

# Computer Networks

## Packet Fragmentation (§5.5.5)



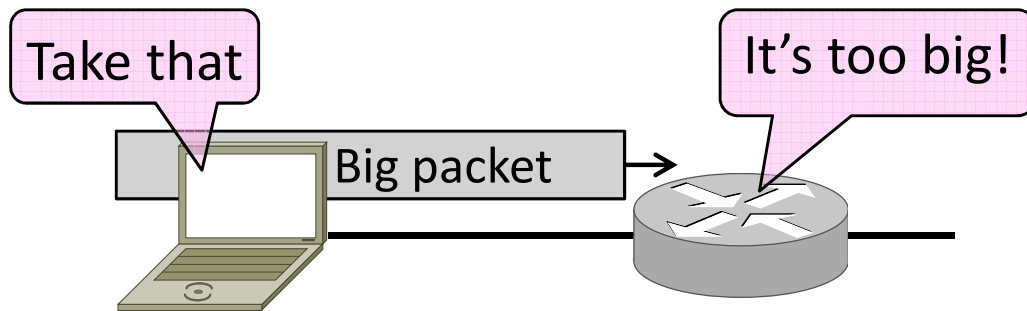
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# Topic

- How do we connect networks with different maximum packet sizes?
  - Need to split up packets, or discover the largest size to use



# Packet Size Problem

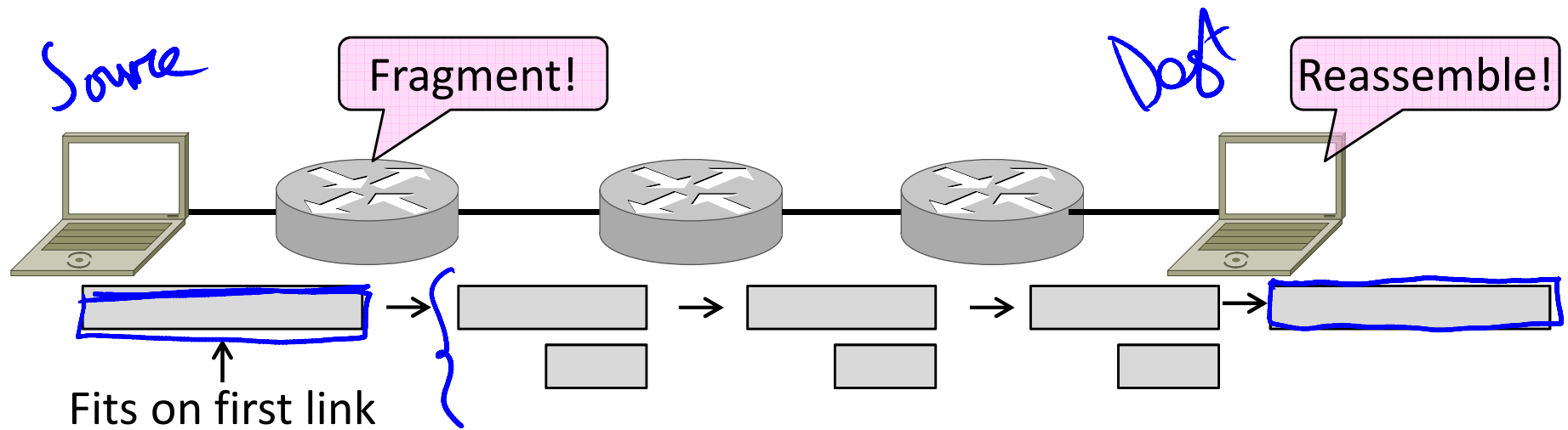
- Different networks have different maximum packet sizes
  - Or MTU (Maximum Transmission Unit)
  - E.g., Ethernet 1.5K, WiFi 2.3K
- Prefer large packets for efficiency
  - But what size is too large?
  - Difficult because node does not know complete network path

# Packet Size Solutions

- Fragmentation (now)
  - Split up large packets in the network if they are too big to send
  - Classic method, dated
- Discovery (next)
  - Find the largest packet that fits on the network path and use it
  - IP uses today instead of fragmentation

# IPv4 Fragmentation

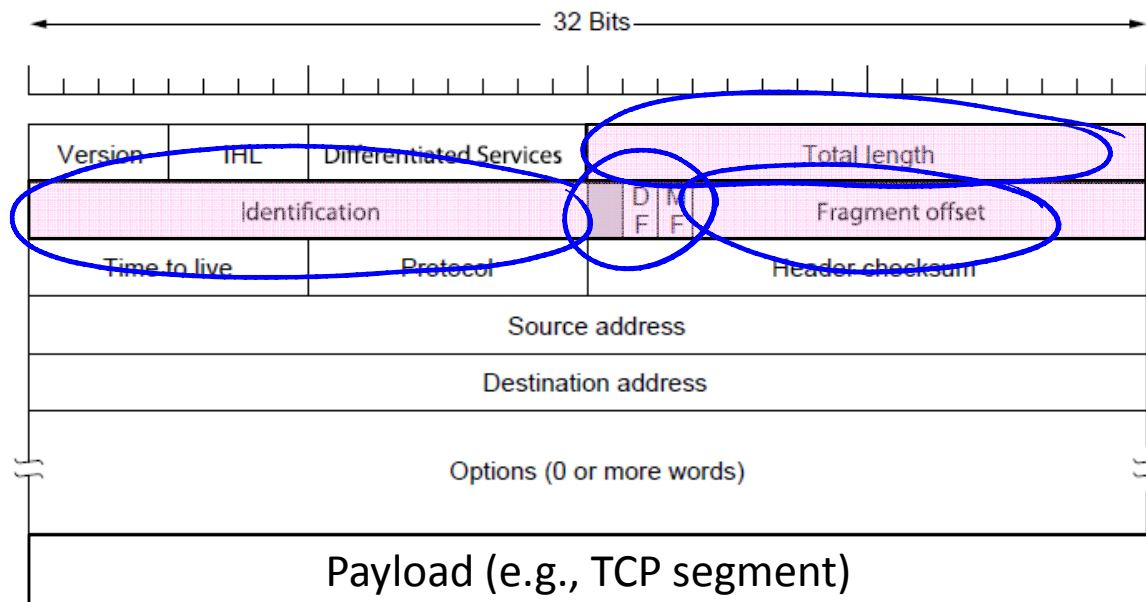
- Routers fragment packets that are too large to forward
- Receiving host reassembles to reduce load on routers



# IPv4 Fragmentation Fields

- Header fields used to handle packet size differences
  - Identification, Fragment offset, MF/DF control bits

*MF = More Fragments  
DF = Don't Fragment*



# IPv4 Fragmentation Procedure

- Routers split a packet that is too large:
  - Typically break into large pieces
  - Copy IP header to pieces
  - Adjust length on pieces
  - Set offset to indicate position
  - Set MF (More Fragments) on all pieces except last
- Receiving hosts reassembles the pieces:
  - Identification field links pieces together,  
MF tells receiver when it has all pieces

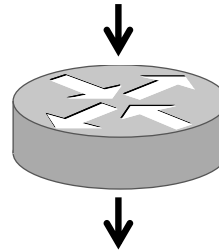
# IPv4 Fragmentation (2)

Before  
MTU = 2300

ID = 0x12ef  
Data Len = 2300  
Offset = 0  
MF = 0



(Ignore length of headers)



After  
MTU = 1500

ID = 0x12ef  
Data Len = 1580  
Offset = 0  
MF = 1

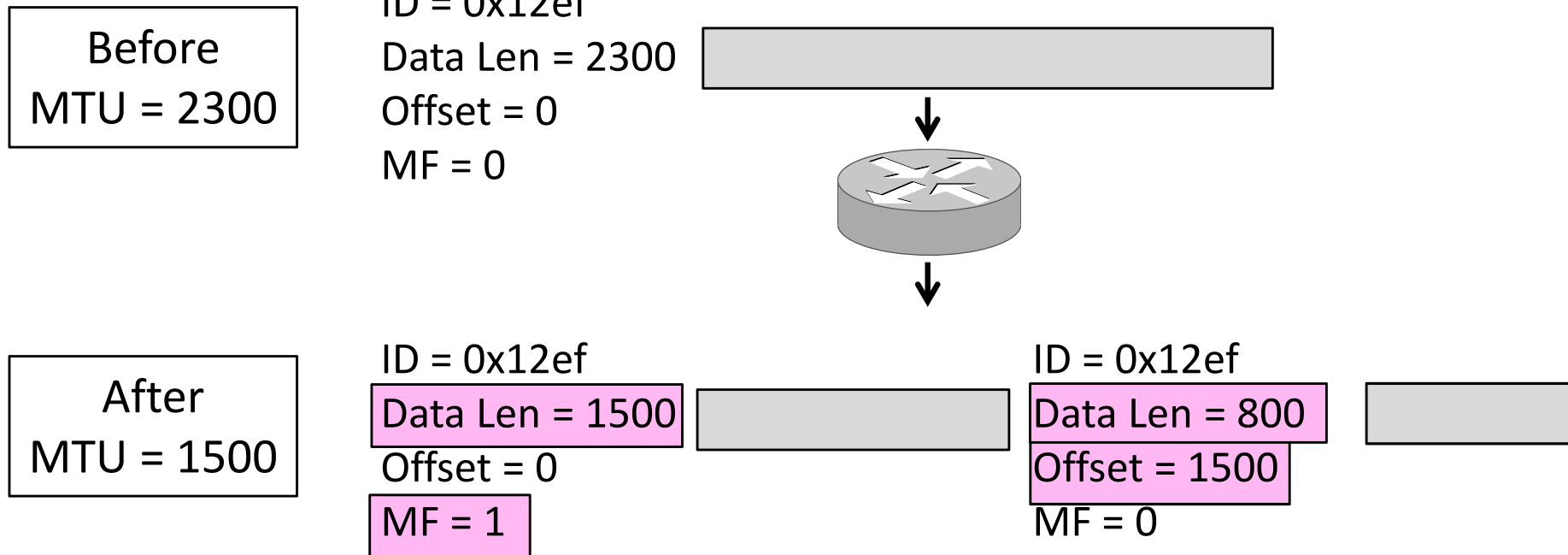


ID = 0x12ef  
Data Len = 880  
Offset = 1580  
MF = 0







# IPv4 Fragmentation (3)



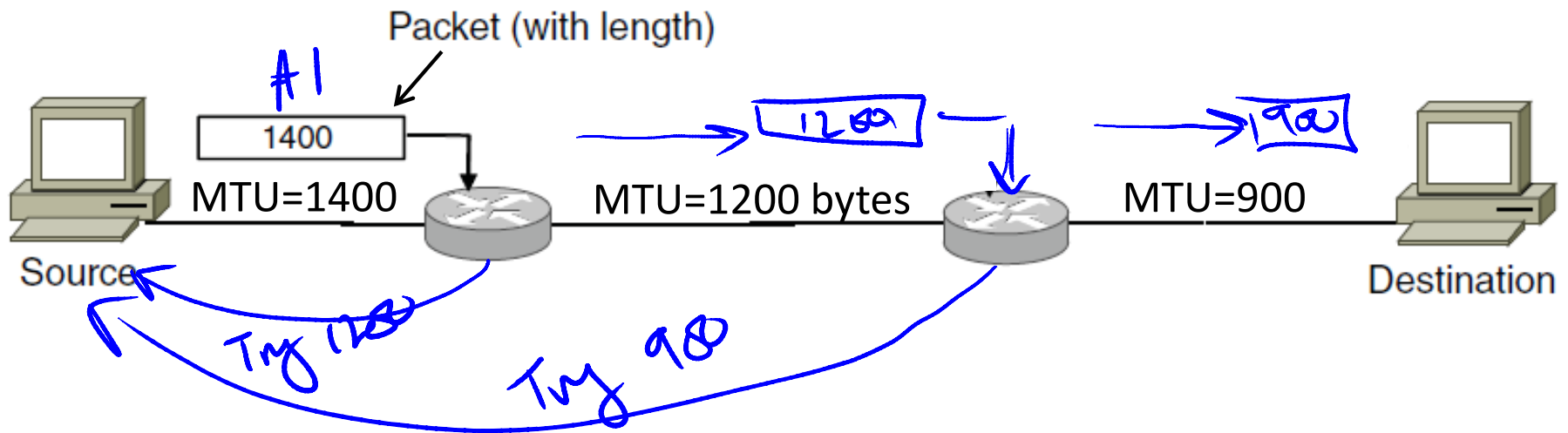
# IPv4 Fragmentation (4)

- It works!
  - Allows repeated fragmentation
-  But fragmentation is undesirable
  - More work for routers, hosts
  - Tends to magnify loss rate
  - Security vulnerabilities too

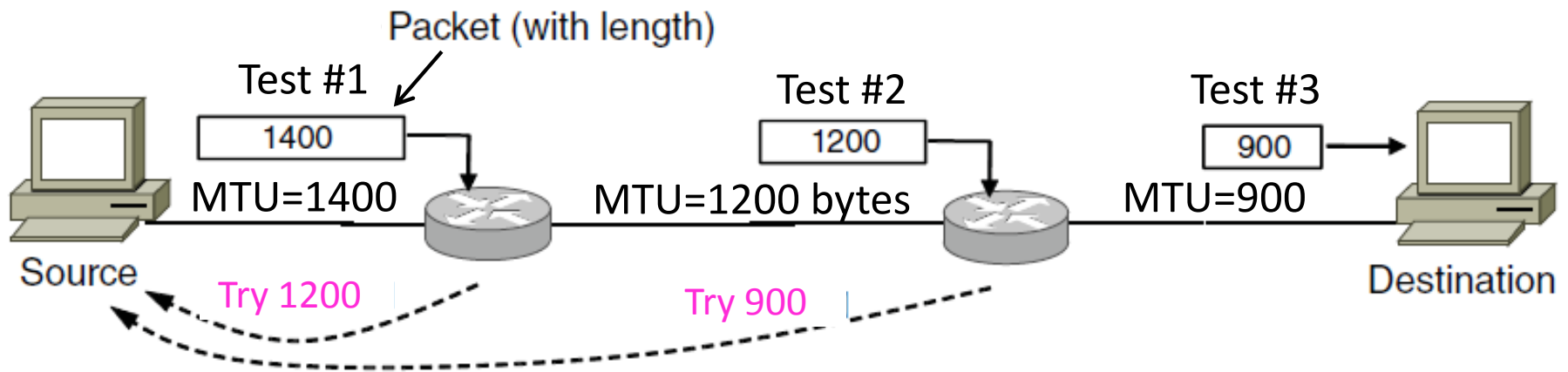
# Path MTU Discovery

- 
- Discover the MTU that will fit
    - So we can avoid fragmentation
    - The method in use today
  - Host tests path with large packet
    - Routers provide feedback if too large; they tell host what size would have fit

# Path MTU Discovery (2)



# Path MTU Discovery (3)



# Path MTU Discovery (4)

- Process may seem involved
  - But usually quick to find right size
- { Path MTU depends on the path and so can change over time
  - Search is ongoing
- { Implemented with ICMP (next)
  - Set DF (Don't Fragment) bit in IP header to get feedback messages

# END

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