CS144:

Introduction to Computer Networking

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Hello!

- TCP
- Router & NAT

TCP - outline

- TCP?
- Features of TCP.
- TCP Diagram.
- cTCP implementation.

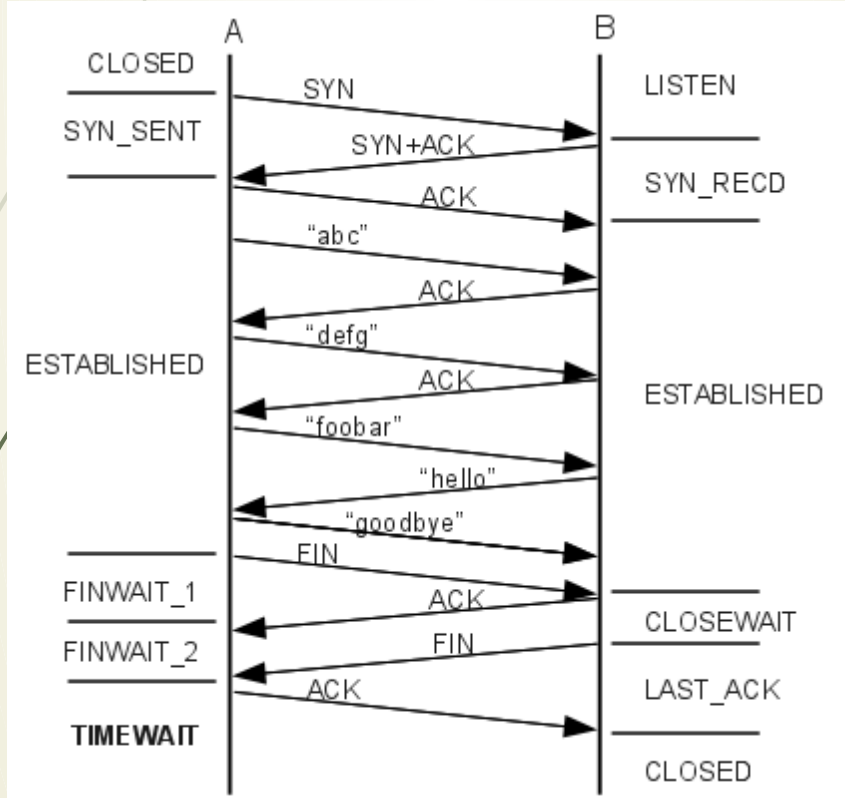
TCP - What is TCP?

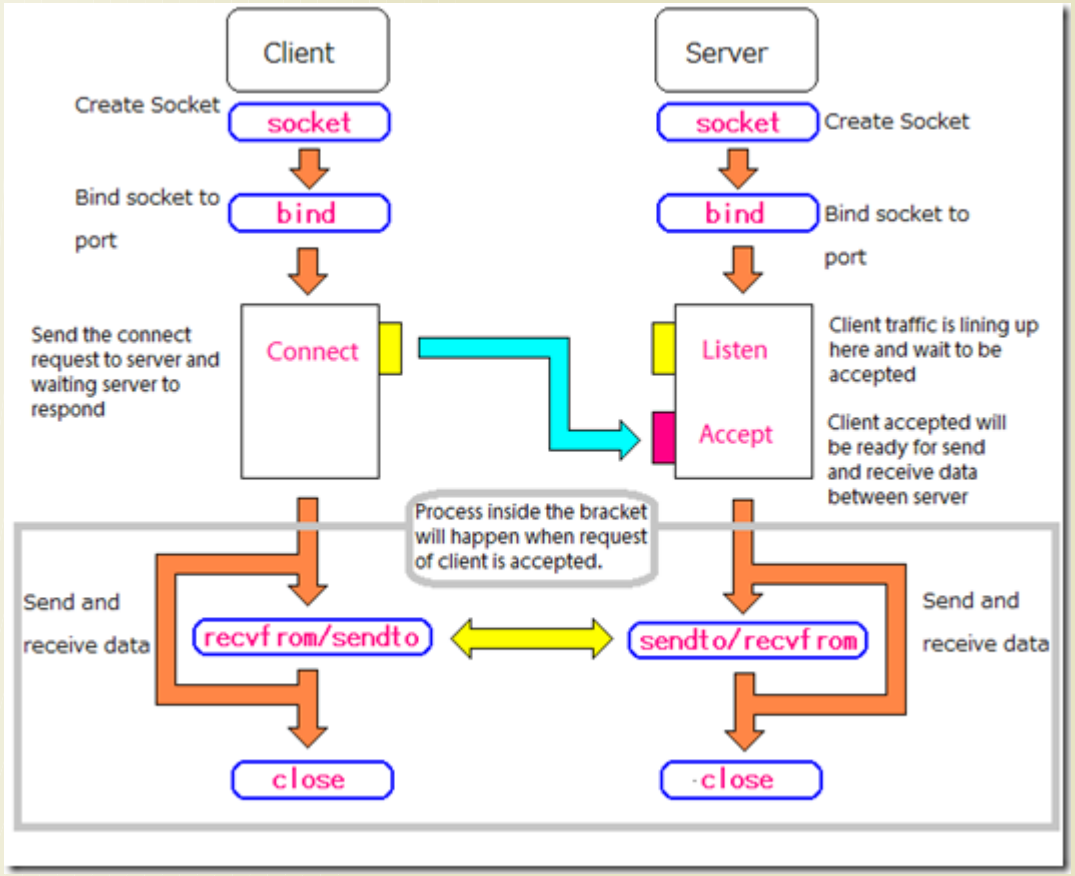
- Transmission Control Protocol – Layer 4
- The TCP is intended for use as a highly reliable host-to-host protocol between hosts in packet-switched computer communication networks, and in interconnected systems of such networks.

TCP - Features of TCP?

- Data Transfer : Data is read as a byte stream.
- Reliability : Recover from data that is damaged, lost, duplicated, or delivered out of order by the internet communication system. (SEQ, ACK)
- Flow Control : Provides a means for the receiver to govern the amount of data sent by the sender. (Window Recv in ACK)
- Multiplexing : Allow for many processes within a single Host to use TCP communication facilities simultaneously - a set of addresses or ports within each host.
- Connections : A connection-oriented protocol. != Connectionless

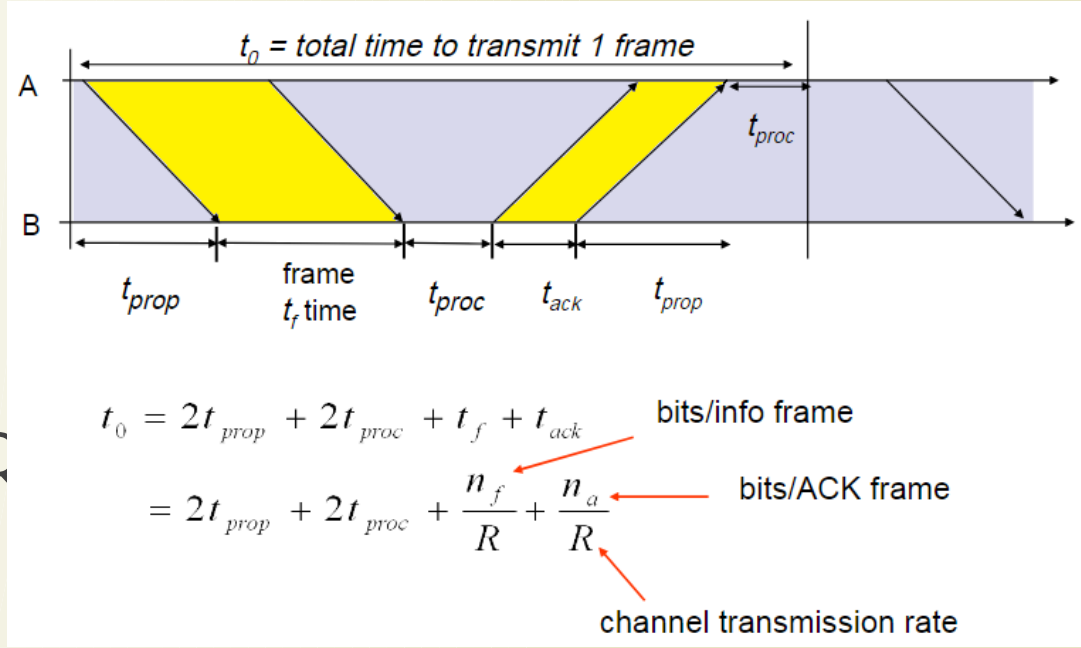
TCP - Diagram


A
B
CLOSED
SYN
LISTEN
SYN_SENT
SYN+ACK
SYN_RECD
ACK
"abc"
ACK
"defg"
ESTABLISHED
ACK
ESTABLISHED
"foobar"
"hello"
"goodbye"
FIN
FINWAIT_1
ACK
CLOSEWAIT
FINWAIT_2
FIN
ACK
LAST_ACK
TIMEWAIT
CLOSED

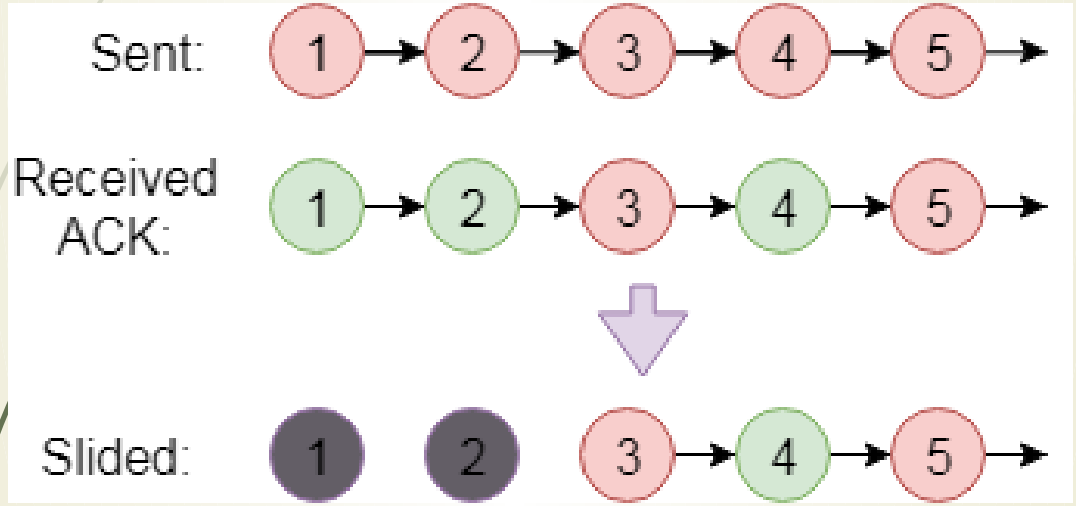

Client
Server
Create Socket
socket
socket
Create Socket
Bind socket to port
bind
bind
Bind socket to port
Send the connect request to server and waiting server to respond
Connect
Listen
Client traffic is lining up here and wait to be accepted
Accept
Client accepted will be ready for send and receive data between server
Process inside the bracket will happen when request of client is accepted.
Send and receive data
recvfrom/sendto
sendto/recvfrom
Send and receive data
close
close

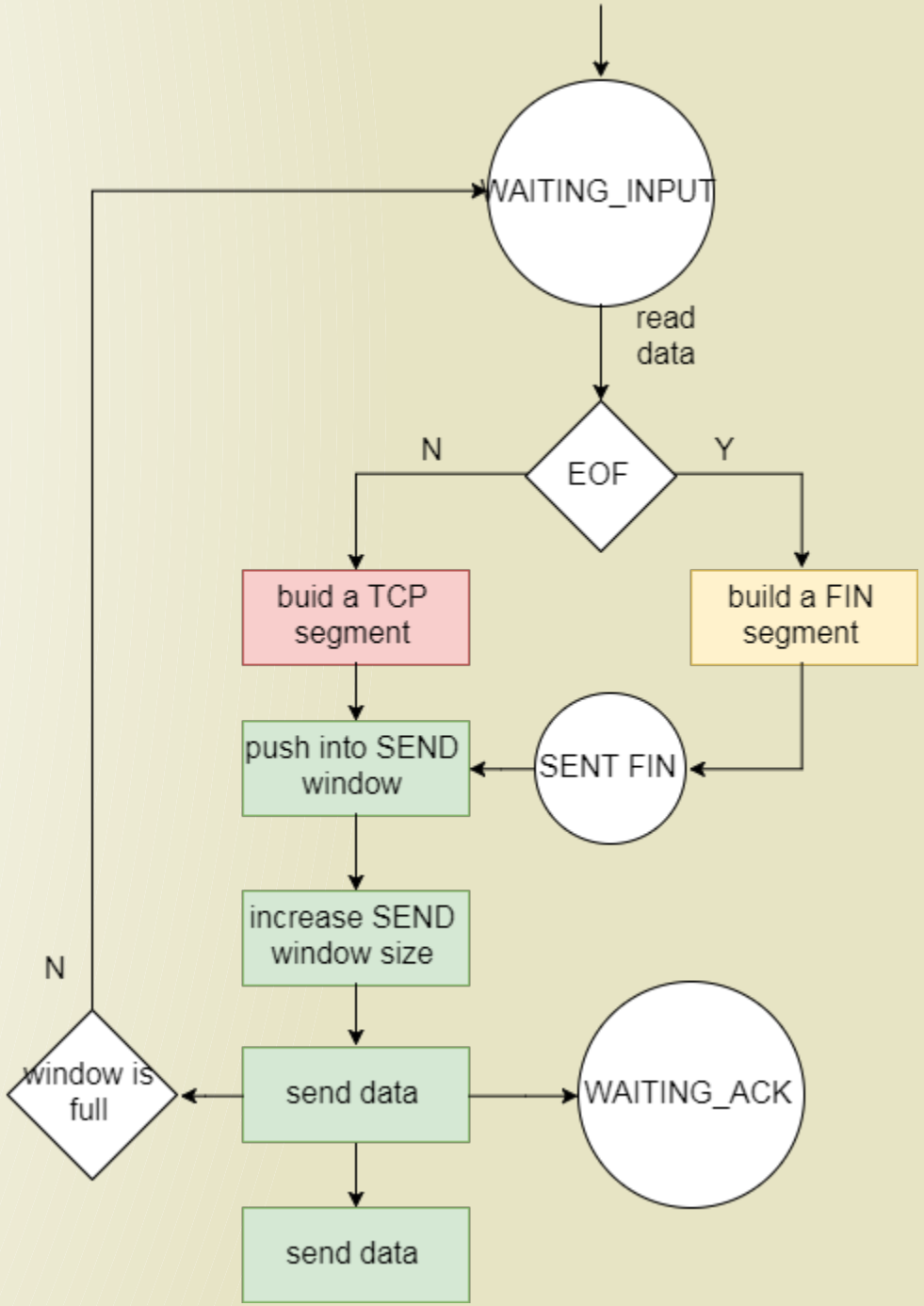
TCP

- Error protocols:
  - Stop and wait
  - Sliding widow ARQ
    - Go-Back-N ARQ
    - Selective Repeat ARQ

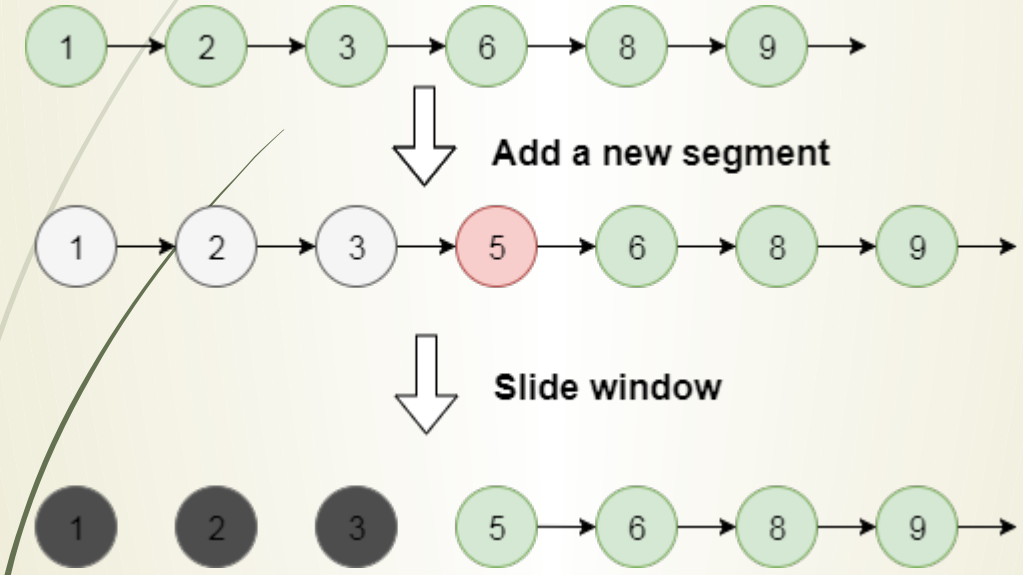


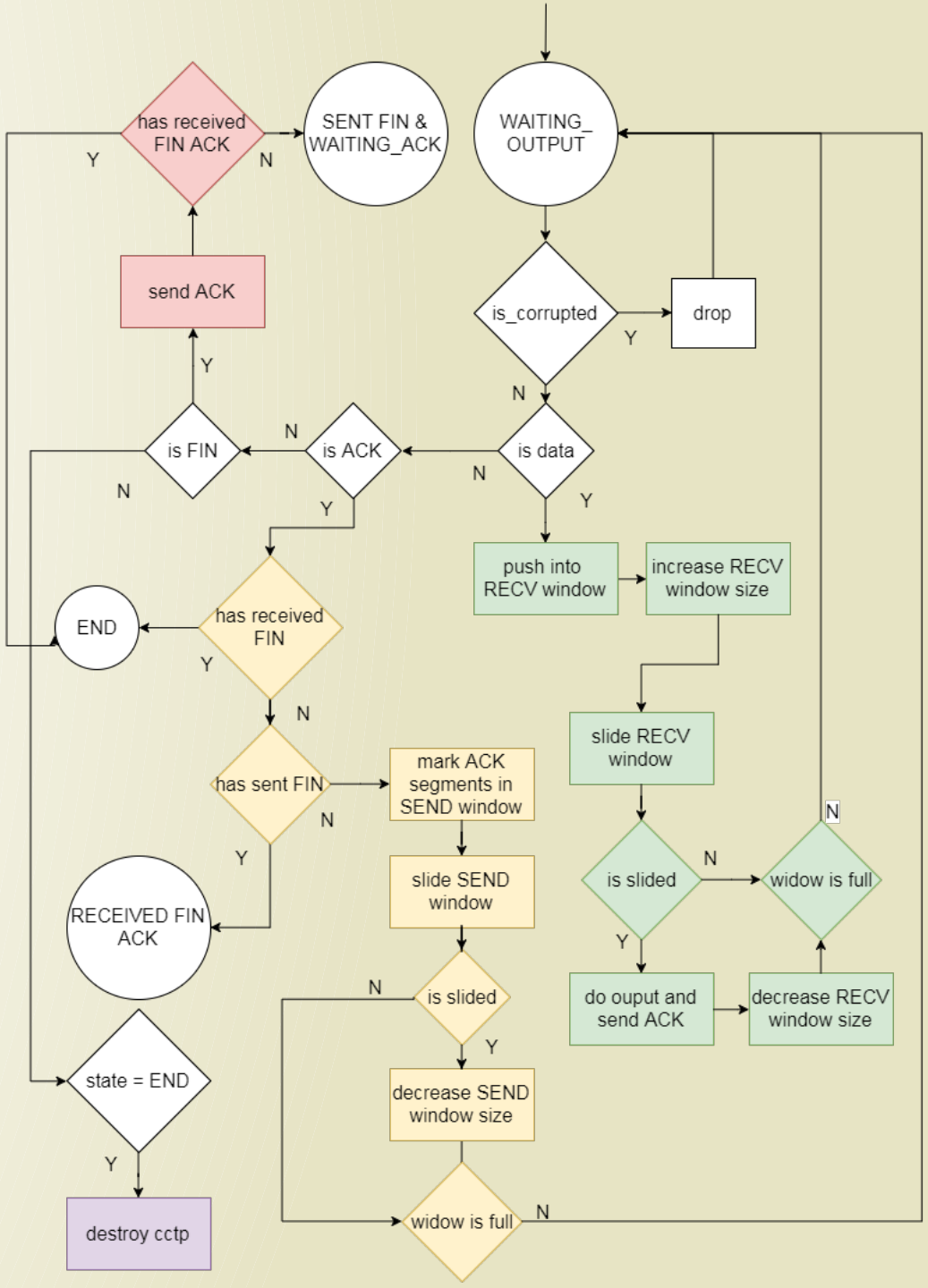
TCP – Sender


Sent:
1
2
3
4
5
Received ACK:
1
2
3
4
5
Slided:
1
2
3
4
5

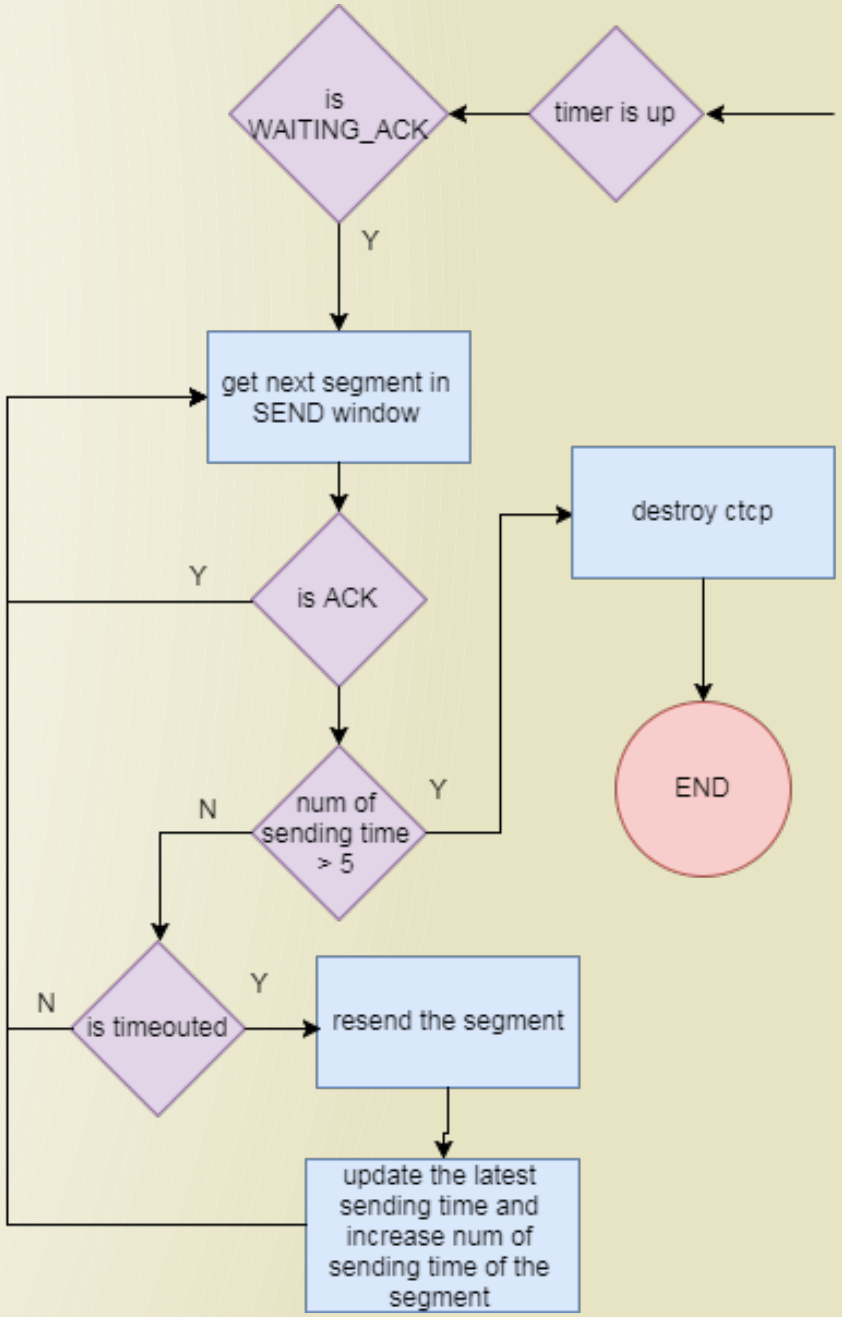

WAITING_INPUT
read data
EOF
N
Y
buid a TCP segment
build a FIN segment
push into SEND window
SENT FIN
increase SEND window size
N
window is full
send data
WAITING_ACK
send data

TCP – Reciever





TCP – cTCP Retransmister



Q&A for TCP

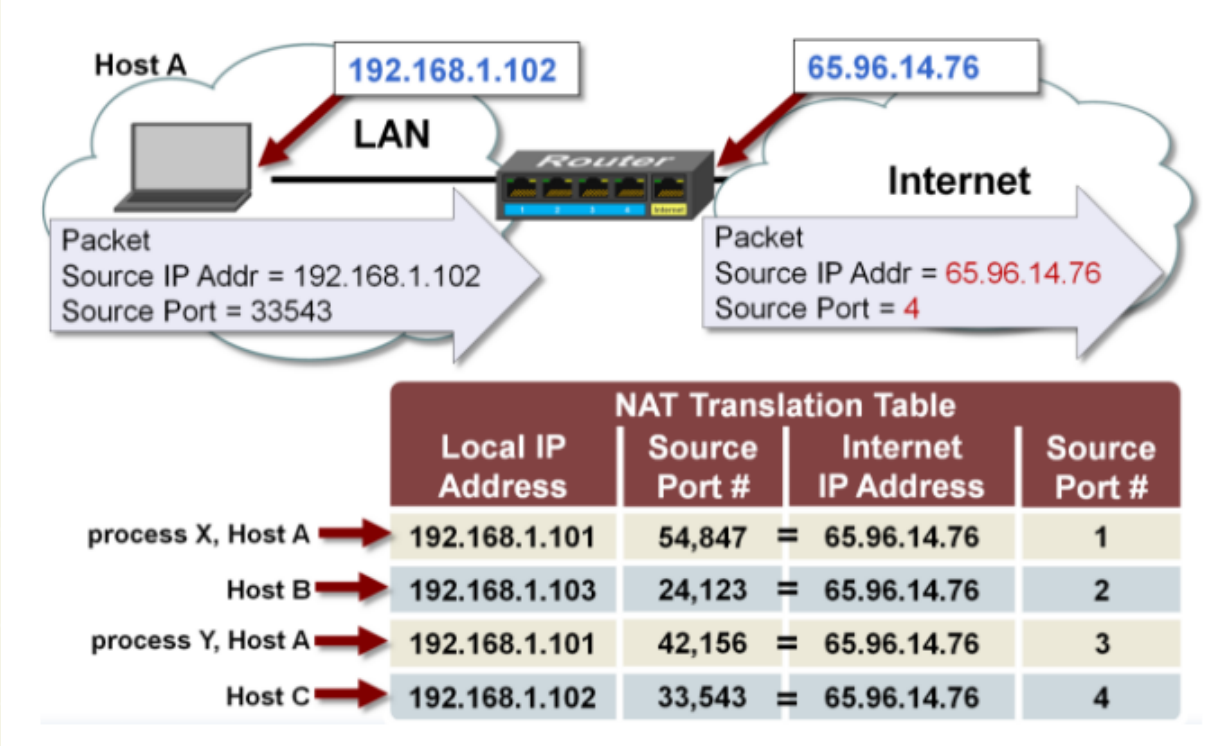
plz give me some questions before
we'll talk about new something

NAT

- NAT?
- Benefits and complications?
- Categories?
- Operation?

NAT – What is Nat?

- Network Adress Translation
- Translate between IP address ranges: Private to public IP address
- Enable one IP address to be shared among a lot of devices

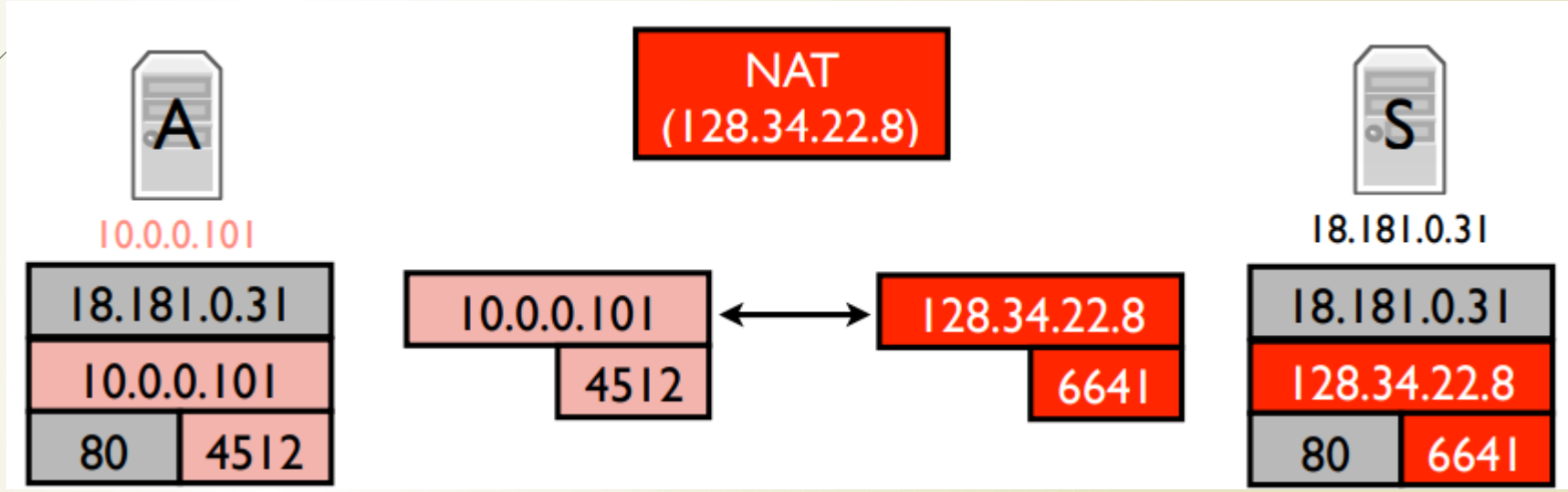


NAT – Benefits and complication

- **Benefits:**
  - Can use private address: there are only 2^32 IP address
- **Complications:**
  - Breaks end-to-end (node doesn’t know its external IP)
  - Node might not even know if it’s behind a NAT
  - Incoming connections break easily
  - NAT must be awre of transoport layer

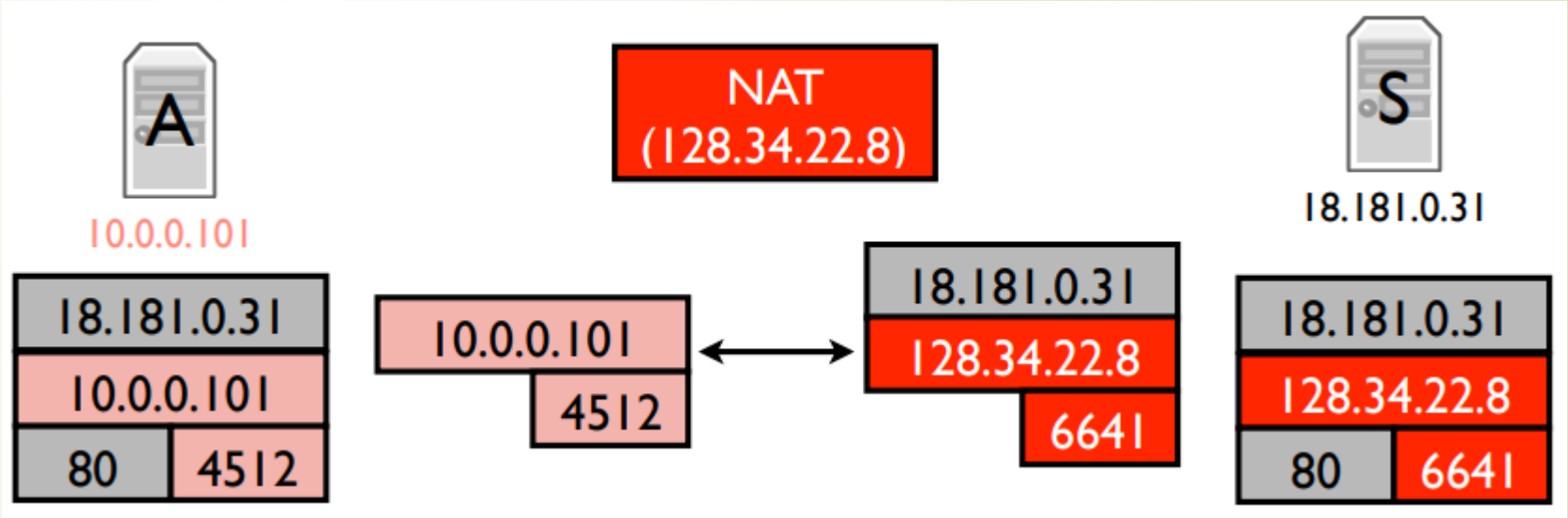
NAT - Categories

- **Full Cone NAT**



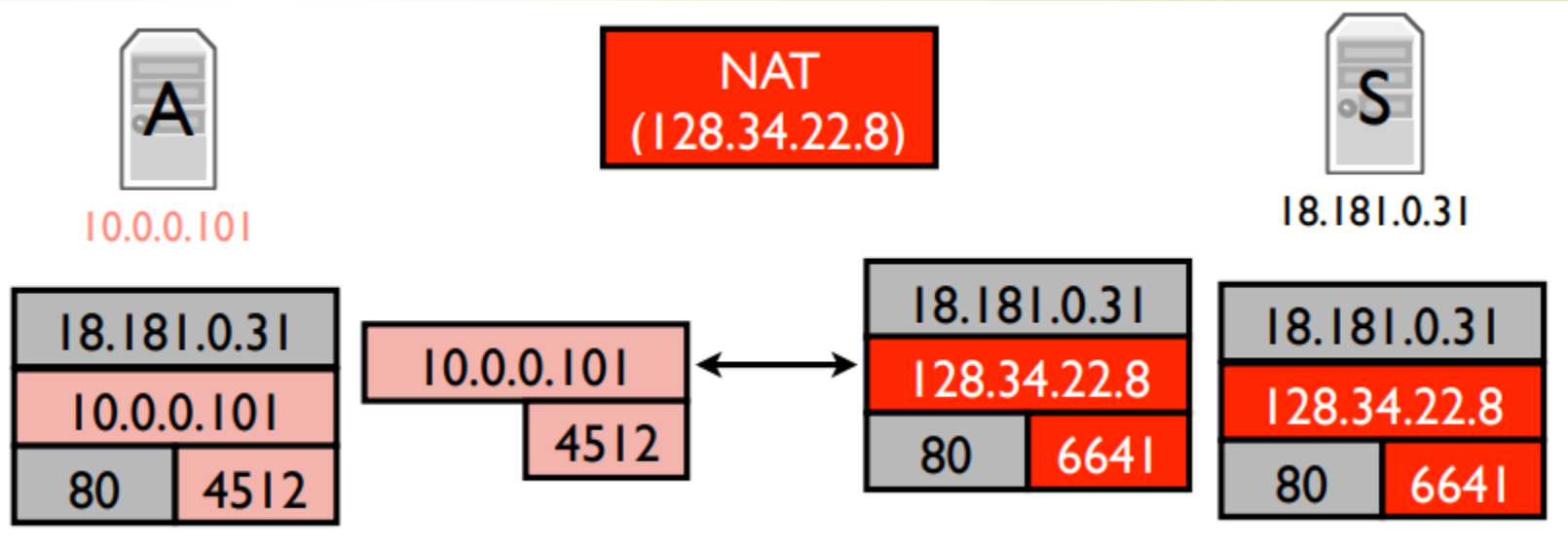
NAT - Categories

- **Restricted Cone NAT**



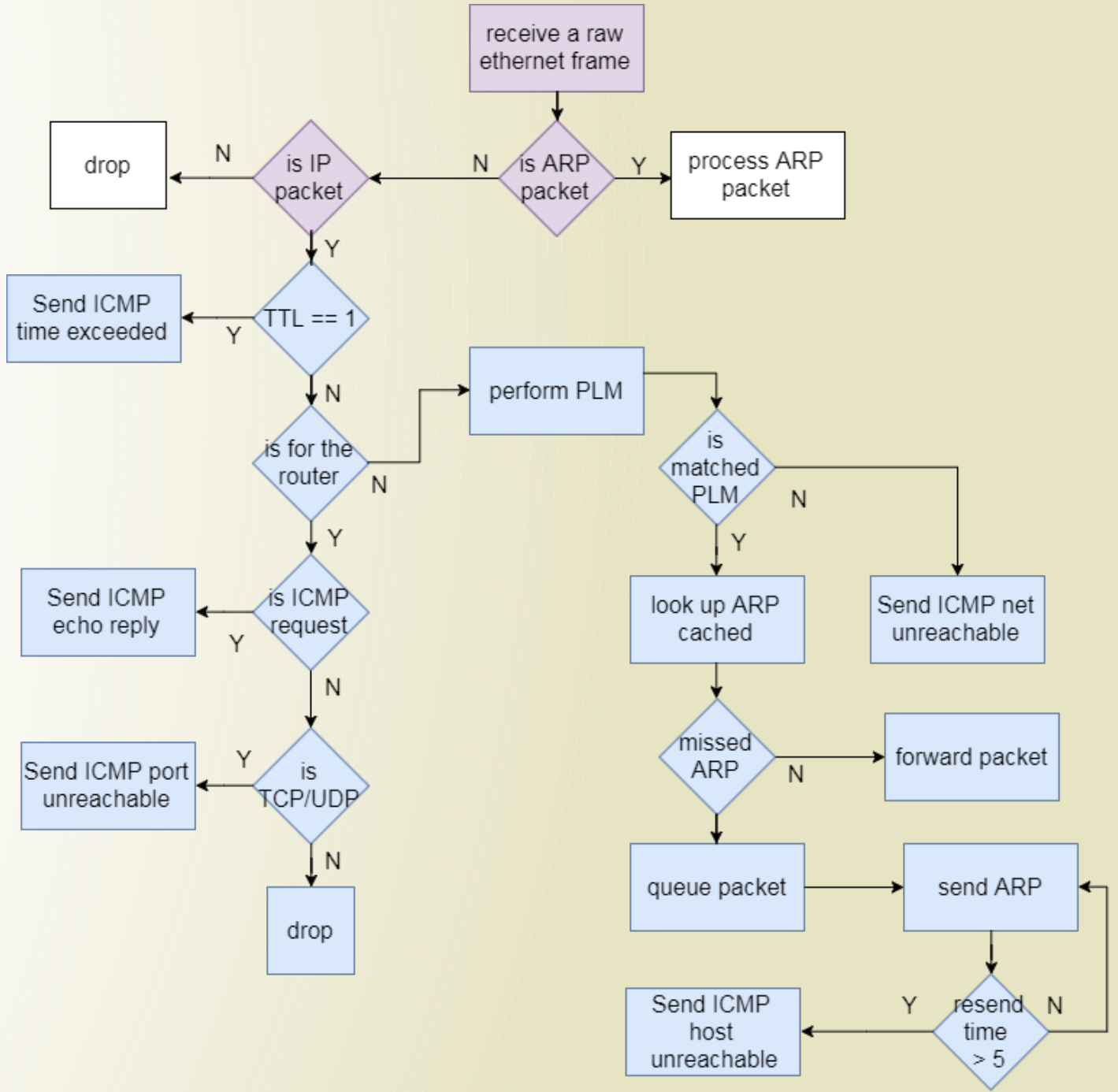
NAT - Categories

- **Port Restricted NAT**



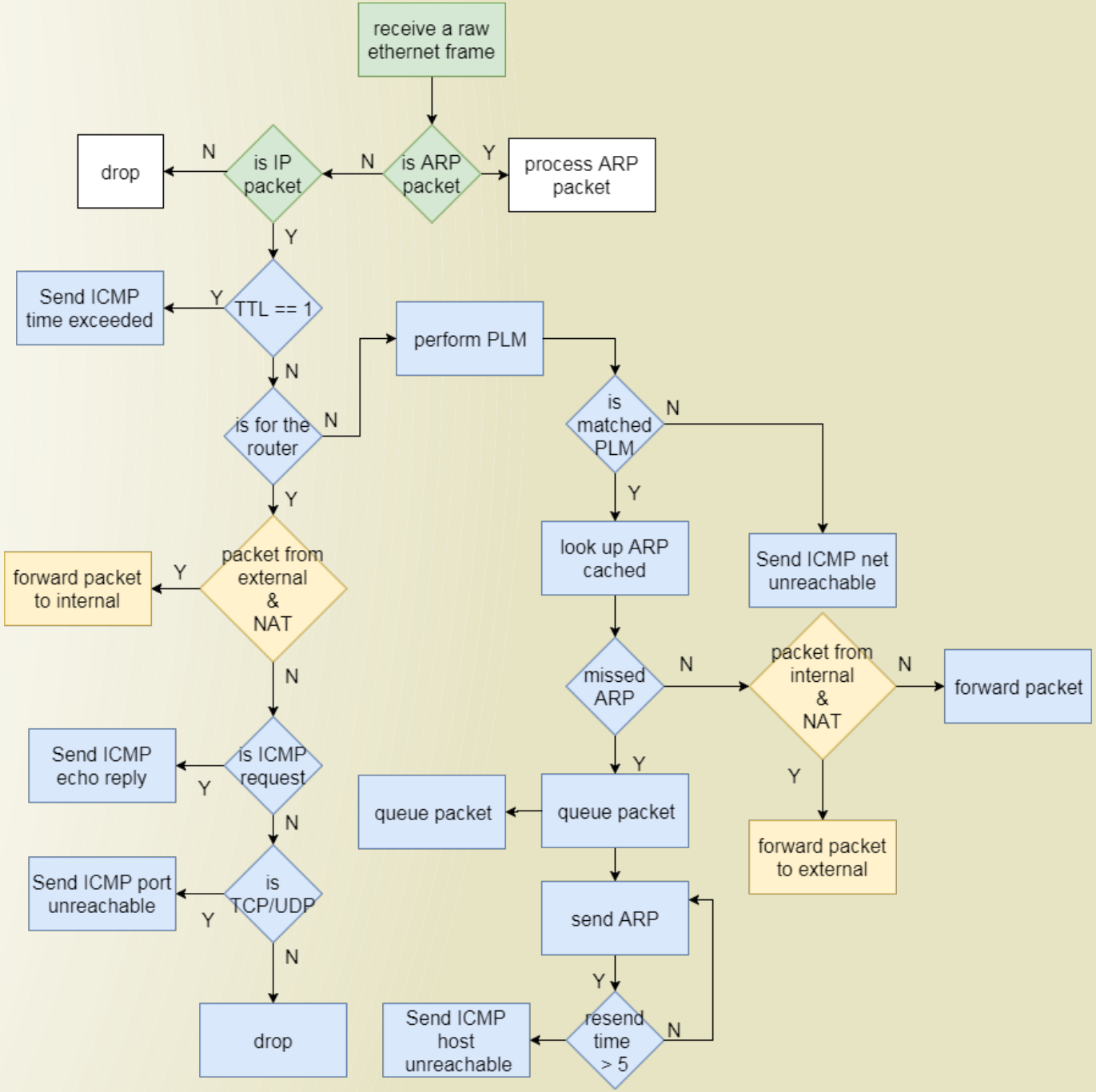
Router without NAT

Incoming IP packet



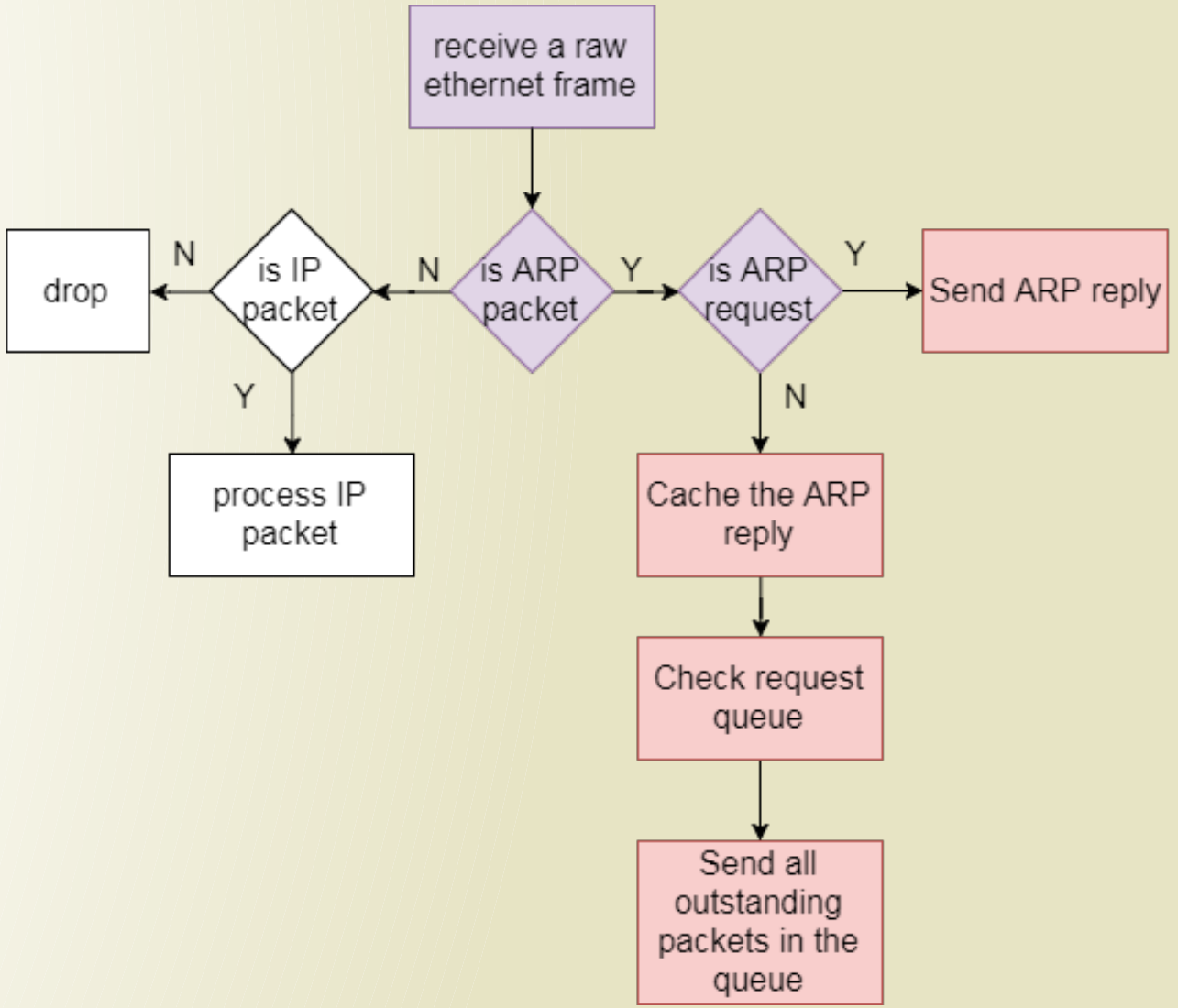
Router with NAT

Incoming IP packet



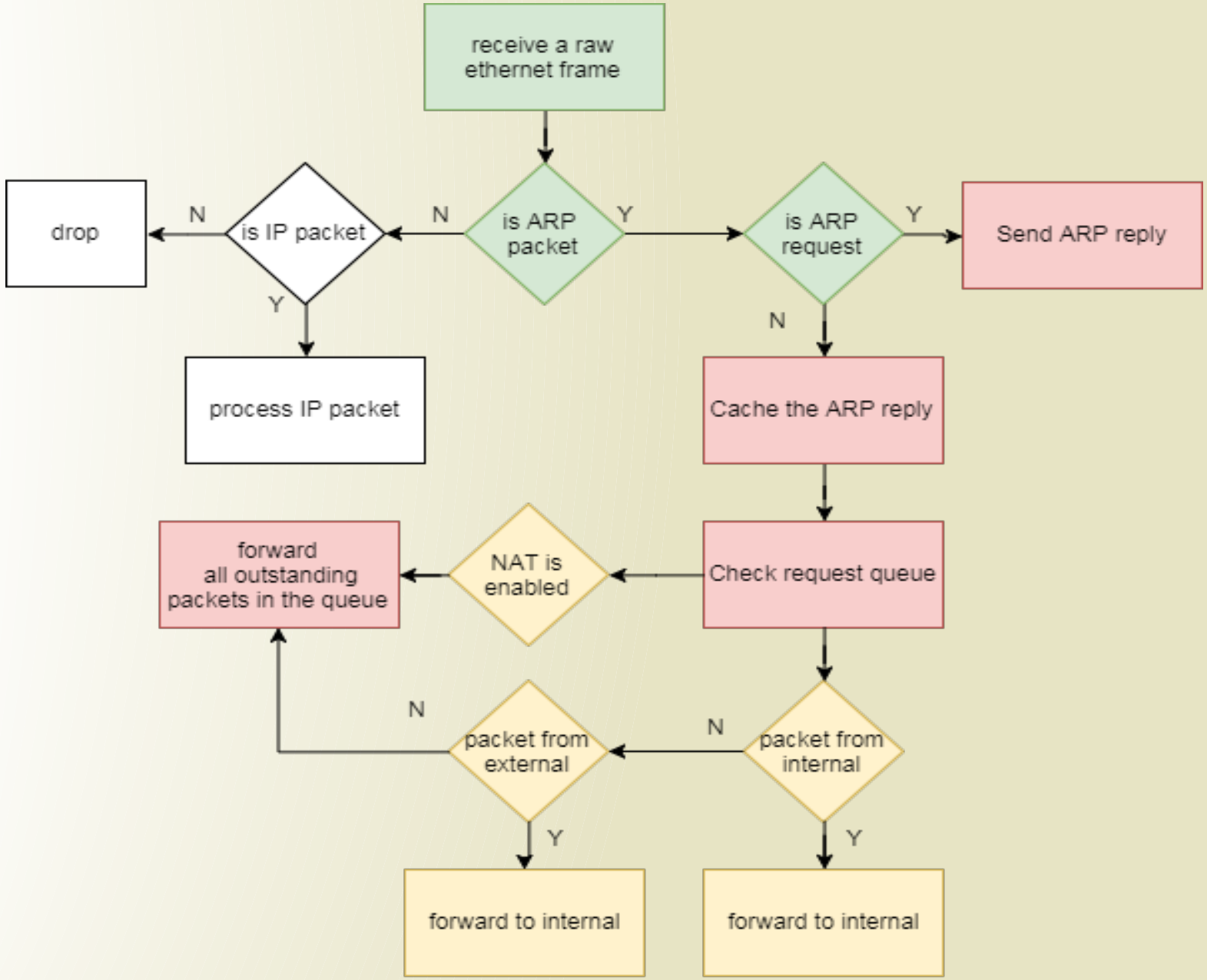
Router without NAT

Incoming ARP packet



Router with NAT

Incoming ARP packet



Q&A

Give me some questions and advice!

Thanks for your listening!