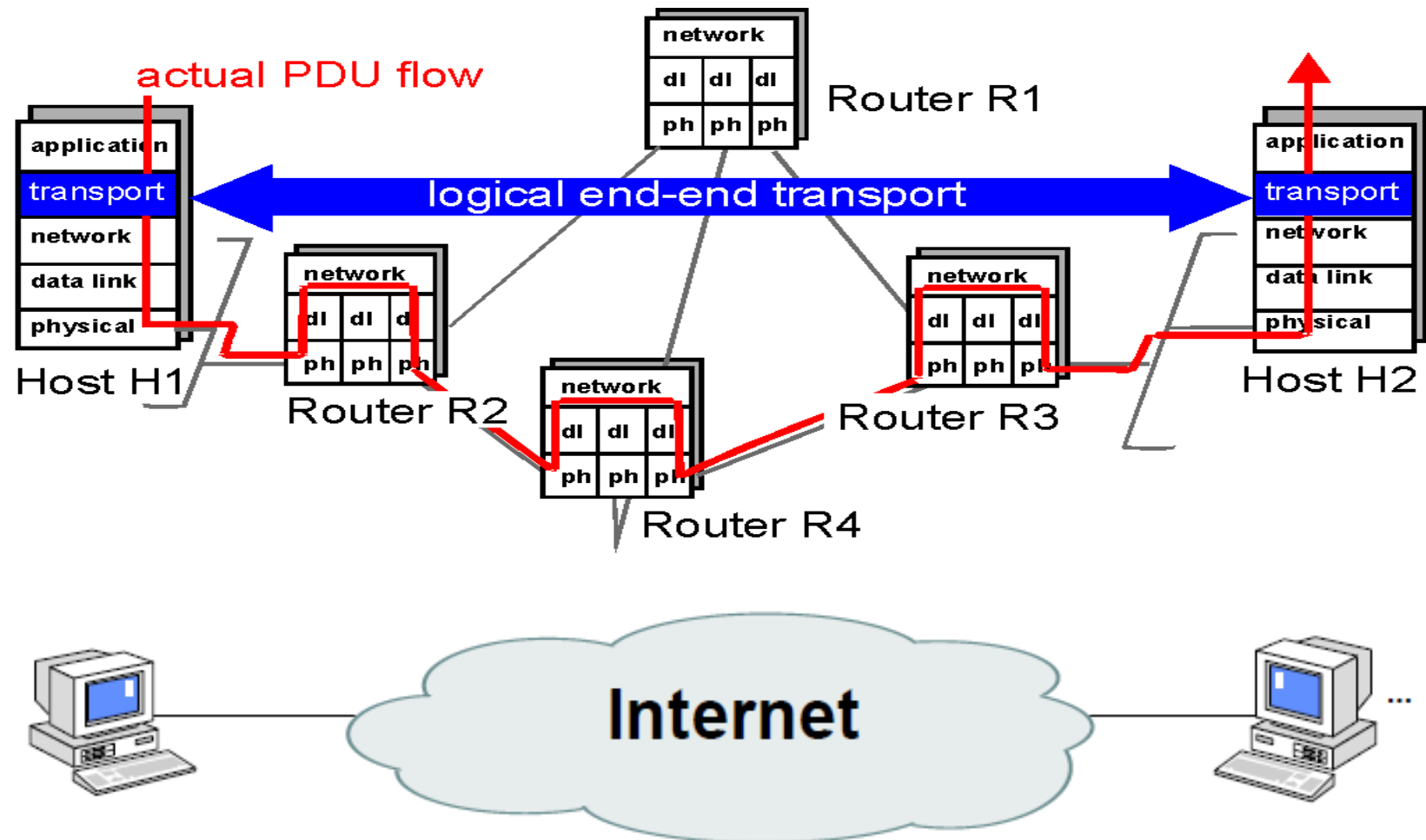


Question 4

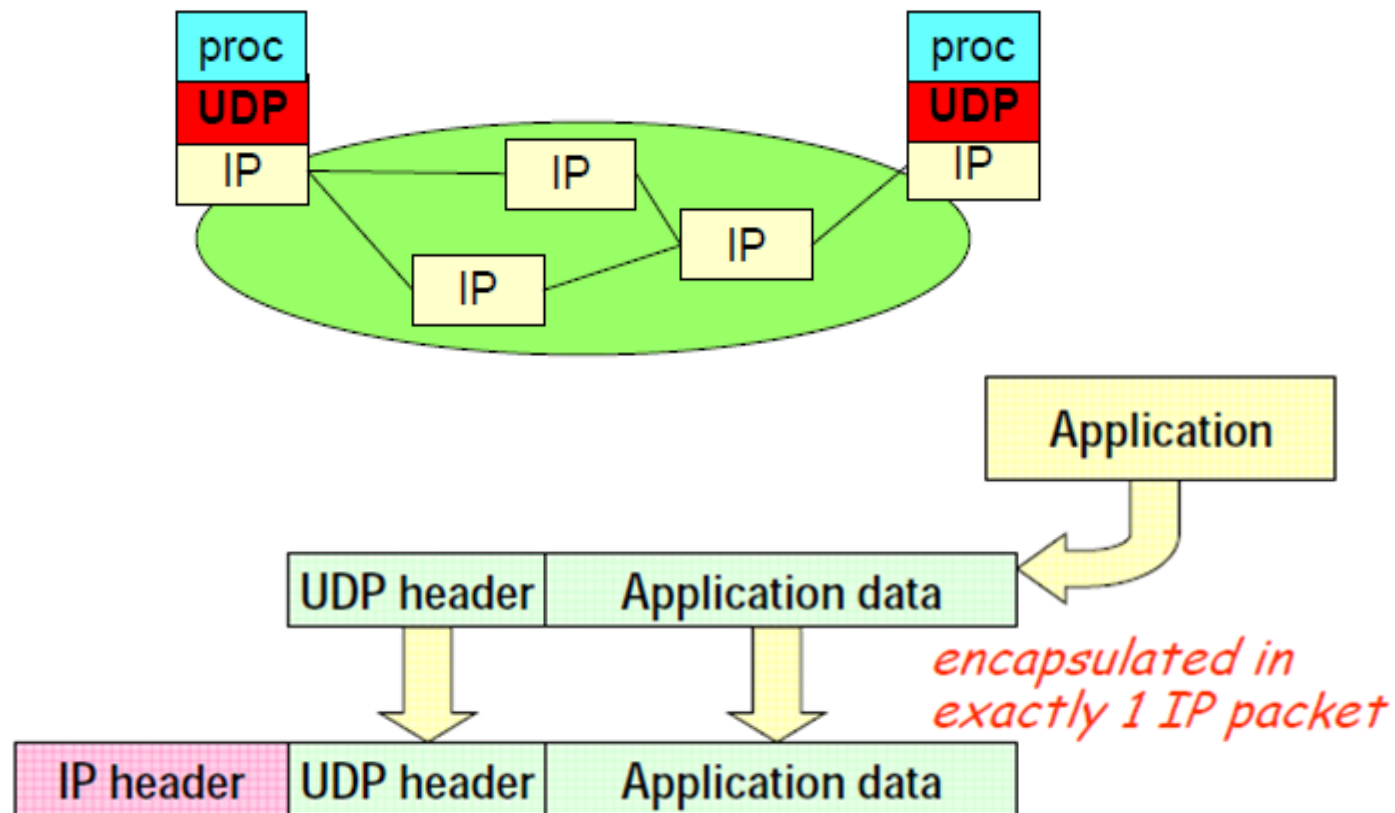
- Part a
- What function does the Transport Layer provide?

- *Entire network seen as a pipe*



Part b

- Explain why UDP is sometimes referred to as **Unreliable Datagram Protocol**.

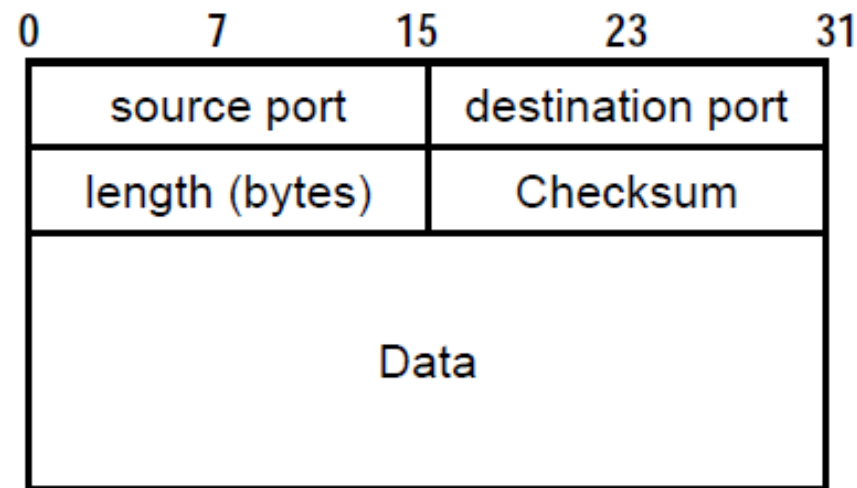


Part b

- Explain why UDP is sometimes referred to as **Unreliable Datagram Protocol**.
 - UDP supports message-oriented communication.
 - UDP provides no guarantee for reliable and ordered message delivery.

Part b

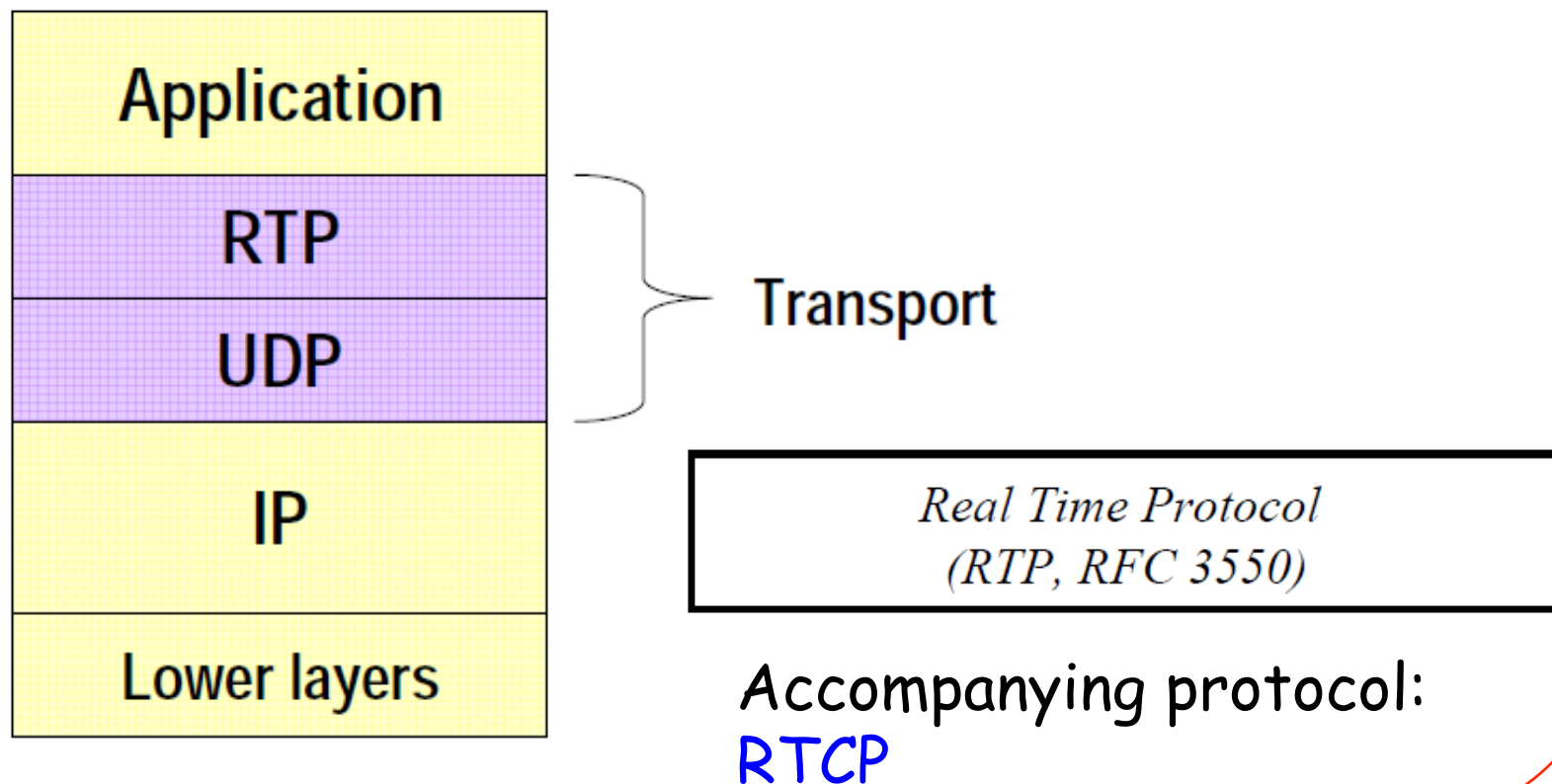
- Explain why the **source port field** in the header of a UDP datagram is optional.



- UDP can support unidirectional communication. If no reply is expected, the source port can be left unspecified.

Part c

- RTP does not support real-time delivery. So why is it called a real-time protocol?



Answer

- No end-to-end protocol, including RTP, can ensure in-time delivery in the Internet.
- RTP provides functionality suited for carrying real-time content.

Part d

- What is the TCP windowing concept?
 - TCP is a sliding window protocol, a window is used to control the amount of unacknowledged data a sender can send before it gets an acknowledgement back from the receiver.
 - **RcvWindow** is used for flow control, to prevent a fast TCP sender from overwhelming a slow TCP receiver.
 - **Congestion Window** is used for congestion control, to avoid congestion in the network.
 - Slow start algorithm is used to adaptively control the size of the congestion window.

Part d

- What are the **THREE segments** exchanged between two hosts when they want to establish a TCP connection?
 1. **ACTIVE OPEN**: Client sends a segment with
 - » SYN bit set
 - » port number of **client** and **server**
 - » initial sequence number (**X**) of client
 2. **PASSIVE OPEN**: Server responds with a segment with
 - » SYN bit set
 - » initial sequence number (**Y**) of **server**
 - » **ACK** for ISN of client (**X+1**)
 3. Client **acknowledges** by sending a segment with:
 - » ACK ISN of server (**Y+1**)

Part d

- Distinguish between **flow** and **congestion control**.
 - Flow control advises the sender of the receiver's buffer limit, so as not to send more data than the receiver can handle.
 - Congestion control limits the sender's transmission rate to avoid congesting any routers in the network.
 - When routers are congested, the communication delay will increase and packets can be dropped.
 - Congestion control ensures fair share of network capacity among all TCP communicators.

Part e

- How a sender can reliably send **three consecutive messages** to a receiver by using the **Go-Back-N protocol**. Assume that message 2 was lost in transmission and needs to be re-transmitted.

Answer

Time 0: message 1 is sent by A

Time 1: message 2 is sent by A, message 1 is received by B, acknowledgement 1 is sent by B

Time 2: message 3 is sent by A, acknowledgement 1 is received by A

Time 3: message 3 is received and discarded by B

Time 4: message 2 timeout, message 2 is sent by A

Time 5: message 3 is sent by A, message 2 is received by B, acknowledge 2 is sent by B

Time 6: acknowledge 2 is received by A, message 3 is received by B, acknowledge 3 is sent by B

Time 7: acknowledge 3 is received by A.

Part e

- Explain why the Selective Repeat protocol is more complicated than the Go-Back-N protocol.
 - For the selective repeat protocol, the receiver must implement a complementary window control of equal sophistication as the sender.
 - In comparison, for the Go-Back-N, the receiver does not need to maintain a sliding window.

Question 5

- Part a: HTTP protocol
- What is the typical port number used by an HTTP server for communication with its client?
- 80

Part a

- Identify at least THREE situations when a proxy server will not cache a Web object.
 - If the HTTP response header tells the proxy server not to cache the content.
 - Cache-control: no-store
 - If no validator in the HTTP response, the web content is considered uncacheable.
 - Last-modified, Etag
 - If the HTTP communication is encrypted, the proxy server will not cache the web content.

Part b

- What is the **store-and-forward model** in an email system?

Electronic Mail

- Email is a method of exchanging digital messages from an author to one or more recipients.
- Flexibility of message delivery:
 - Temporally decoupled communication
 - Store-and-forward message delivery
 - Cut-through message delivery
 - Spatially decoupled communication



Part b

- What is the **store-and-forward model** in an email system?
 - Store-and-forward model: email servers will accept and store the entire message locally before forwarding / delivering the messages.
 - Neither the users nor their computers are required to be online simultaneously.
 - Decoupled communication in time.

Part b

- Identify and briefly explain **THREE protocols** that are often used in practice to retrieve emails from mail servers.
 - POP: post office protocol
 - IMAP: Internet mail access protocol
 - HTTP: used in Web mail applications

Part c

- List THREE data transfer modes supported by FTP. Which data transfer mode is the most frequently used?

Data Transfer

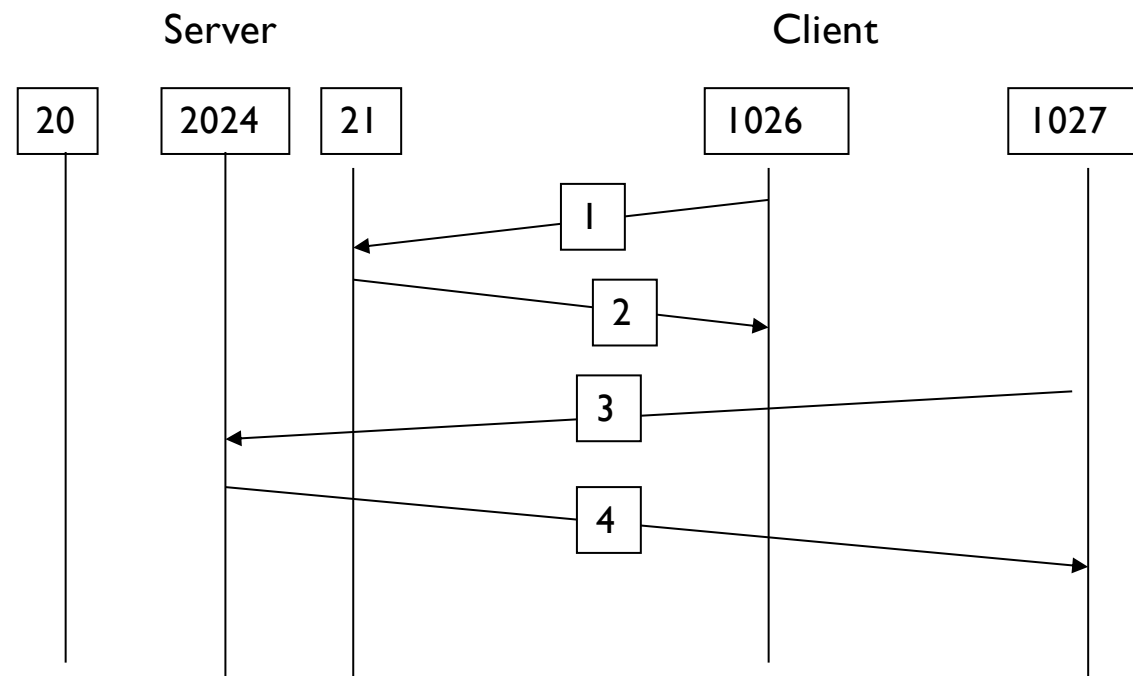
- Data representation
 - **ASCII mode**: used for plain text
 - **Image mode**: used for sending binary data, byte by byte
 - **EBCDIC mode**: used for sending plain text in EBCDIC character set
 - **Local mode**: send data in proprietary format understandable to both sender and receiver
- Data transfer mode
 - **Stream mode**: data is sent as a continuous stream
 - **Block mode**: break data into block
 - **Compressed mode**: data is compressed

Stream mode for data transmission

- The **stream mode is simple** and easy to implement.
- The **stream mode is general** because it treats all files as simple streams of bytes without paying attention to their content.
- The **stream mode is efficient**, no control information will be transmitted through the TCP data connection.

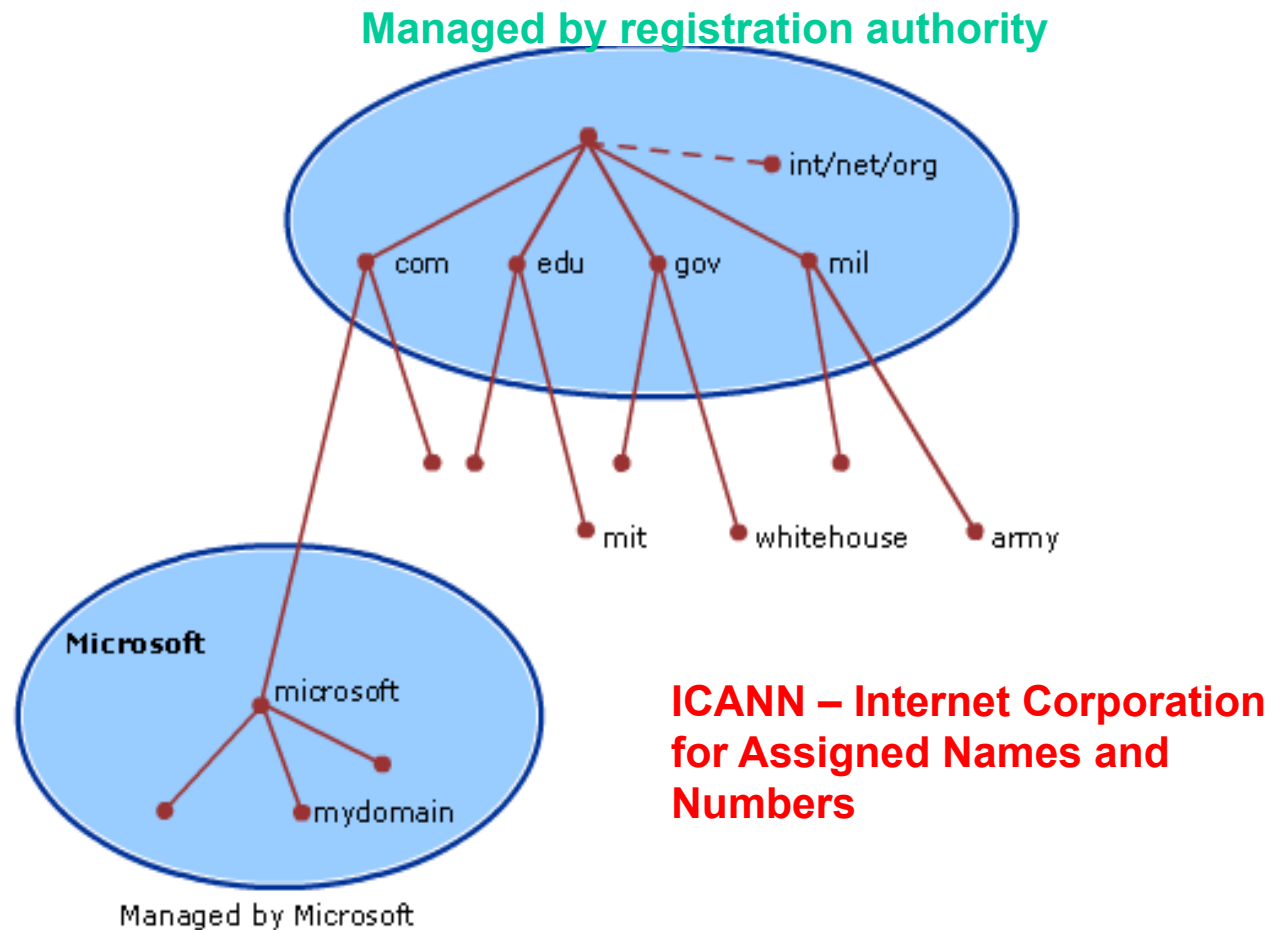
Part c

- Explain why the FTP **passive mode** is generally preferred when a firewall is involved in handling FTP traffics.



Part d

- Who is responsible for managing the top-level domain name space.



Part d

- Does each local area network (LAN) need to have its own DNS server?
 - No need to have a DNS server for each LAN.
 - DNS is an application-layer technology, its use can expand across the boundary of IP networks.
 - Configure a host to access a DNS server located in a different network. Router can provide the necessary relay service for any DNS query.

Question 6

- Part a: XML
- Identify **THREE major benefits** of using XML for representing domain knowledge.
 - Support the sharing of both text and non-text information.
 - Automatic validation of XML documents.
 - Support internalization - UNICODE.
 - Platform independent.
 - Both machine and human understandable.

Part a

- Identify FOUR building blocks of an XML document.
 - Elements
 - Attributes
 - Processing Instructions
 - Comments
 - Character data

Part b

- In a WSDL document, which element is used to specify the network address of the endpoint hosting the Web Service?

<definitions>: Root WSDL Element

<types>: What data types will be transmitted?

<message>: What messages will be transmitted?

<portType>: What operations will be supported?

<binding>: How will the messages be transmitted over the wire?

<port>: What's the physical address of the service?

<service>: Where is the service located?

Part b

- When should a message element be used in a WSDL document?
 - Each message element is used to define the input and output messages within an operation.

Part b

- List and briefly explain four main technologies that are commonly used in XML-based Web Services.
 - XML
 - WSDL
 - UDDI
 - SOAP: Simple Object Access Protocol
 - A protocol for delivery web service related messages in the form of xml documents. It allows clients to invoke web services and receive responses from the corresponding web service providers.

Part c

- Identify at least **THREE different types of resources** that can be externalized in an Android application.
 - Simple-valued resources such as Strings, Colors, Integers.
 - Drawable resources (images): high resolution, low resolution
 - Layout resources
 - Miscellaneous resources: animations, menus, etc.

Part c

- What are the benefits of externalizing resources in Android applications?
 - Make it easy to maintain, update and manage resources.
 - Make our application highly adaptive.

Part d

- Outline the forward error correction scheme that can be used by multimedia protocols to hide the effect of packet loss.

Concealing Packet Loss

What is sent

Packet 1	0	1	1	1	0	1	0	1
Packet 2	0	0	1	1	0	0	0	0
XOR packet	0	1	0	0	0	1	0	1

What is received

Packet 1	0	1	1	1	0	1	0	1
Packet 2	LOST!!!							
XOR packet	0	1	0	0	0	1	0	1

Reconstructing the lost packet

Packet 1	0	1	1	1	0	1	0	1
XOR packet	0	1	0	0	0	1	0	1
Recovered packet 2	0	0	1	1	0	0	0	0

Part d

- State the THREE main problems to be solved in order to allow a best-effort multimedia service to be implemented at the application level.
 - Limited bandwidth
 - Random network delay
 - Packet loss