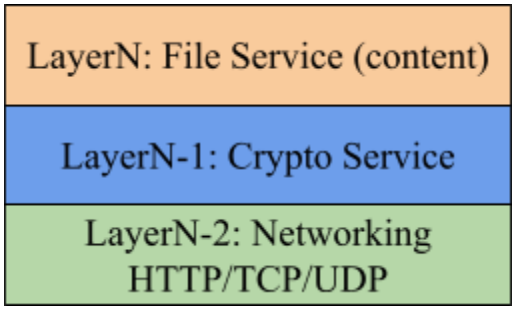
Assignment-01 **CS 433 Computer Networks (2022-23)** **100 points**
Submission Deadline: 15-Sep-2022 11:59PM.

Part I: Network Application using Socket Programming: (75 points)

1. Goal: Develop a simple remote file system service (RFS) and understand the principles of layered network architecture. You can use sockets/websockets or even consider using HTTP to build your application. The application needs to support the following 5 commands that the client can perform:

CMD	Description	Status
CWD	Retrieve the path of the current working directory for the user	
LS	List the files/folders present in the current working directory	
CD <dir>	Change the directory to <dir> as specified by the client	OK/NOK
DWD <file>	Download the <file> specified by the user on server to client	OK/NOK
UPD <file>	Upload the <file> on client to the remote server in CWD	OK/NOK



A Template Layer N model of the RFS client and server;

Top most layer: File Service will ensure to exercise the requested RFS command and take use of the associated OS API's on the client/server for file operations and rely on the underlying Crypto service to encode/encrypt and decode/decrypt the contents at either ends of the client.

Crypto Layer: This will facilitate 3 options (Plain Text, Substitute, Transpose modes) to mangle the data before transmitting to the networking layer.

1. Plain text → No change to the input; (No encryption or decryption)
2. Substitute → Only alphanumeric characters will be substituted with fixed offset, say Caesar cipher with offset 2. *Example ARTZ will be substituted with CTVB*
3. Transpose → Revere the contents in a word by word manner. *Example ARTZ will be substituted with ZTRA.*

You need to share the following: (consider download of any simple test file with 3 crypt modes):

a) Source code (preferably on github) and means to compile and execute your code (25 points).

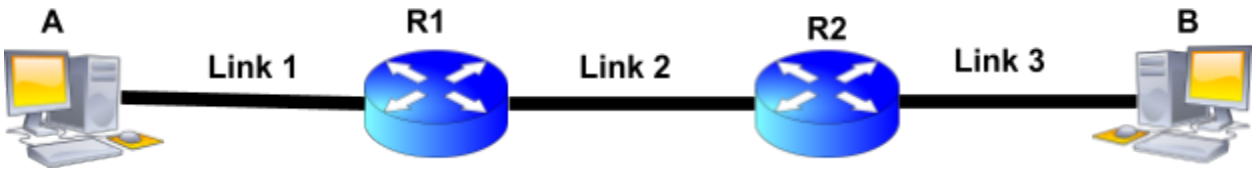
b) Design document detailing the mode of layering, protocol design for each of the layers, associated challenges and screenshots for execution of the 5 commands. (25 points).

c) Wireshark dump and analysis indicating data was correctly encrypted. (25 points)

Part II Networking Problems: (15 points)

2. Consider a packet switched network as shown below. We have three Links as Link1 (400Mbps) ,Link2 (100Mbps) and Link3 (200Mbps) respectively. A needs to send a message of size 100 Kilobytes. Source will packetize the data and transmit to the receiver. For each packet that needs to be transmitted, we need to add an additional 100 bytes header (meta-data). Consider the propagation and processing delays to be zero. Suggest which of the below configurations be chosen for lowest delivery time. (5 points)

a. 1 Packet
b. 10 packets
c. 50 packets
d. 100 packets



3. Consider that Link between R1 and R2 is of length 10 Kms and has 100 Gbps bandwidth. Given the speed of propagation to be ⅔ the speed of light. Estimate the following (5 points)

a. Propagation delay
b. Maximum number of bits that the R1 can send, until the first bit sent by R1 reaches R2.
c. Bit width of the data in the link.

4. Consider the RTT between client and server to be 10ms. Assume the web page of size 1 KB consists of 10 objects each of size 100KB. (5 points)

a. Page load time with HTTP 1.0 (Non-persistent)
b. Page load time with HTTP 1.1 (Persistent connection).
c. Page load time with HTTP 2.0 (Persistent + Pipelined and data frames of 1KB each).

Part III: Network Tools (10 points)

5. Run the Wireshark tool and capture the trace of the network packets on your host device. I expect you would be connected to the Internet and perform regular network activities.

a. List at-least 5 different network protocols that we have not discussed so far in the classroom and describe in 1-2 sentences the operation/usage of protocol and its layer of operation and indicate the associated RFC number if any (5 points).
b. Identify any one connection and try to estimate the RTT of that connection (2 points).
c. List the cookies and identify the characteristics of the cookies setup when you visit *ims.iitgn.ac.in* and also when you login to the student portal (3 points).