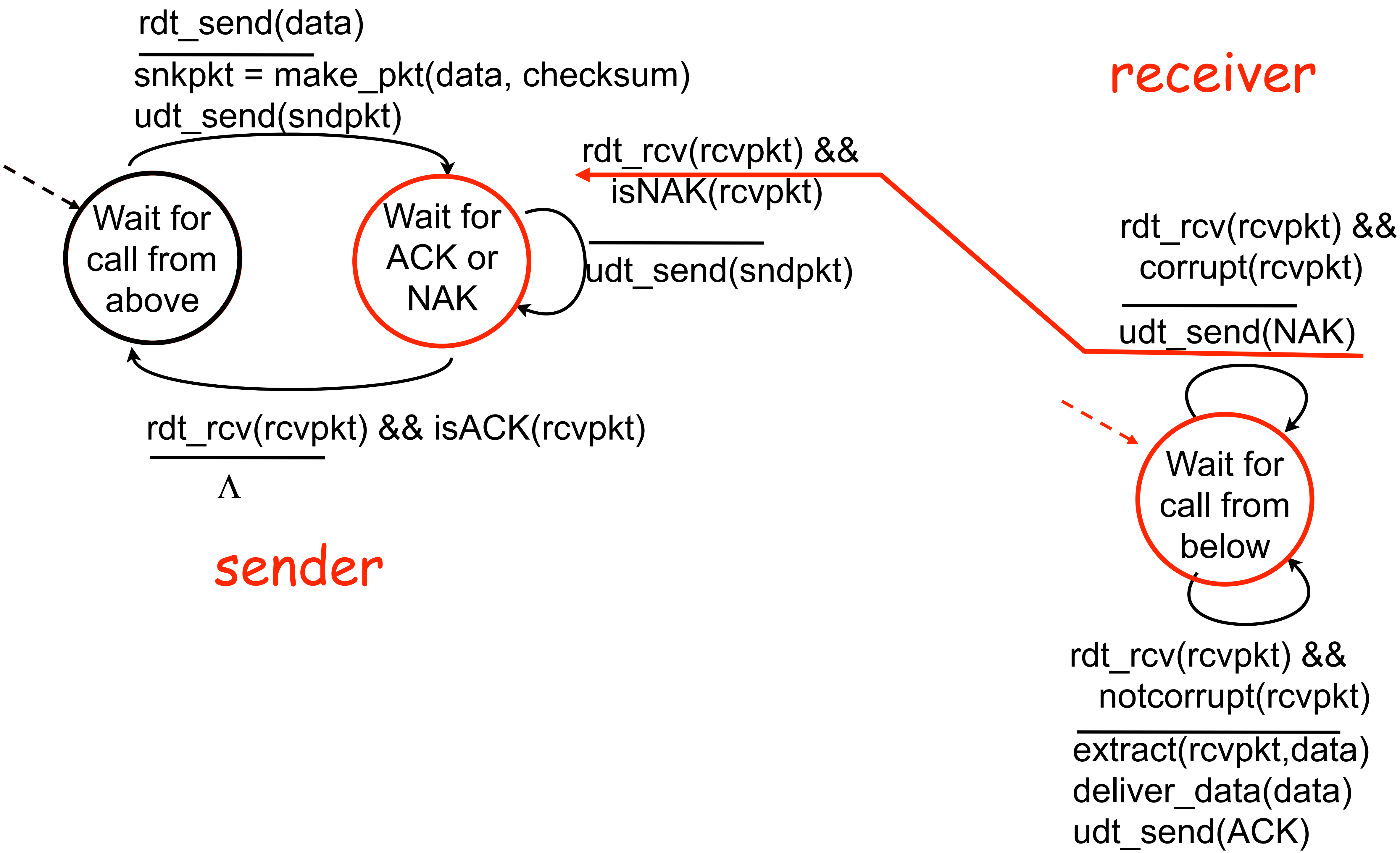

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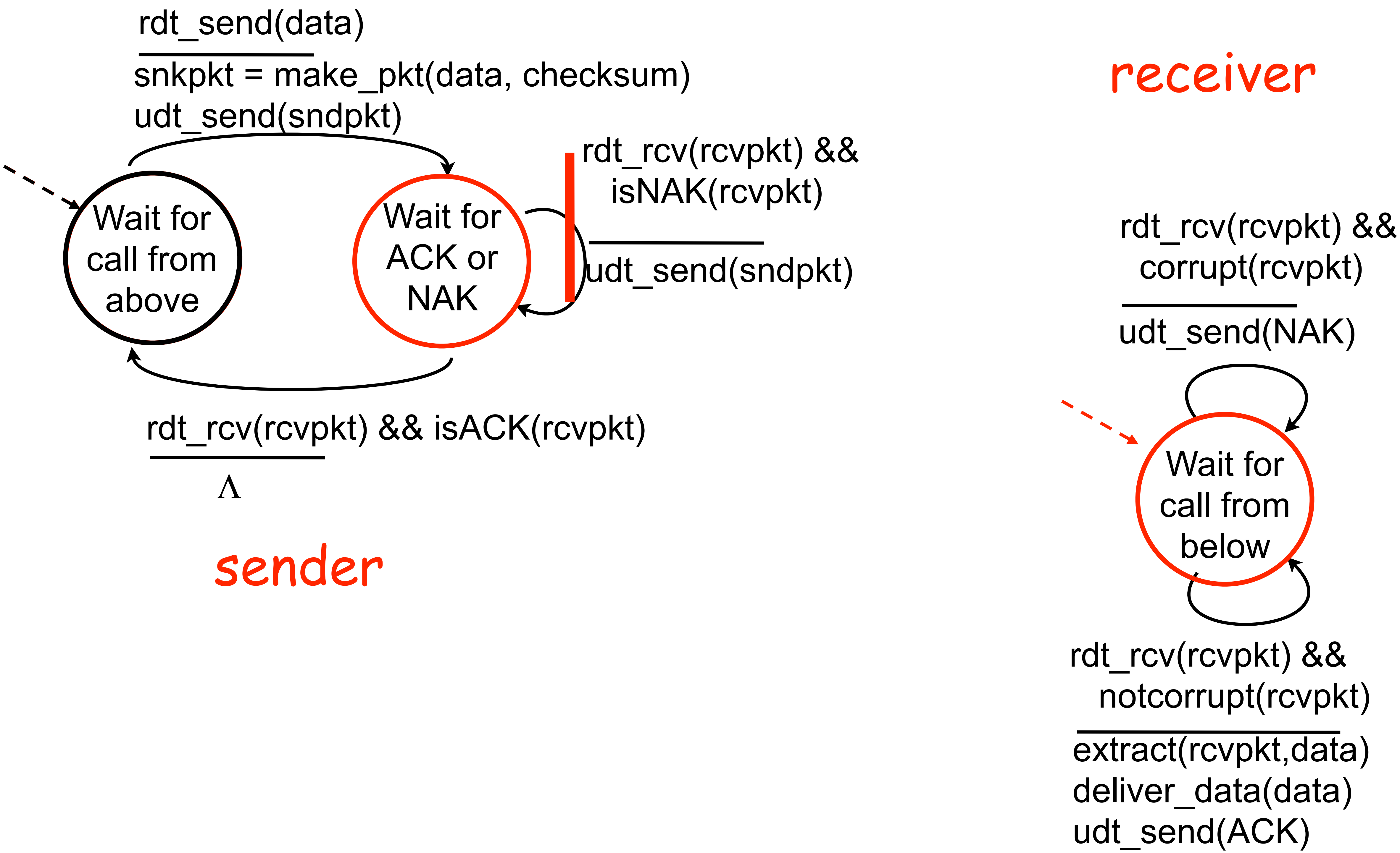

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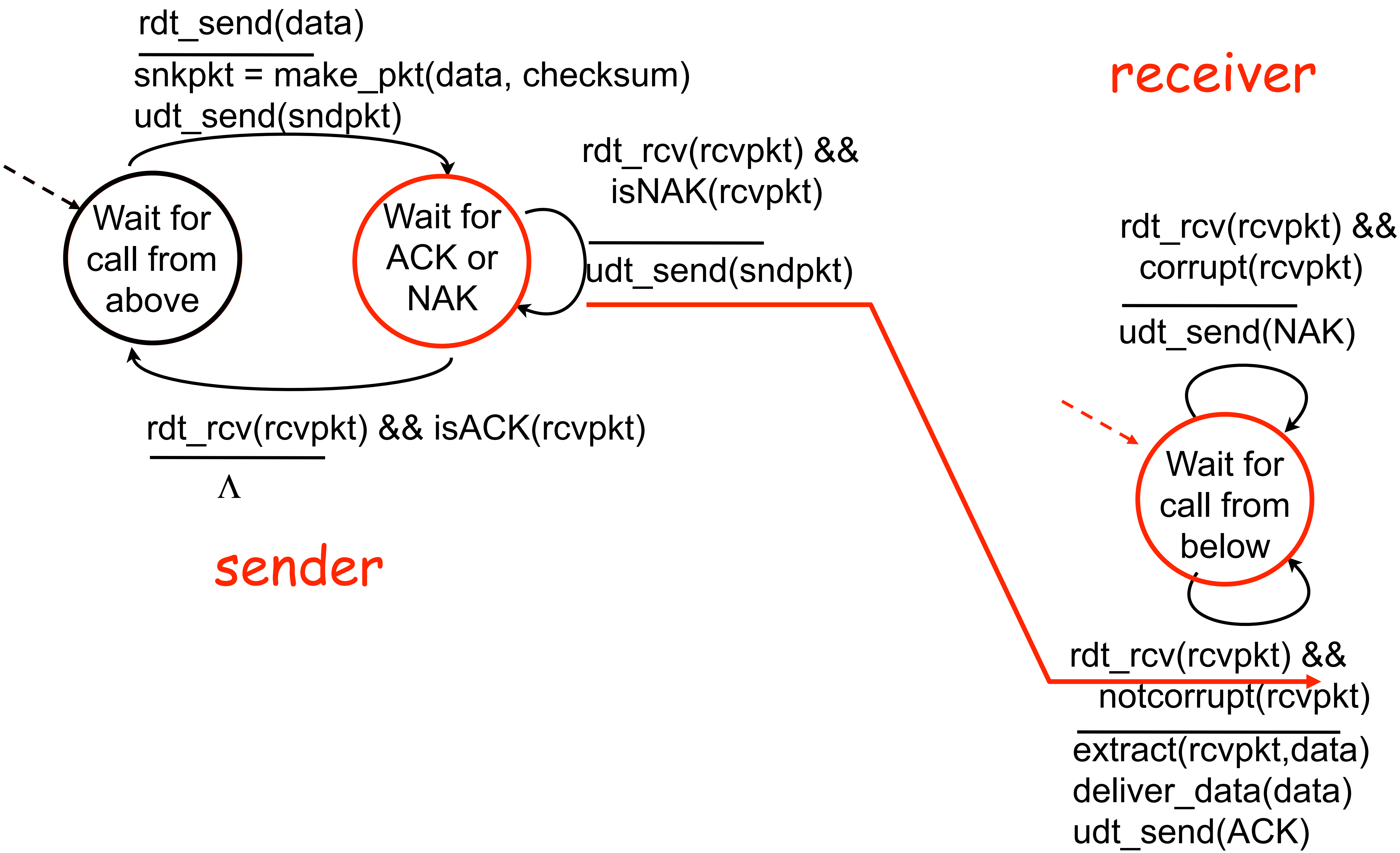

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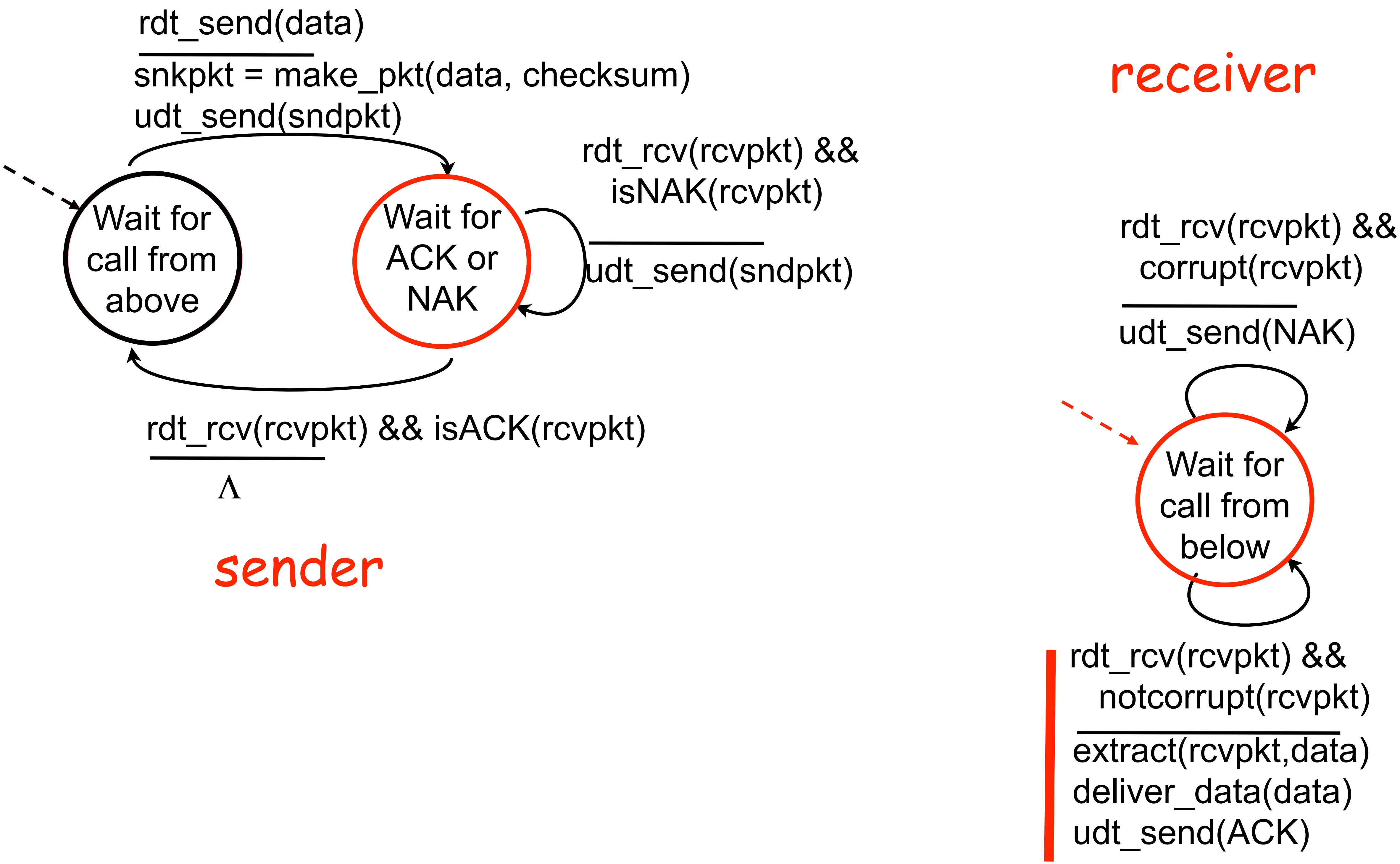

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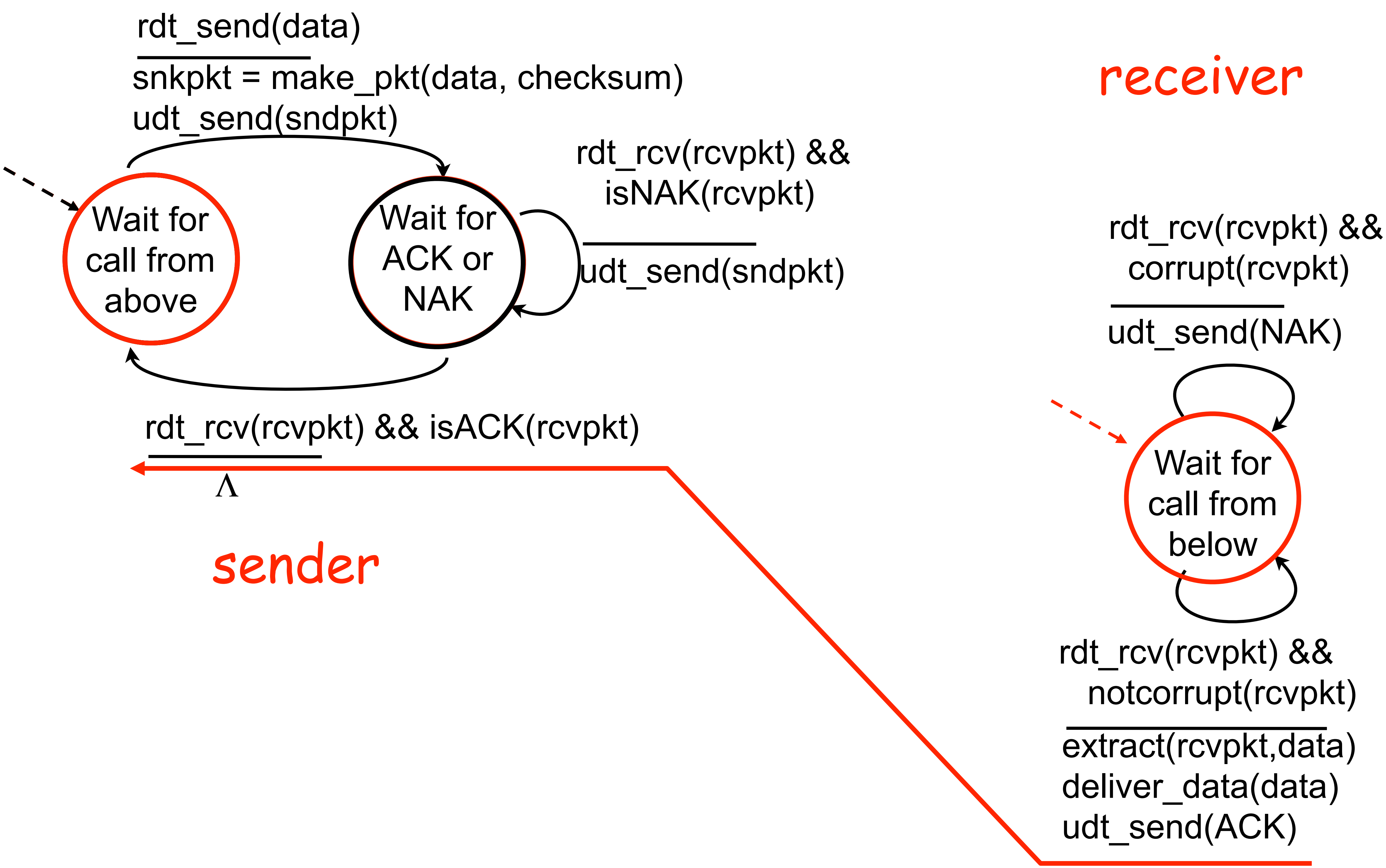

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- can't just retransmit: possible duplicate