The access to a cloud is provided by the Internet, a packet-switched network; thus,we start our discussion

with an overview of this important concept. A packet-switched network transports data units called

packets through a maze of switches, where packets are queued and routed toward their destination.

Packets are subject to a variable delay and loss and possibly arrive at their final destination out of order.

A datagram is a basic transfer unit in a packet-switched network; it consists of a header, which contains

control information necessary for its transport through the network, and a payload or data.

A packet-switched network has a network core consisting of routers and control systems interconnected

by very high-bandwidth communication channels and a network edge where the end-user systems

reside. A network architecture describes the protocol stack used for communication. A protocol is a

discipline for communication that specifies the actions taken by the sender and the receiver of a data

unit. We use the term host to describe a system located at the network edge and capable of initiating

and receiving communication, whether a computer, a mobile device such as an phone, or a sensor.

This very concise description hints that a packet-switched network is a complex system consisting of

a very large number of autonomous components and subject to complex and sometimes contradictory

requirements. Basic strategies for implementing a complex system are layering and modularization; this

means decomposing a complex function into components that interact through well-defined channels

(e.g., a layer can only communicate with its two adjacent layers).

All network architectures are based on layering; this justifies the term protocol stack, as shown in

Figure 7.1. In the Internet architecture the network layer is responsible for routing packets through

the packet-switched network from the source to the destination. The transport layer is responsible for

end-to-end communication, from an application running on the sending host to its peer running on the

destination host.

Physically, at the sender site the data flows down the protocol stack from the application layer to the

transport, network, and data link layers; the streams of bits are pushed through a physical communication

link encoded as electrical, optical, or electromagnetic signals. Once they reach a router, the bits are passed

to the data link and then to the network layer.

The network layer decides where the packet should be sent, either to another router or to a destination

host connected to a local area network connected to the router. Then the data link layer encapsulates

the packet for the communication link to the next hop, and then the bit stream is passed to the next

physical channel (see Figure 7.1). At the receiving end the data flows upward from the data link to the

application layer.

A protocol on one system communicates logically with its peer on another system. For example,

the transport protocol on the sender, host A, communicates with the transport protocol on the receiver,

hostB.On the sending side, A, the transport protocol encapsulates the data from the application layer and

adds control information as headers that can only be understood by its peer, the transport layer on host B.

When the peer receives the data unit, it carries out a decapsulation, retrieves the control information,

removes the headers, then passes the payload to the next layer up, the application layer on host B.

The payload for the data link layer at the sending side includes the network header and the payload at

the network layer. In turn, the network layer payload includes a transport layer header and its payload,

consisting of the application layer header and application data.