

Introduction to Computer Networks

Packet Fragmentation (§5.5.5)



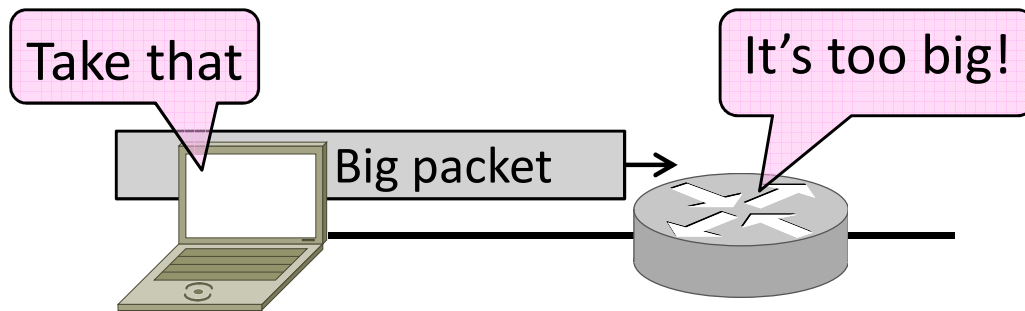
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Topic

- 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

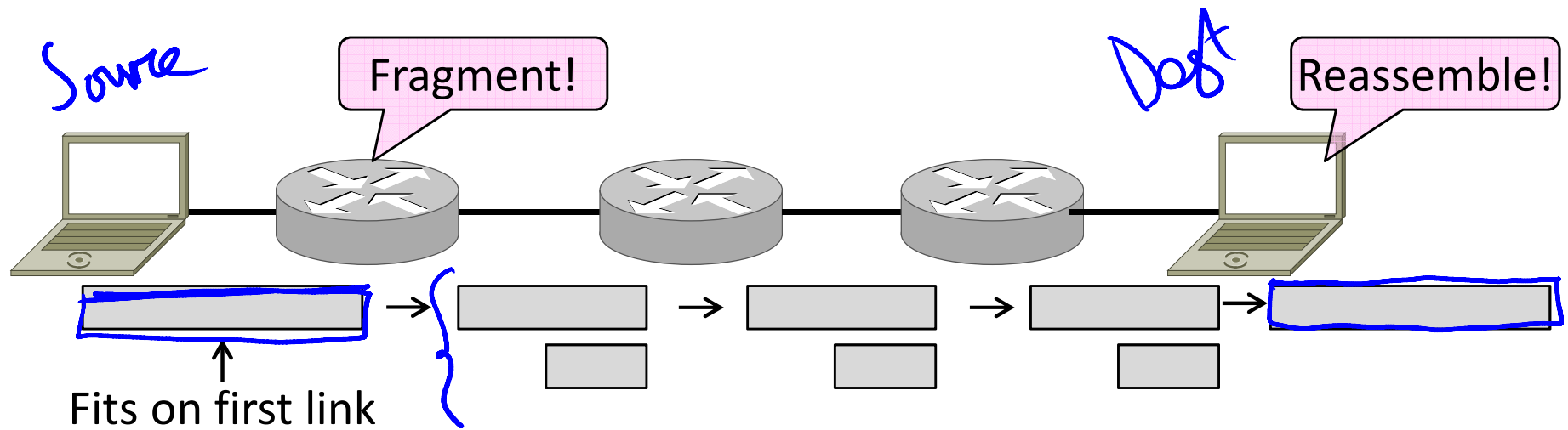
- Different networks have different maximum packet sizes
 - Or MTU (Maximum Transmission Unit)
 - E.g., Ethernet 1.5K, WiFi 2.3K
- Prefer large packets for efficiency
 - But what size is too large?
 - Difficult because node does not know complete network path

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

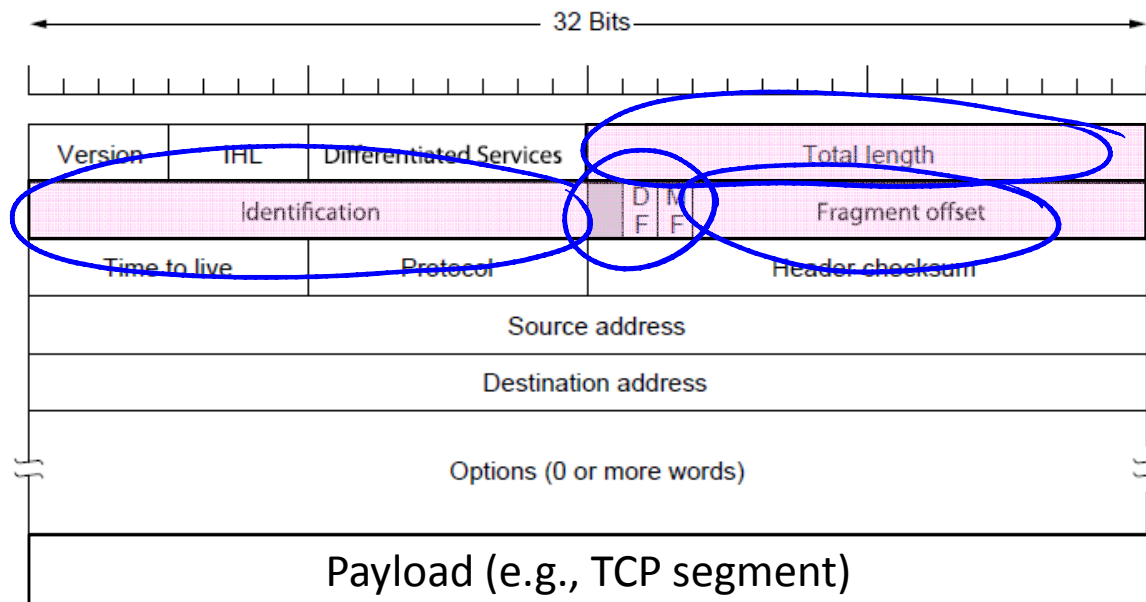
- Routers fragment packets that are too large to forward
- Receiving host reassembles to reduce load on routers



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

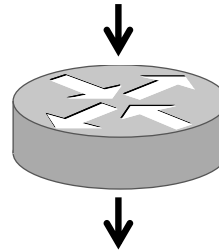
IPv4 Fragmentation (2)

Before
MTU = 2300

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



(Ignore length
of headers)



After
MTU = 1500

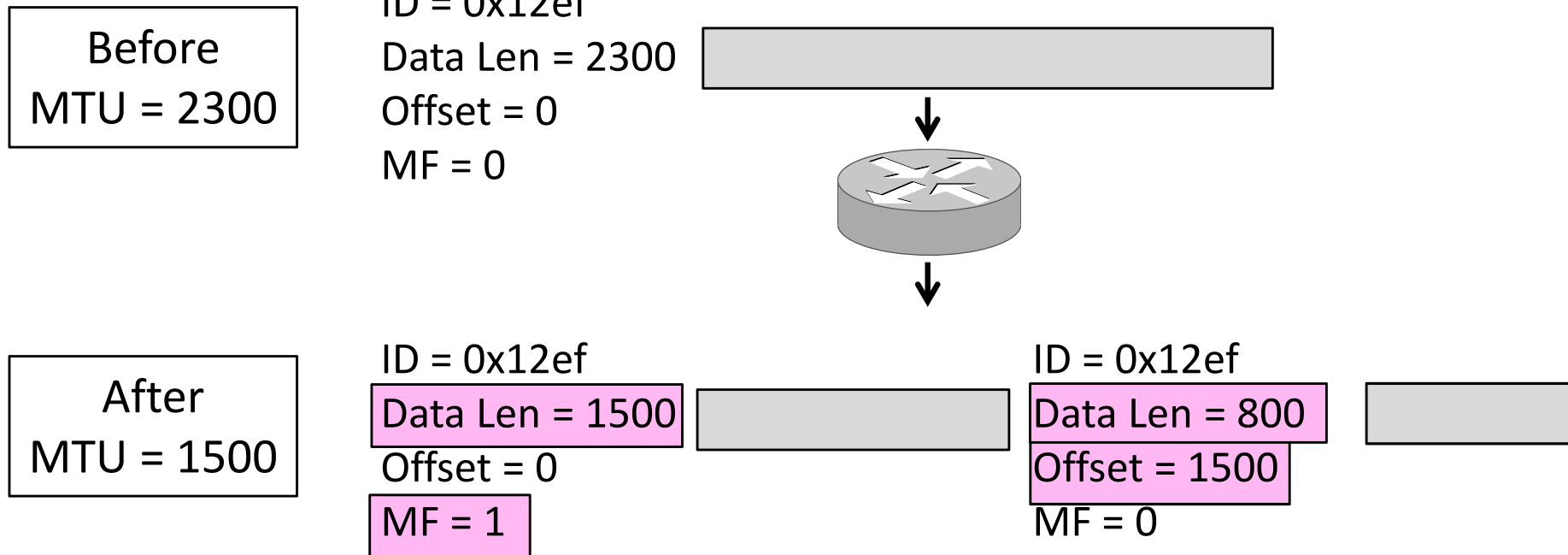
ID = 0x12ef
Data Len = 1580
Offset = 0
MF = 1



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




IPv4 Fragmentation (3)



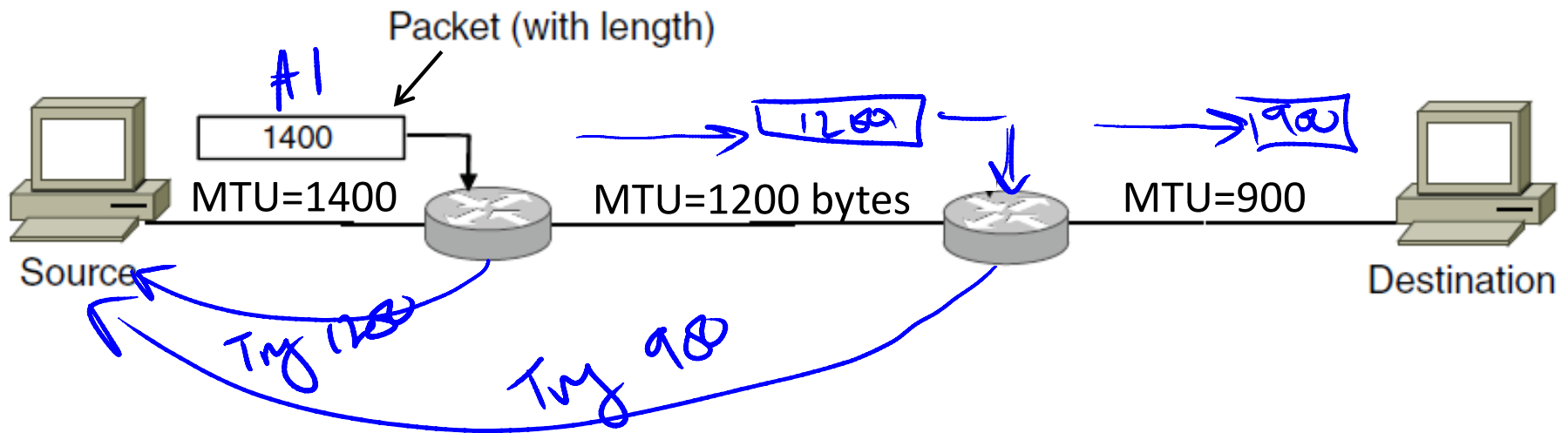
IPv4 Fragmentation (4)

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

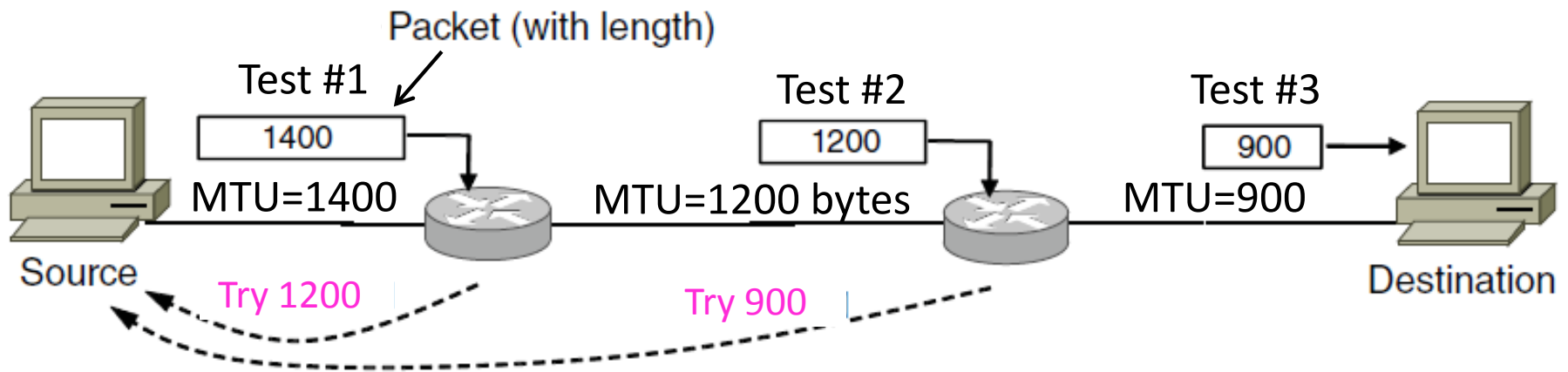
Path MTU Discovery

- 
- 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)



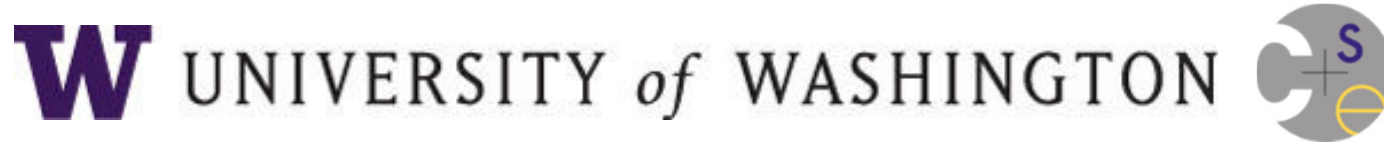
Path MTU Discovery (3)



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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