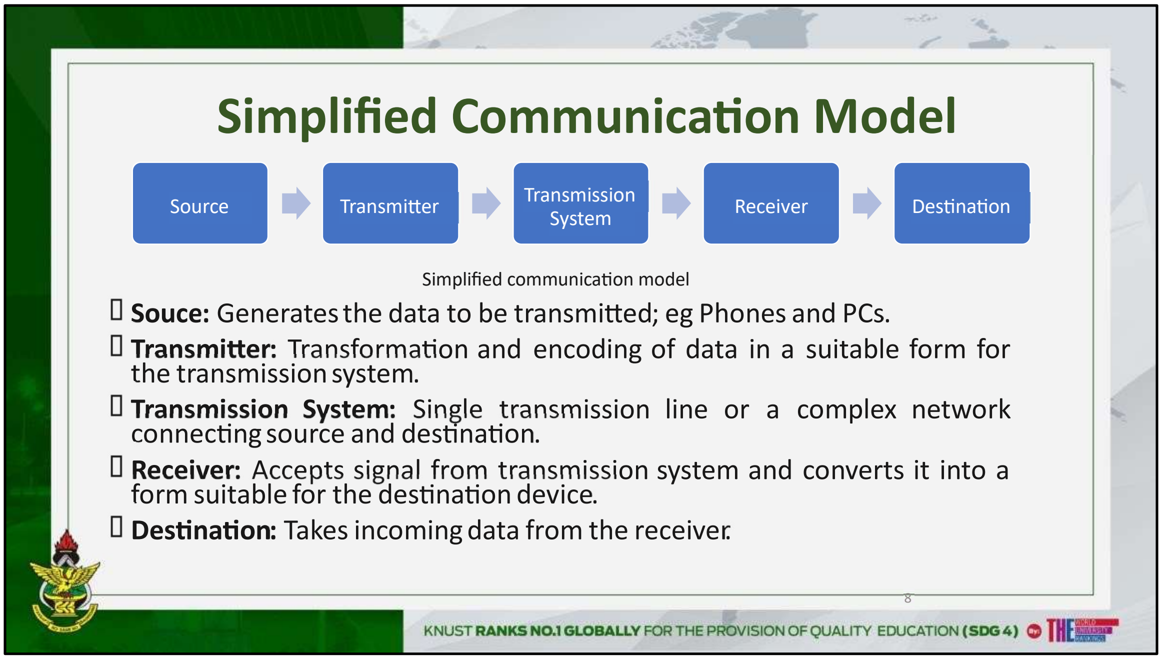
# Lecture 1: Introduction

- Communication models
- Definition of computer networks
- LANs, WANs, ISO – OSI reference model
- Network components and topologies




The fundamental purpose of a communications system is the exchange of data between two parties.

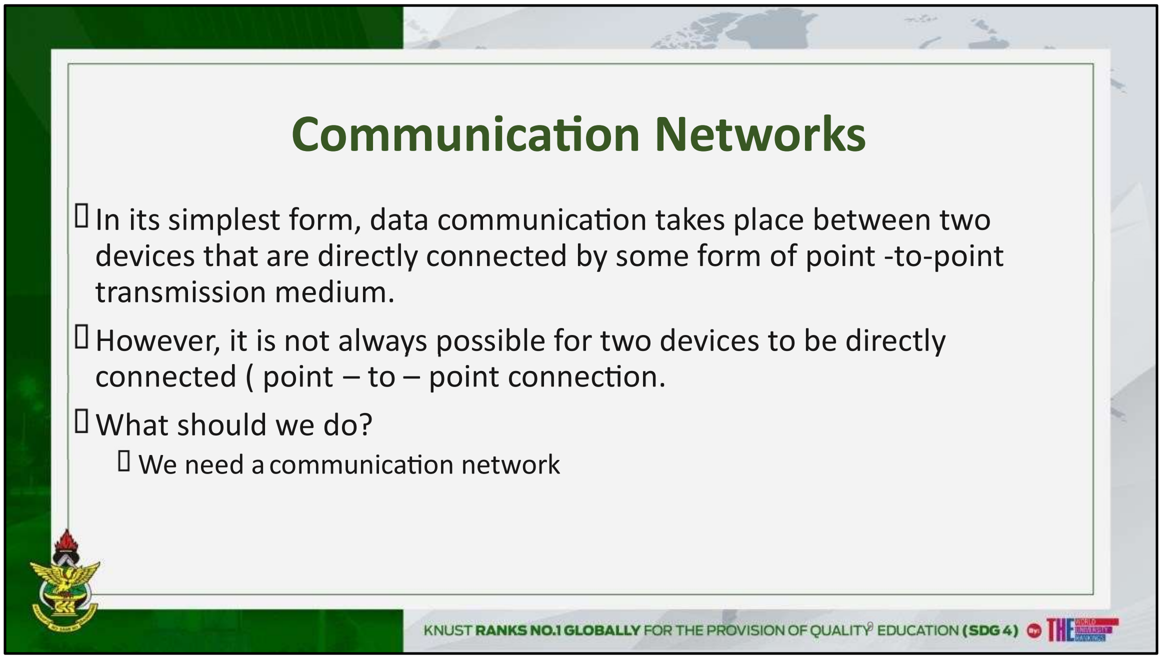
**Source:** This device generates the data to be transmitted; examples are telephones and personal computers.

**Transmitter:** Usually, the data generated by a source system are not transmitted directly in the form in which they were generated. Rather, a transmitter transforms and encodes the information in such a way as to produce electromagnetic signals that can be transmitted across some sort of transmission system. For example, a modem takes a digital bit stream from an attached device such as a personal computer and transforms that bit stream into an analog signal that can be handled by the telephone network.

**Transmission System:** This can be a single transmission line or a complex network connecting source and destination.

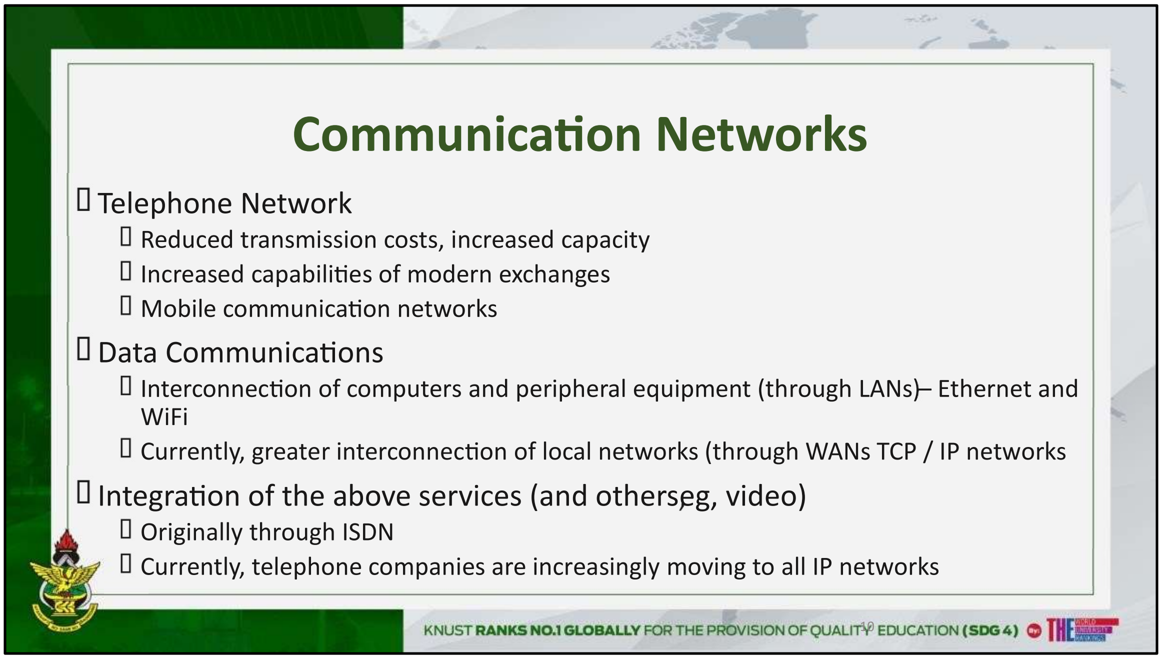
**Receiver:**The receiver accepts the signal from the transmission system and converts it into a form that can be handled by the destination device. For example, a modem will accept an analog signal coming from a network or transmission line and convert it

into a digital bit stream.
**Destination:**Takes the incoming data from the receiver.




In its simplest form, data communication takes place between two devices that are directly connected by some form of point-to-point transmission medium. Often, however, it is impractical for two devices to be directly, point-to-point connected. This is so for one (or both) of the following contingencies:

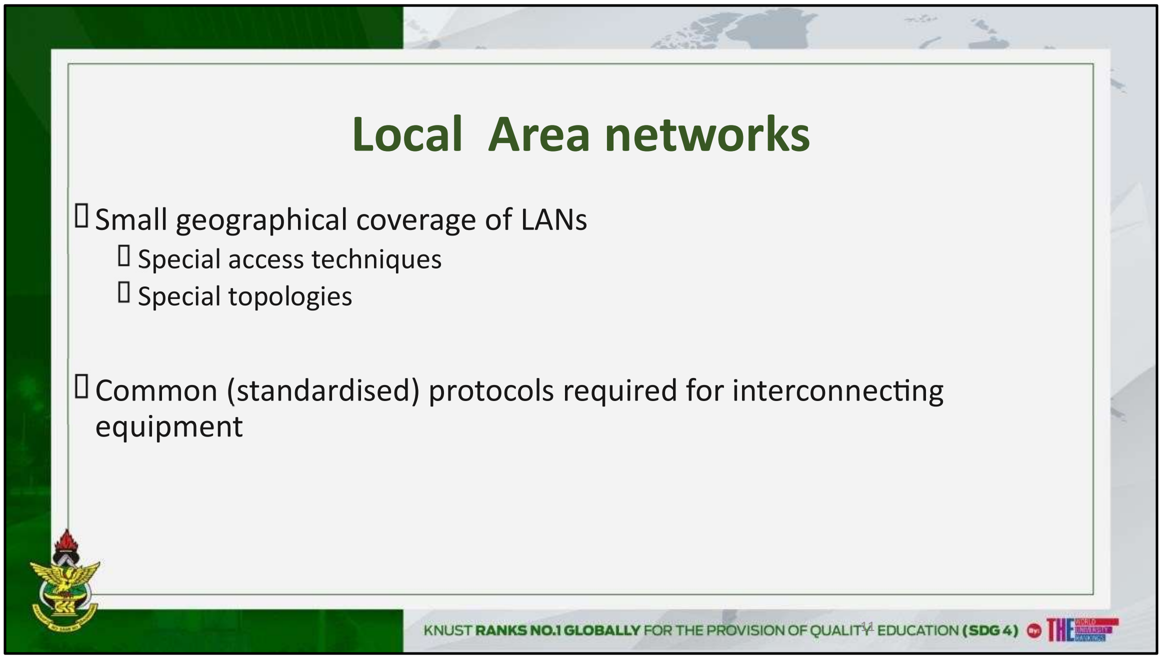
- The devices are very far apart. It would be inordinately expensive, for example, to string a dedicated link between two devices thousands of miles apart.
- There is a set of devices, each of which may require a link to many of the others at various times. Examples are all of the telephones in the world and all of the terminals and computers owned by a single organization. Except for the case of a very few devices, it is impractical to provide a dedicated wire between each pair of devices.




The use of optical fibres has led to substantial reductions in transmission costs for telephone networks, while increasing their capacities. Satellite communications have also enhanced the information carrying capacity of long-distance routes. Some of the most important developments, however, were those brought about by advances in VLSI technology, which has led to the availability of very powerful computers for telephone exchange control.

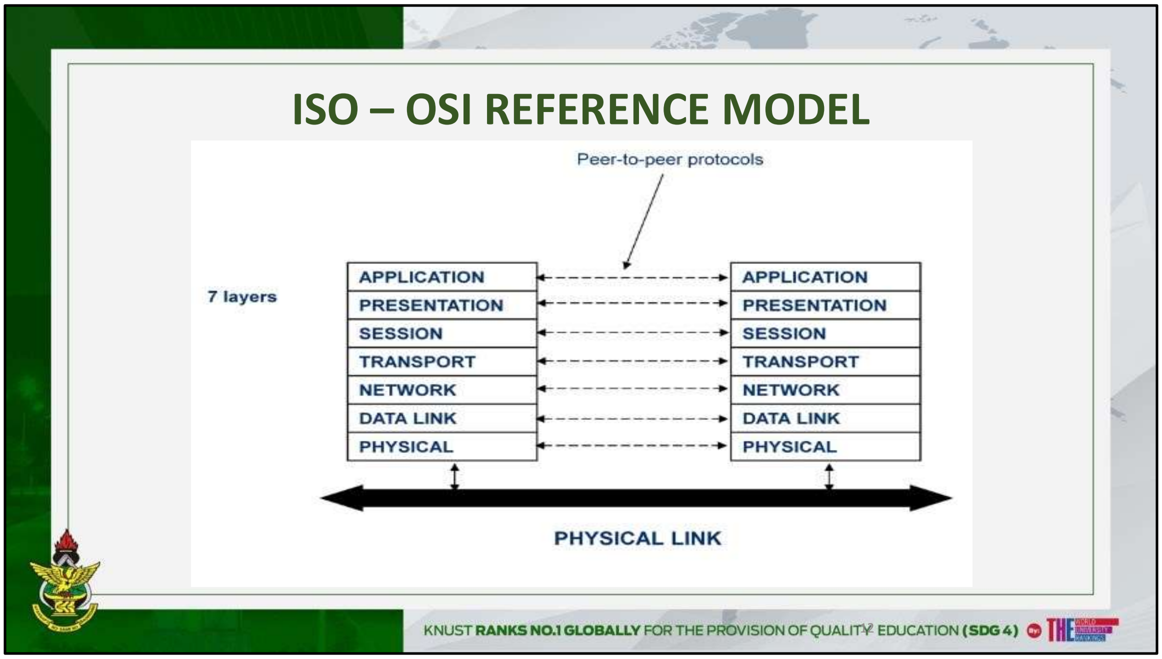
Mobile communication networks have placed very different requirements on the demands for bandwidth, mainly due to the limited spectrum available.
The increased use of computers generally has led to increased requirements for data communications. At a local level this has meant interconnecting computers, terminals, printers, etc. but there is generally a requirement to connect these local networks to other networks, perhaps separated by large distances. This may be done through point-to-point links originally implemented as part of the telephone network, or other WANs.

With digital techniques ubiquitous in the telephone and mobile telephony networks, there has been an increasing convergence between data and voice networks. ISDN was a move to try and standardise this integrated single network, but developments are continual and generally ahead of the standardisation process.




The small geographical coverage of LANs allows for different topologies (device connectivity) and access techniques to be used, compared to larger networks. This was particularly the case when LAN protocols were being developed, due to the small ratio between the time for data to propagate through the network compared to the typical packet duration (a ratio referred to as the a parameter).

For two or more machines to communicate, common protocols must be used. Equipment in a network, may be of different types, and from different manufacturers. Standard protocols are required. These are generally designed with reference to a reference model for standards - the ISO model for Open Systems Interconnection (OSI).

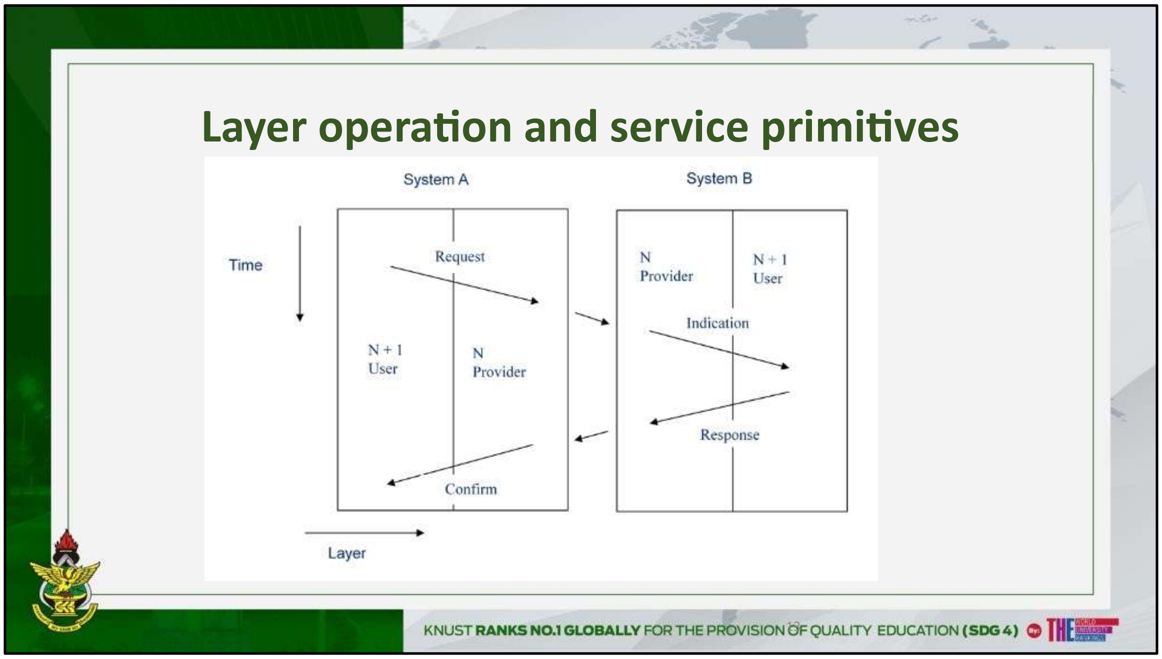



The OSI (Open Systems Interconnection) model is an example of a layered network architecture.
Architecture refers to the rules and conventions that define the system. As the rules governing communications are the protocols, this is also referred to as a 'protocol stack'.

The layering consists of grouping functions into manageable and logical sets.
Functions can be upgraded without affecting the whole system.

Entities at the same layer (referred to as N entities at the N layer) communicate via an N layer protocol. This is a virtual communication path.

The real communication path is down through the layers and back up at the destination end. Generally, each layer adds control (header) information to the data passed to it (by the higher layers) which is stripped off by the corresponding layer at the receiving end. This information is used for the peer protocol.



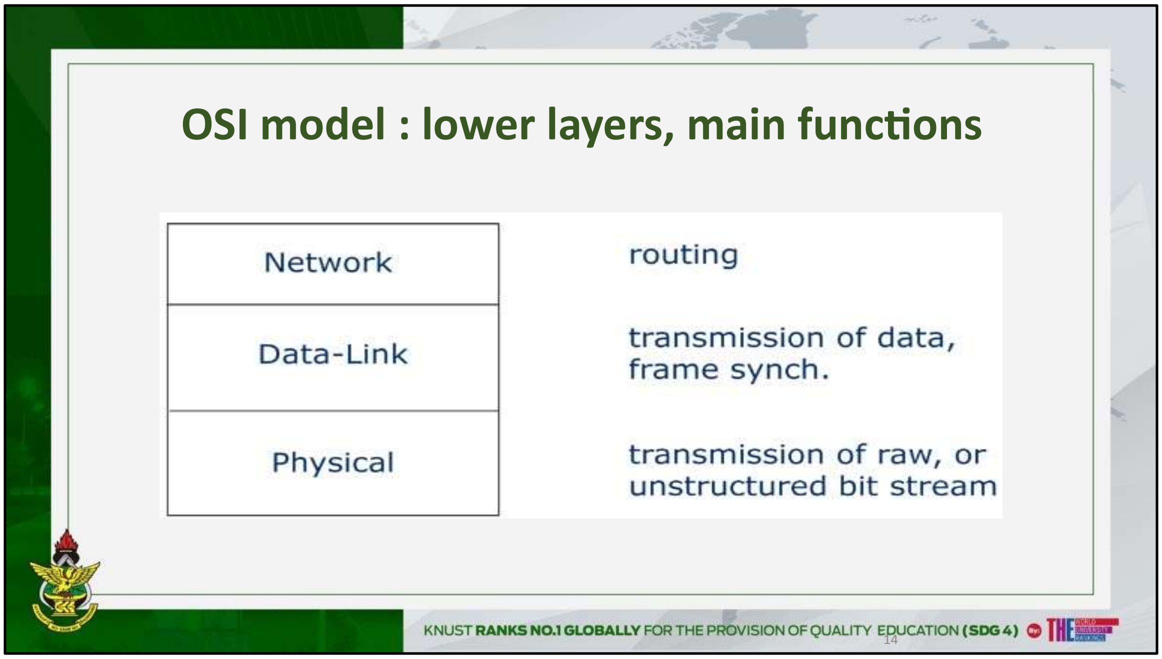

Each layer is a SERVICE PROVIDER to the layer above it, the SERVICE USER.

N services are offered to (N + 1) entities via SERVICE ACCESS POINTS (SAPs) which are *logical interfaces between layers.*

The interaction between two layers is controlled by SERVICE PRIMITIVES.

Primitives are exchanged between layers implemented on one system - they are not externally visible. They are used to create headers at the local site (and to remove them at remote site).

Not all types have to be implemented as implied above at every layer - this could be wasteful of processing power.

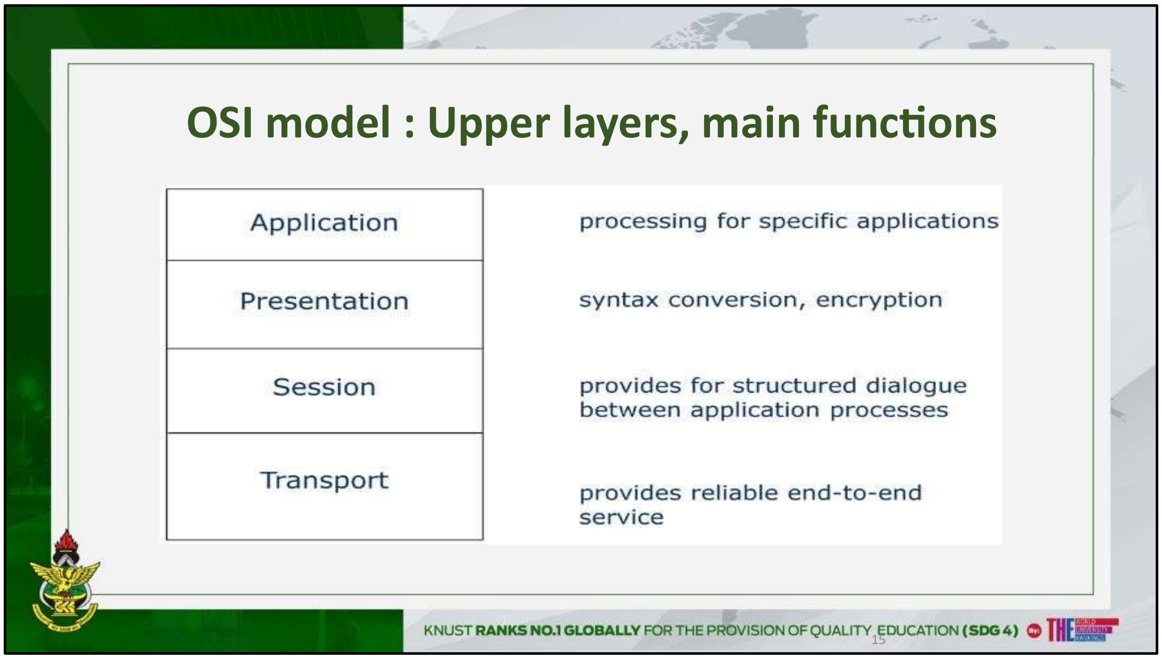



The Physical layer activates, maintains and deactivates the physical link for the reliable transfer of bits. It looks after bit synchronisation, and specifies cableconnecter types, and signal levels.

The Data-link layer is concerned with the reliable transfer of data, which requires a knowledge of the identity of bits. Its functions include information segmenting (framing) and frame synchronisation. It usually performs error checking and some flow control to take into account b/w of attached devices. The two basic protocol types used are: character-oriented, bitoriented.

The Network layer's most important functions concern providing the switching and routing necessary to establish, maintain and release network connections.

The lower layers of the OSI model are network-oriented or network dependent - they are very much concerned with the technology of the communications equipment and media used.




The upper layers (esp. upper three) are application-oriented. They usually reside in the hosts, terminals, etc. desiring to communicate. (Lower layers usually reside in the communications/network equipment).

The Transport Layer provides an end-to-end communications service of a quality demanded by the Session Layer. It may have to multiplex several network connections in order to do so, or it may multiplex several user connections on one network connection. It provides the Session Layer with an information transfer facility independent of the particular type of network.

The Session Layer provides a means for organising and structuring the dialogue between two application processes; it establishes synchronisation points in the dialogue. It also provides for address mapping into names.

The Presentation Layer provides independence for the Application Layer from different data representation (syntax). Presentation Layer entities establish a common syntax for information transfer and provide for conversion for the application processes. The Presentation Layer also provides for encryption.

The Application Layer is concerned with the semantics (or meaning) of the application; it carries out the information processing required for specific applications. This may be to allow users access (and associating them with the right application) or for file and message transfer. There are generally two types: CASEs, eg user login; and SASEs, file transfer, job transfer, database access. Each application layer entity may consist of CASE and SASE elements.

In IP networking the upper three layer functions are grouped into the application layer.