

# Internet Engineering

241-461

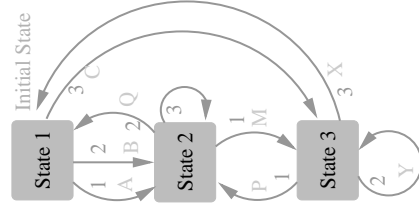
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## FSM (example)



Three States 1 2 and 3

Three events that occur 1 2 and 3

Several output actions

State 1 is the initial state

For input events

1 1 1 2 3 2 3 1 2 2 3

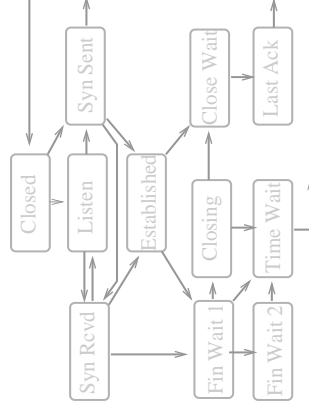
What states does FSM pass through?

What output actions are performed?

1 2 3 2 1 3 3 1 2 1 2

2

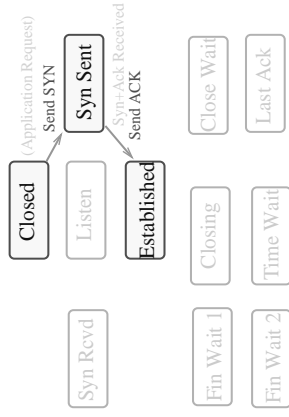
## TCP Connections (States)



FSM of TCP connection machinery

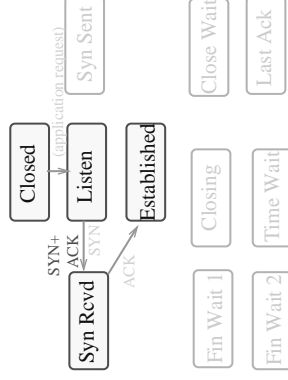
> Inputs & Outputs to come later

# TCP Client Open



- ◊ 3-way Handshake
- ◊ SYN SYN+ACK ACK

# TCP Server Open



- ◊ Same 3-way handshake
  - SYN SYN+ACK ACK

# TCP Opens

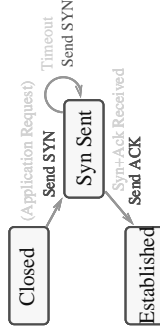
- ◊ Start in CLOSED state
  - Neither system knows anything about other
- ◊ Send SYNchronise
  - Inform other end we want to communicate
  - Tell it what sequence number we use
- ◊ SYN is a kind of data
  - Uses one sequence number itself
  - Always the first sequence number of this connection
- ◊ Sender picks sequence number
  - Not just Start at zero
  - To meet some objectives
    - No old packets from previous connection
    - Not easy for anyone to guess

## TCP Opens (2)

- ◇ SYN is data
  - So must be acknowledged
- ◇ Receiver of SYN server
  - Must send ACKnowledge
    - ▷ So sender knows it was received
- ◇ TCP is full duplex
  - data goes both directions
  - Need sequence numbers both directions
  - So must SYNchronise in reverse
    - ▷ Send SYN back to client
- ◇ Data and ACK can travel in same packet
  - Data here is SYN
    - ▷ Therefore SYN+ACK

## TCP Opens (3)

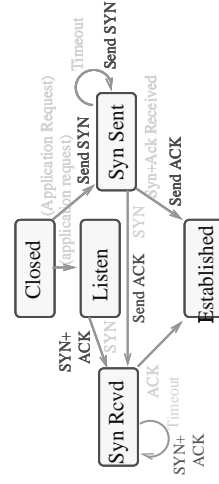
- ◇ Data in SYN+ACK packet must be acknowledged
  - That is the SYN
- ◇ Must ACKnowledge that SYN
  - But just ACK this time
  - SYN already sent
    - ▷ Other than retransmit
    - ▷ Just one SYN per connection
      - In each direction



- ◇ Investigate
  - 2 systems talking to each other
    - ▷ Both acting as clients

## TCP Simultaneous Open

- ◇ Both systems want to open connection
  - At approximately the same time
  - Before either has seen SYN from the other



# The End Problem

- ◇ **Dealing with the last packet is hard**
  - What if it gets lost ?
  - Can we acknowledge it?
  - If we do,
    - ▷ Which packet is the last packet?
- ◇ **Common transport protocol problem**
  - ISO Transport simply aborts connection
    - ▷ Anything not received is discarded