1.3 PROTOCOL LAYERING

When communication is simple,we need only one simple protocol; when the communication is complex, we need to divide the task between different layers, in which case we need a protocol at each layer .

Dividing the task between different layers is called Protocol layering.

Scenarios

Two simple scenarios are available to understand the need for protocol layering.

First Scenario

In the first scenario, communication is simple that it can occur in only one layer.

Assume Maria and Ann are neighbors with a lot of common ideas. Communication between Maria and Ann takes place in one layer, face to face, in the same language, as shown in Figure 1.3.1.
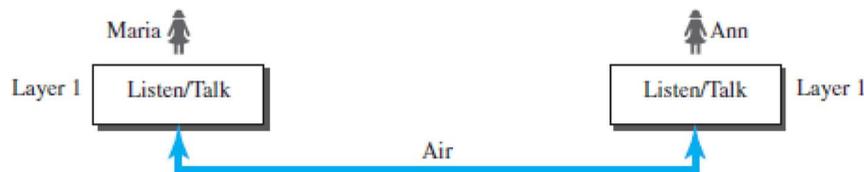
Fig1.3.1: Single layer protocol.

[Source : "Data Communications and Networking" by Behrouz A. Forouzan,Page-32]

Set of rules followed in this scenario:

First, Maria and Ann know that they should greet each other when they meet. **Second**,they know that they should confine their vocabulary to the level of their friendship. **Third**, each party knows that she should refrain(not talking) from speaking when the other party is speaking.**Fourth**, each party knows that the conversation should be a dialog. **Fifth**, they should exchange some nice words when they leave.

Second Scenario

In the second scenario, we assume that Ann is offered a higher-level position in her company, but needs to move to another branch located in a city very far from Maria.The two friends still want to continue their communication and exchange ideas because they have come up with an innovative project to start a new business when they both retire.They decide to continue their conversation using regular mail through the post office. They agree on an encryption/decryption technique.

The sender of the letter encrypts it to make it unreadable by an intruder; the receiver of the letter decrypts it to get the original letter.
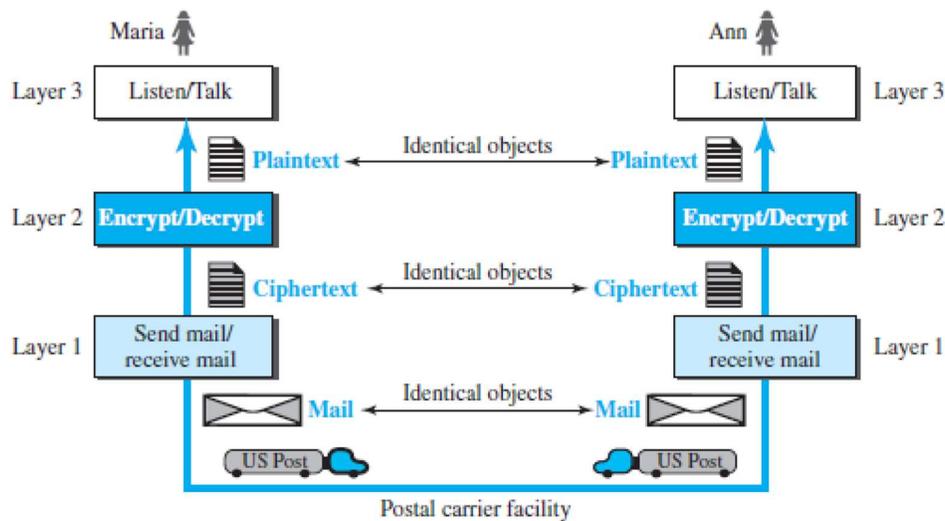

Fig1.3.2: Three layer protocol.

[Source : "Data Communications and Networking" by Behrouz A. Forouzan,Page-33]

Consider that Maria sends the first letter to Ann. Maria talks to the machine at the third layer as though the machine is Ann and is listening to her. The third layer machine listens to what Maria says and creates the plaintext (a letter in English), which is passed to the second layer machine.

The second layer machine takes the plaintext ,encrypts it, and creates the ciphertext, which is passed to the first layer machine. The first layer machine, takes the ciphertext, puts it in an envelope,adds the sender and receiver addresses, and mails it.

Protocol layering enables us to divide a complex task into several smaller and simpler tasks.

For example, in the Figure 1.3.2, we could have used only one machine to do the job of all three machines. However, if Maria and Ann decide that the encryption/decryption done by the machine is not enough to protect their secrecy, they would have to change the whole machine. In the present situation, they need to change only the second layer machine; the other two can remain the same. This is referred to as modularity.

Principles of Protocol Layering

First Principle

If we want bidirectional communication, we need to make each layer so that it is able to perform two opposite tasks, one in each direction. For example, the third layer task is to listen (in one direction) and *talk* (in the other direction).

The second layer needs to be able to encrypt and decrypt. The first layer needs to send and receive mail.

Second Principle

The second principle that we need to follow in protocol layering is that the two objects under each layer at both sites should be identical.

For example, the object under layer 3 at both sites should be a plaintext letter. The object under layer 2 at both sites should be a cipher text letter. The object under layer 1 at both sites should be a piece of mail.

Logical connection between each layer is shown in Figure 1.3.3.

We have layer-to-layer communication. Maria and Ann can think that there is a logical (imaginary) connection at each layer through which they can send the object created from that layer.
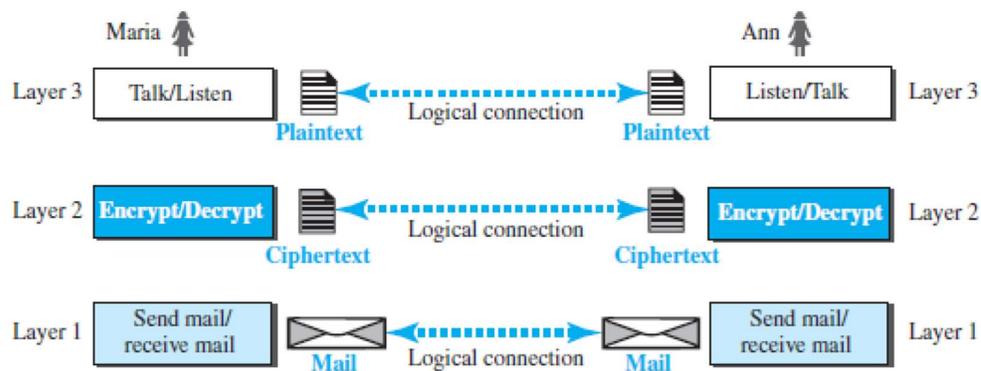
Fig1.3.3: The concept of logical connection between layers.
[Source : "Data Communications and Networking" by Behrouz A. Forouzan,Page-35]