Simple Internetworking: IPv4 Packet Fragmentation and Reassembly

Hui Chen

Department of Computer & Information Science

CUNY Brooklyn College

Outline

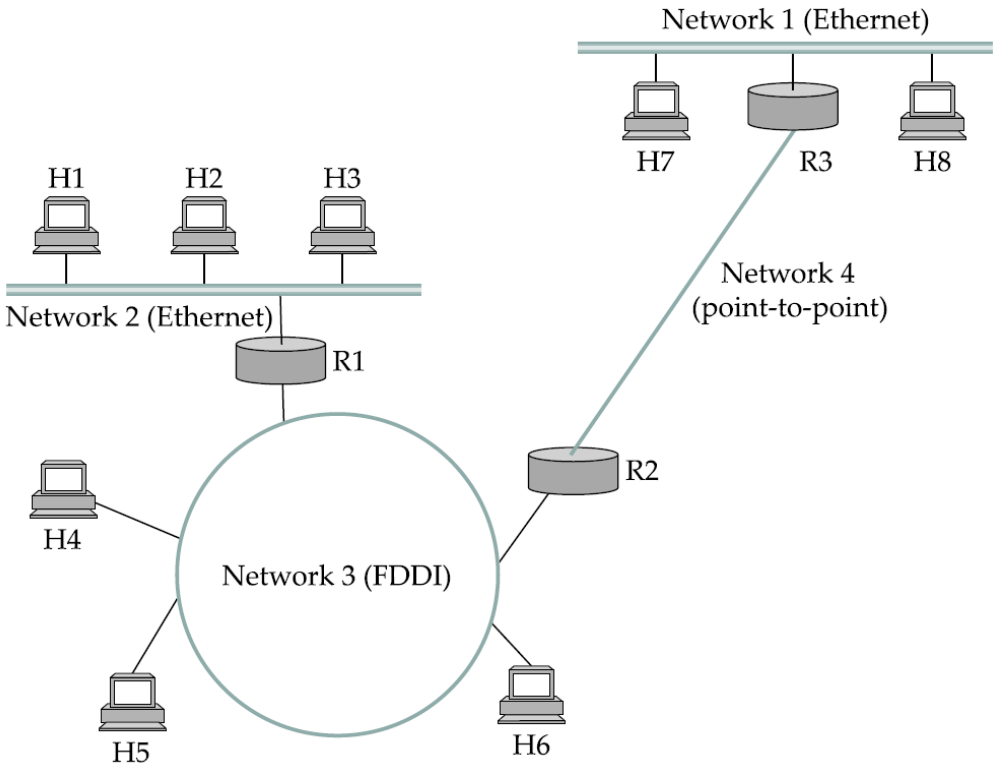
- Topic: internetworking
  - Case study: Internet Protocol (IP) Suite
- Simple interworking
  - Overview of internet and the Internet
  - Global addressing scheme
  - Best effort service model and datagram forwarding
  - **Packet fragmentation and assembly**
  - Address translation
  - Host configuration
  - Error reporting

IPv4 Fragmentation and Reassembly

- Each network has some MTU (Maximum Transmission Unit)
  - Ethernet (1500 bytes), FDDI (4500 bytes)
- Strategy
  - Fragmentation occurs in a router when it receives a datagram that it wants to forward over a network which has (MTU < datagram)
  - Reassembly is done at the receiving host
  - All the fragments carry the same identifier in the *Ident* field
  - Fragments are self-contained datagrams
  - IP does not recover from missing fragments

IPv4 Fragmentation and Reassembly: Example

- IP packet
  - Data: 1400 bytes
  - IP header: 20 bytes
- MTU
  - Ethernet=1500
  - FDDI=4500
  - PPP=532

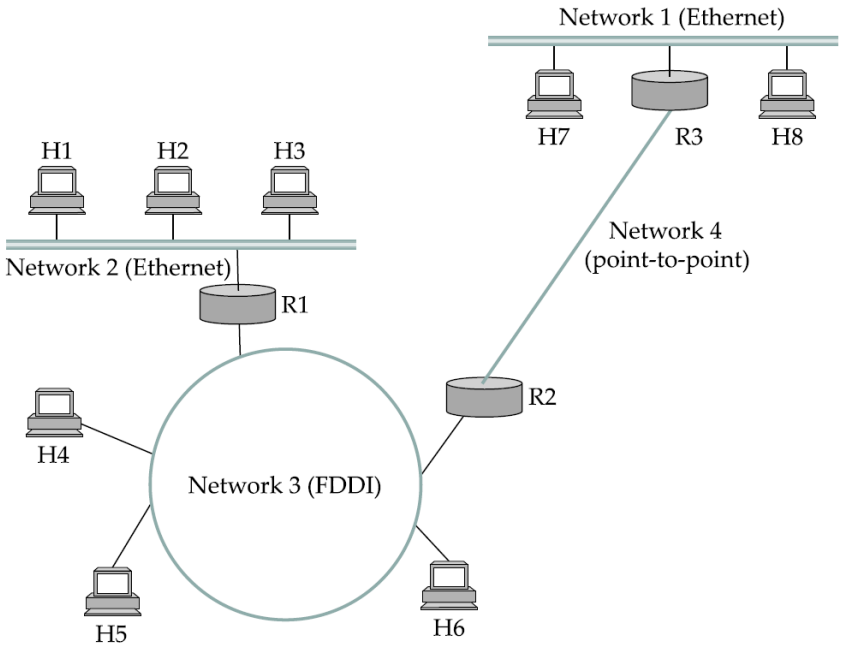


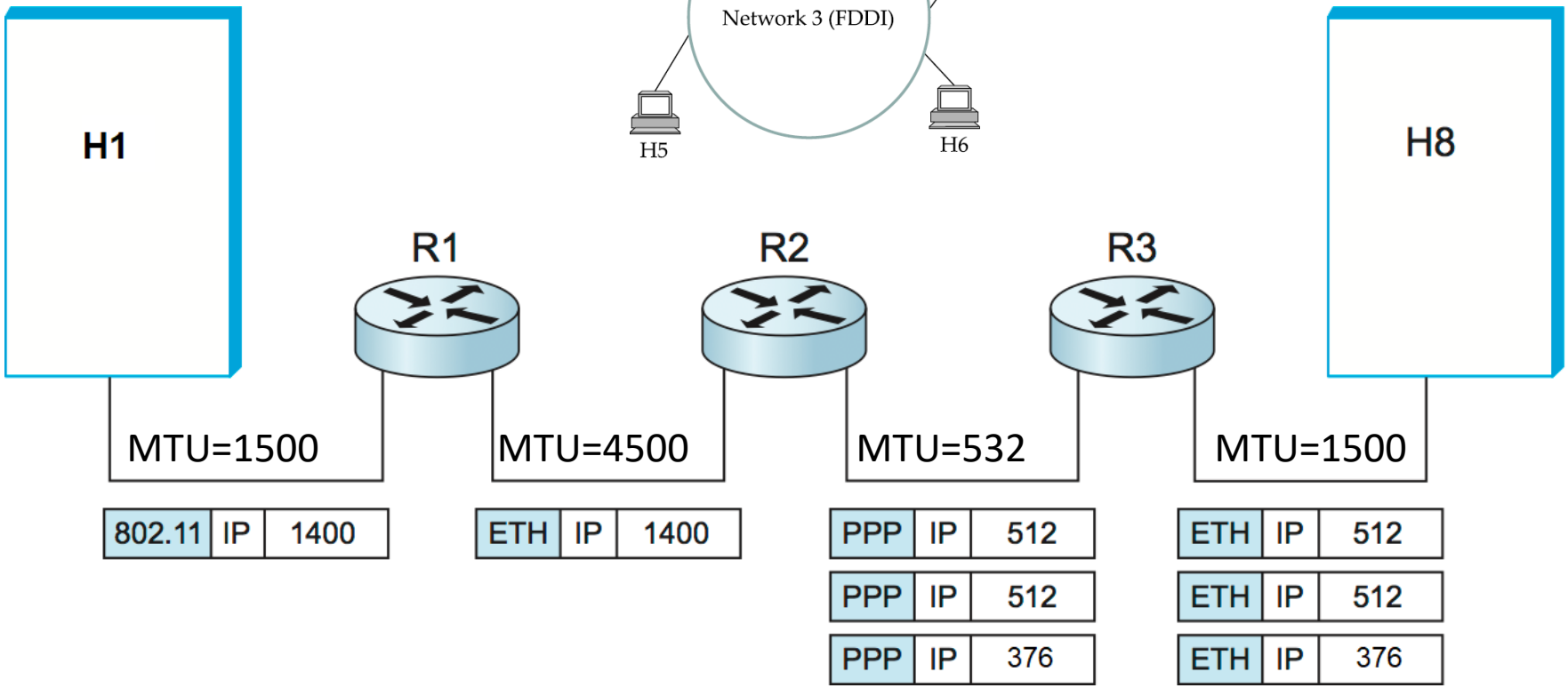
Example

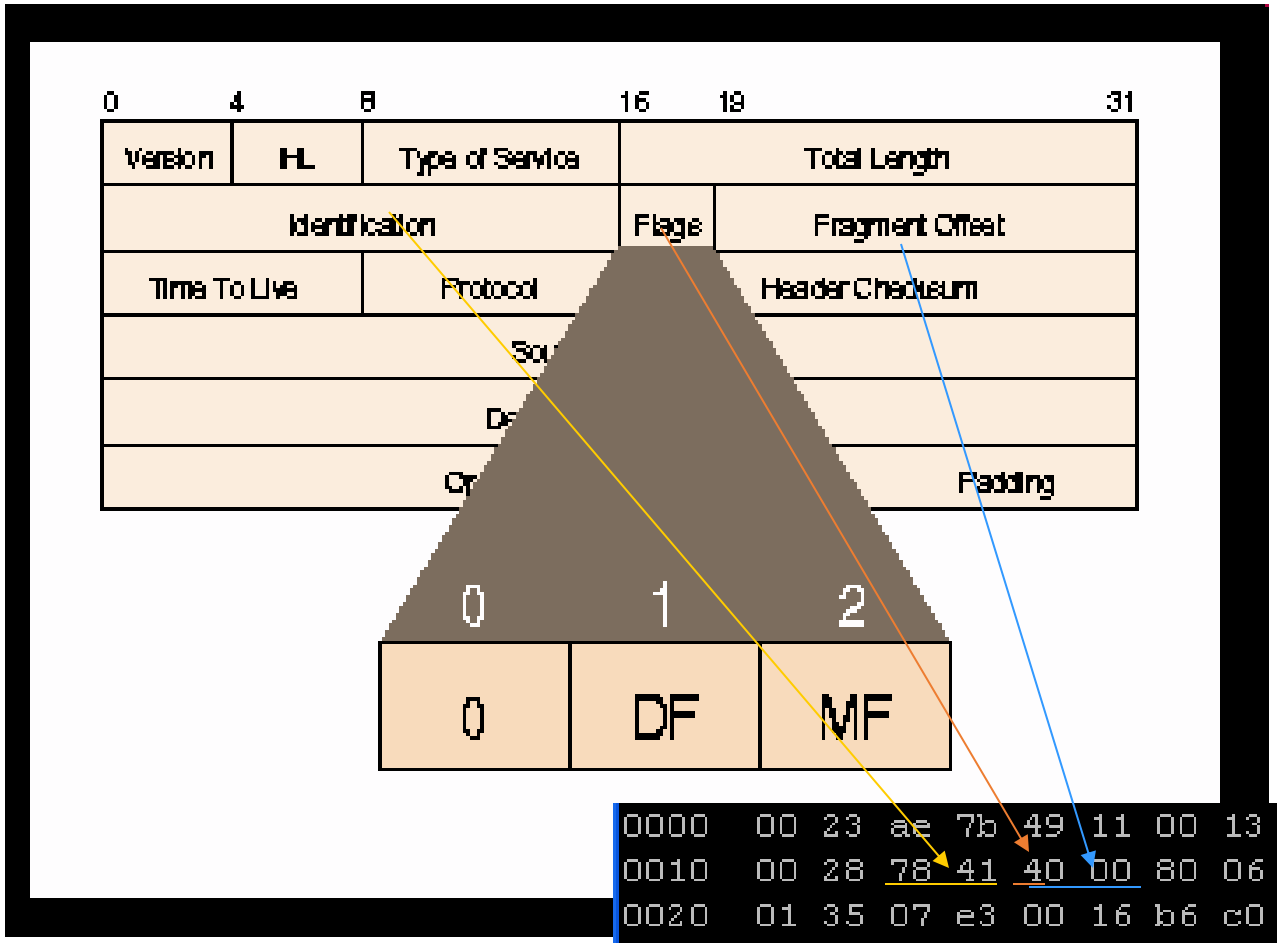
IP packet at H1

Data: 1400 bytes

IP header: 20 bytes







IP packet begins

```
0000  00 23 ae 7b 49 11 00 13 72 8f ba 11 08 00 45 00
0010  00 28 78 41 40 00 80 06 fe d4 c0 a8 01 34 c0 a8
0020  01 35 07 e3 00 16 b6 c0 0a da b6 1e 1a b7 50 10
0030  f1 80 a0 30 00 00 00 00 00 00 00 00
```

IP packet ends

Bit 0: reserved, must be zero
Bit 1: (DF) 0 = May Fragment, 1 = **D***on't* **F***ragment*.
Bit 2: (MF) 0 = Last Fragment, 1 = **M***ore* **F***ragments*.
Source: http://www.freesoft.org/CIE/Course/Section3/7.htm

Example

Ident:

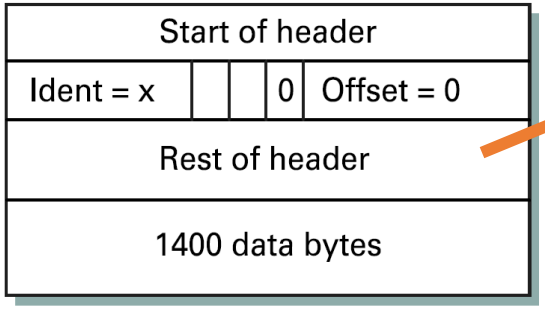
- Same across all fragments
- Unique for each packet

MF (M_{ore} $F_{ragments}$) bit in Flags:

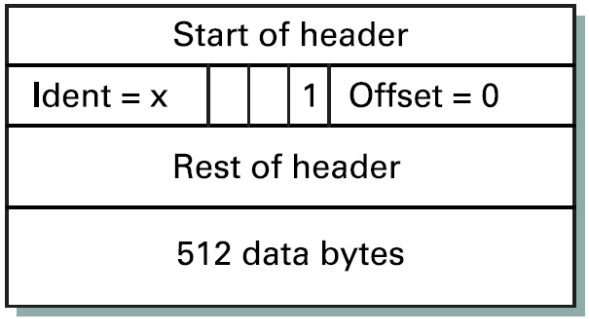
- set → more fragments to follow
- 0 → last fragment

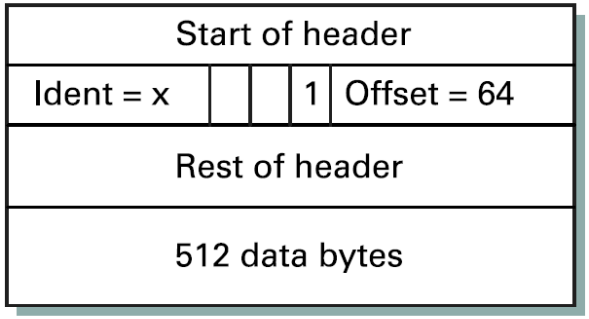
Offset

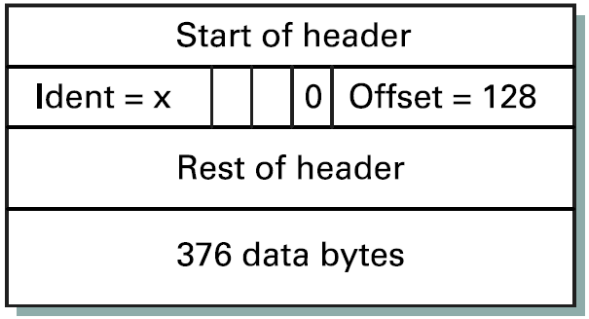
- in 8-byte chunks



Fragmented into three fragments

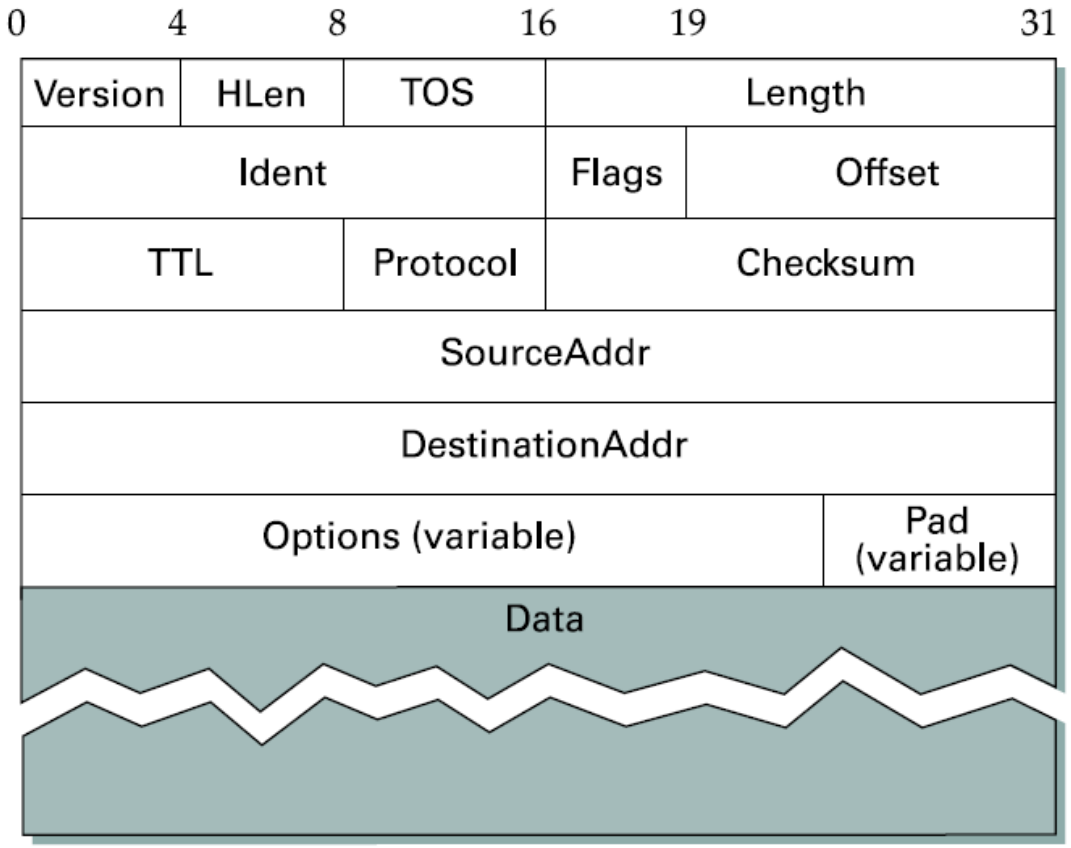






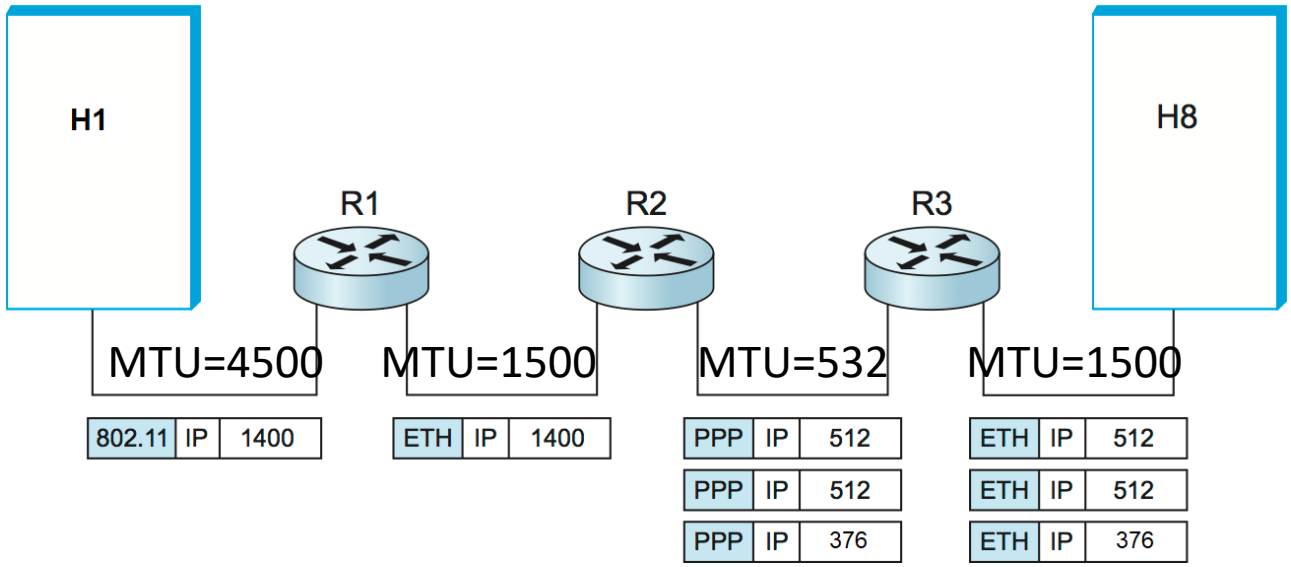
Q: why 8-byte chunks?

Hint for "*Why 8-byte Chunk?*"



IPv4 Fragmentation and Reassembly

- IP datagrams traversing the sequence of physical networks



(a)

Start of header				
Ident = x			0	Offset = 0
Rest of header				
1400 data bytes				

(b)

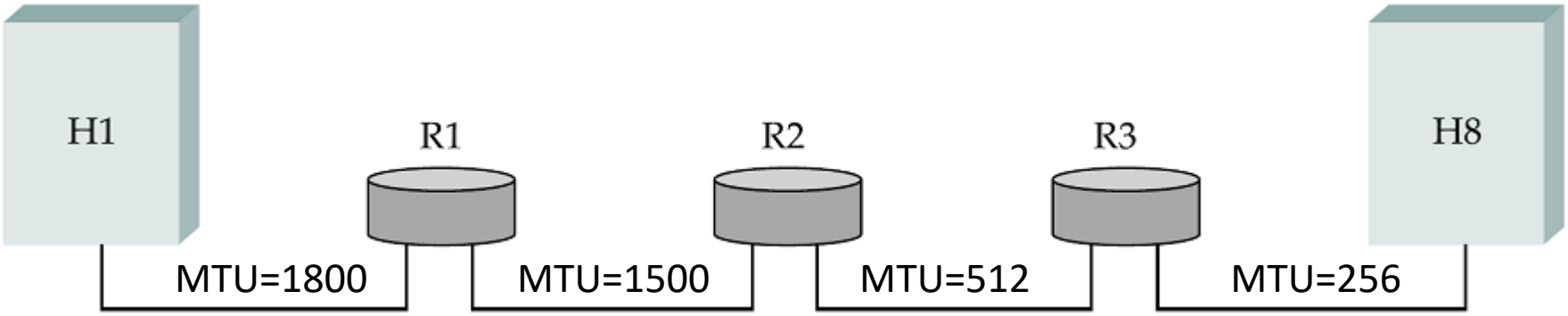
Start of header				
Ident = x			1	Offset = 0
Rest of header				
512 data bytes				

Start of header				
Ident = x			1	Offset = 64
Rest of header				
512 data bytes				

Start of header				
Ident = x			0	Offset = 128
Rest of header				
376 data bytes				

Exercise 1

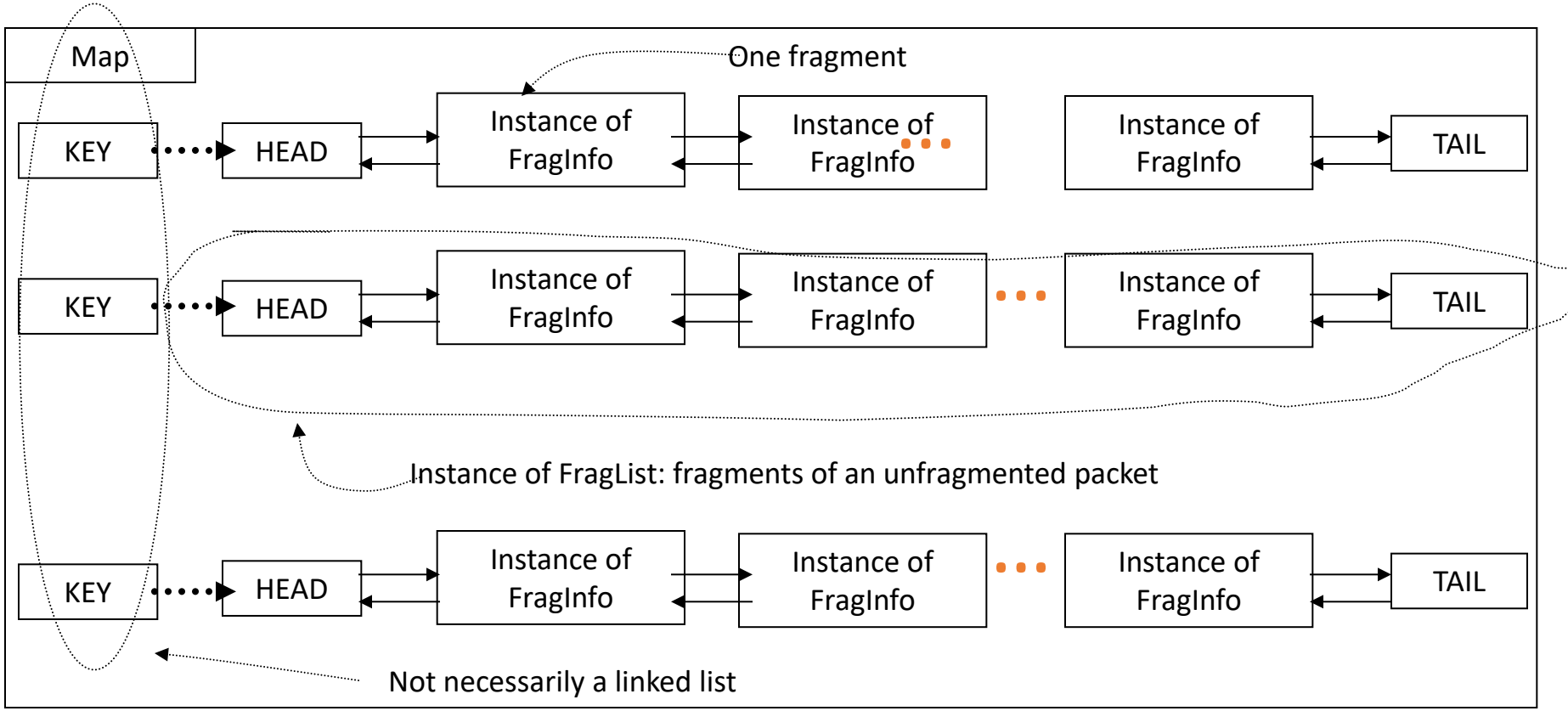
- For an imaginary network below



- Q: H1 sends an IP packet of 1800 bytes including IP header to H8. Please show
  1. IP datagrams traversing the sequence of physical networks graphed above
  2. Header fields of IP datagrams before entering and after leaving each router and hosts

Implementation of Reassembly

- Hints to understand the program



Summary and Discussion

- Fragmentation and reassembly of IPv4 packets
- What is your critique about IPv4 fragmentation and reassembly?