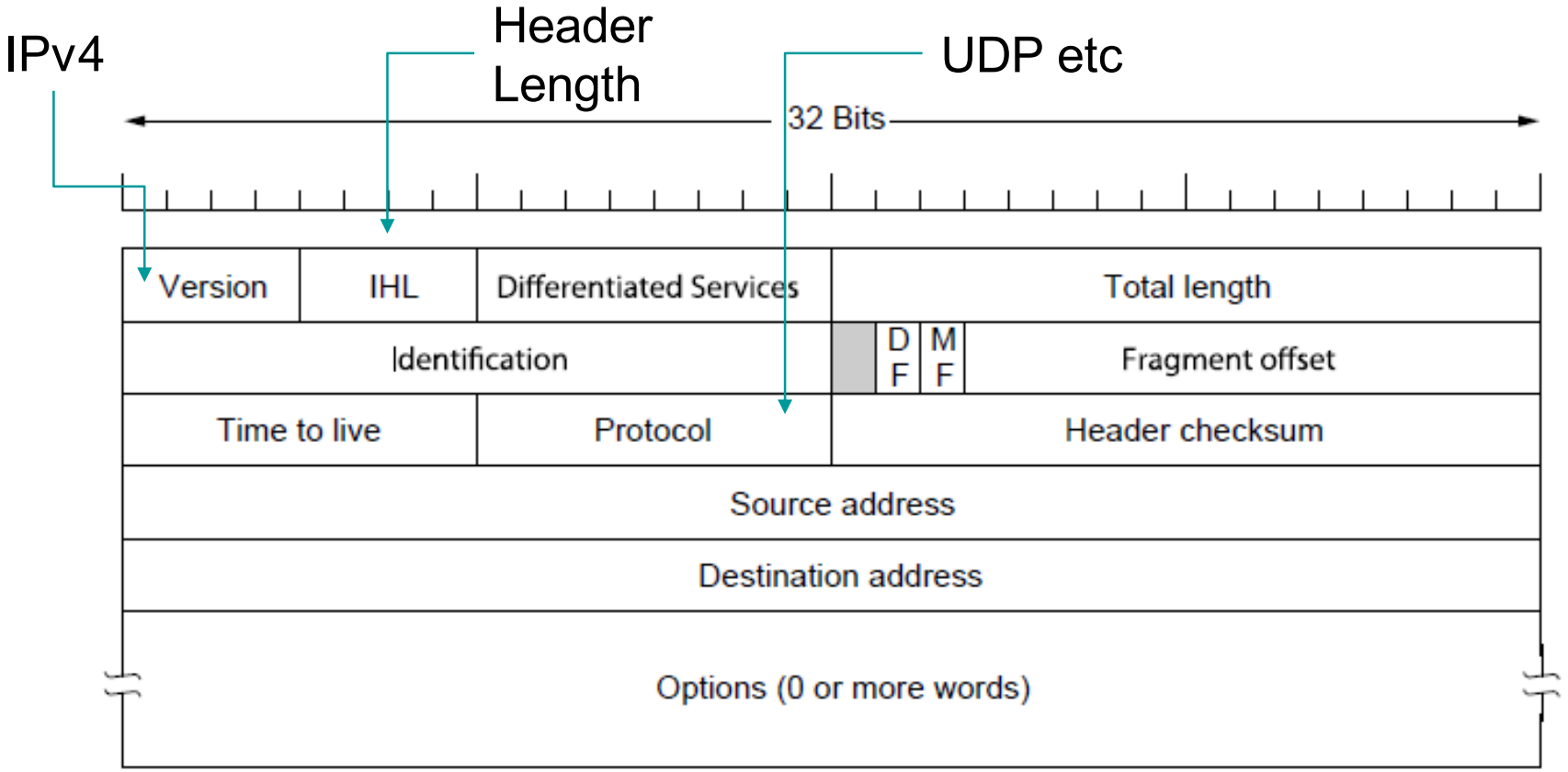
Week 7 – Network Layer Contd

Internet Technologies
COMP90007

How does IP datagram look then

- IPv4 (Internet Protocol) header is carried on all packets and has fields for the key parts of the protocol



IPv4 Datagram Structure in Detail

- IPv4 datagram consists of a header and some text
- Header is 20 byte fixed part + variable length optional part
- Version: IPv4 or IPv6
- IHL: Header Length – in 32bits units, min 5 and max is 15
- Type: differentiates different classes of service
- Total Length: header and payload, maximum length 65535 bytes
- Identification: allows host to determine which datagram the new fragment belongs to - all fragments of same datagram have same ID
- DF: Don't Fragment byte
  - Originally, it was intended to support hosts incapable of putting the pieces back together again.
  - Now it is used as part of the process to discover the path MTU, which is the largest packet that can travel along a path without being fragmented.

IPv4 Datagram Structure in Detail (continued)

- MF: More Fragment byte - are there more or is this the last one
- Fragment offset: where in the datagram the current fragment belongs
- TTL: limits packet lifetimes - hops or seconds
- Protocol: TCP, UDP, others...
- Header Checksum: Verifies the header only
- Source Address: IP - host/network
- Destination Address: IP - host/network
- Options: eg., security options, timestamping by routers if need be, etc.

Other Protocols to Consider: Internet Control Protocols

- IP works with the help of several control protocols:
  - ICMP is a companion to IP that returns error info to source
    - Required, and used in many ways at routers, e.g., for traceroute
  - ARP (Address Resolution Protocol)
    - Finds MAC address of a local IP address
    - Glue that is needed to send IP packets
    - E.g. over Ethernet query an address and the owner replies
  - DHCP assigns a local IP address to a host
    - Gets host started by automatically configuring it
    - Host sends request to server, which grants a lease

Remaining Considerations

- Congestion Control Algorithms
- Quality of Service (QoS) Guarantees

  - Handling these is the responsibility of the Network and Transport layers working together
  - We go back to these after looking into the Transport Layer

Transport Layer

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Reading

- Please read Chapter 6 from the book
  - *This is a long chapter, selective reading is needed*
  - *Please read algorithms we see in this chapter more carefully then others*

Transport Layer Function

- Main function
  - provide **efficient, reliable & cost-effective data transmission service to the processes in the application layer…independent** of physical or data networks

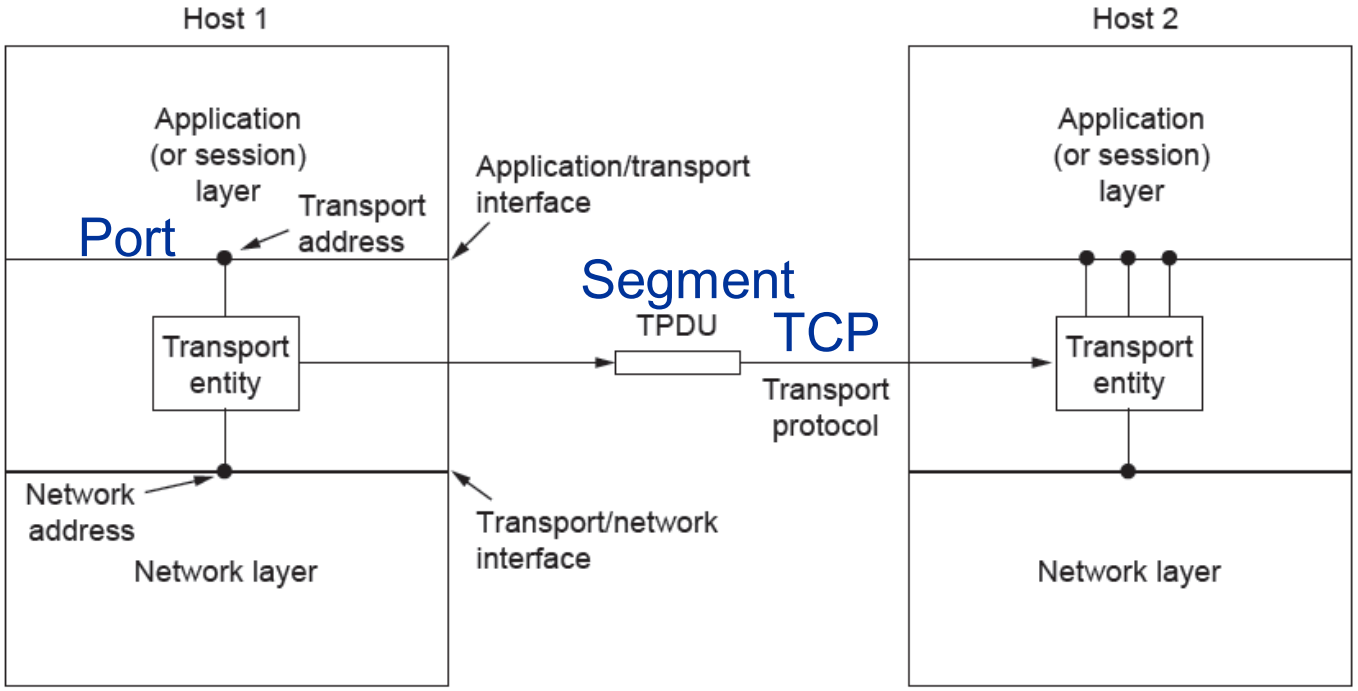
- Recall: To Achieve this
  - It calls services provided by the Network layer

Transport Layer Services

- Transport Layer Services provide interfaces between the *Application Layer and the Network Layer*
- Transport Entities (the hardware or software which actually does the work) can exist in multiple locations
- **Where are these entities and where it should not be (but sometimes is)?**
  - OS kernel
  - System library (library package bound into network applications)
- Not so much…
  - User process
  - Network interface card

Services Contd.

- Transport layer adds **reliability** to the network layer
  - Also offers connectionless (e.g., UDP) service in addition to famous **connection-oriented**/TCP services to applications
- Relationship between network, transport and application layers:



Transport Layer and Network Layer Services Comparison

- **Transport and Network layers are very similar in many ways but why two layers then**
- Transport layer code runs entirely on hosts, Network layer code runs almost entirely on routers
- Transport layer ***fixes reliability problems*** caused by the Network layer (e.g., delayed, lost or duplicated packets)
- ***Users have no real control over the network*** layer – Transport layer: we can improve QoS

Position of the Transport Layer

- The Transport Layer occupies a key position in the layer hierarchy because it clearly delineates
  - ***providers*** of data transmissions services
    - at the network, data link, and physical layers
  - ***users*** of reliable data transmission services
    - at the application layer
- In particular, ***users commonly access connection-oriented transport services*** for a reliable service on top of an unreliable network
- And we commonly write programs at this layer