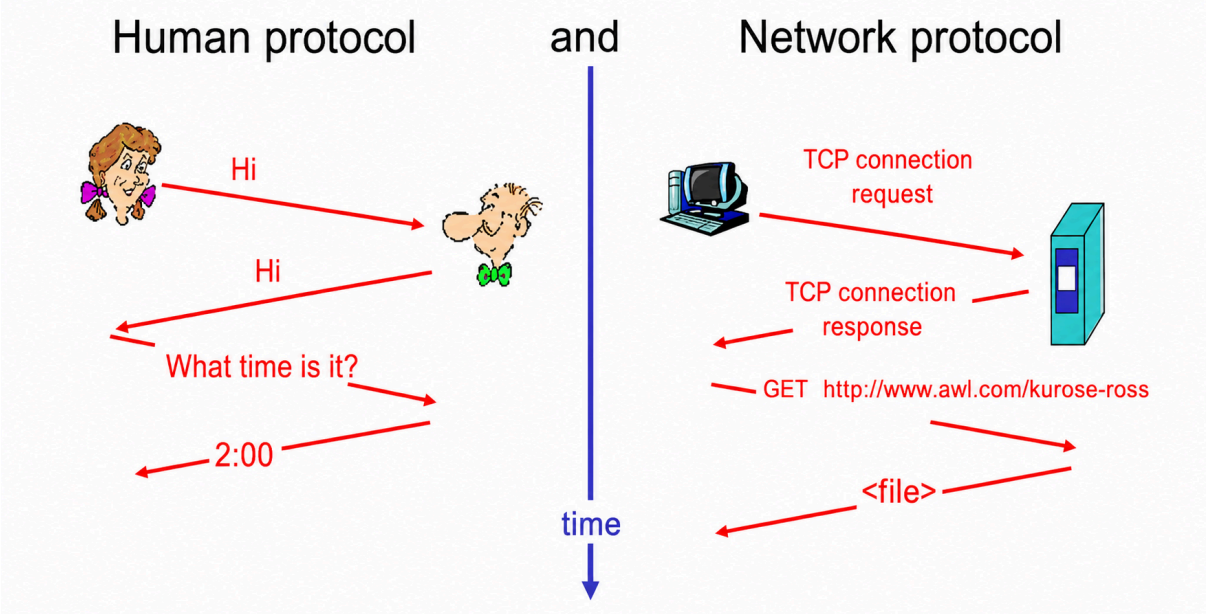
Network Protocols

A network protocol is a set of rules that determines how two or more devices must communicate with one another. These rules define the format of messages, the order in which they are exchanged, and the actions to take in the event of errors or missing responses.

A communication protocol can therefore be defined as a set of agreed rules for establishing effective communication. For example, two people with different native languages might agree to use English to communicate.

More specifically, a protocol defines the language formed by the messages being exchanged, which must be interpreted correctly.



Compliance with protocols ensures that two software applications running on different machines can communicate effectively, even when they have been developed independently. In other words, protocols ensure **interoperability**.

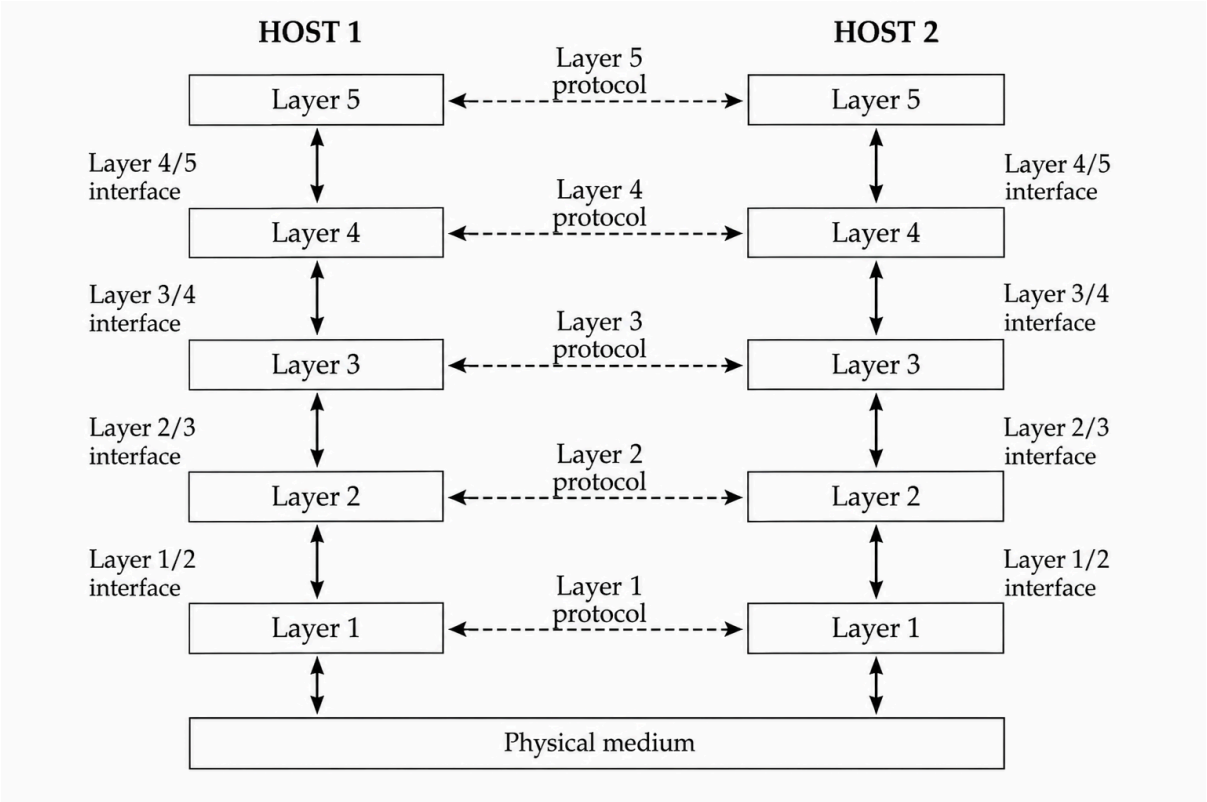
Interoperability is the ability of a computer system or product to cooperate and exchange information or services with other systems or products.

The purpose of interoperability is therefore to facilitate interaction between different systems.

The implementation of network protocols within a network architecture defines what is known as network software. This is implemented through both software and hardware components, including the operating system, network drivers, applications and, for certain tasks, the network interface card.

To reduce complexity, most networks are organised into a protocol stack, made up of layers built on top of one another.

Each layer provides services to the layer above it and hides the technical details of how those services are implemented.



When layer *n* on one computer communicates with layer *n* on another computer, the rules and conventions used for this communication are collectively known as the **protocols of that layer**.

The entities that form corresponding layers on different computers are called **peers**.

In other words, peers communicate with one another using a protocol.

When layer *n* on one computer needs to communicate with layer *n* on another computer, the sender passes the information down to layer *n–1*. This process continues until the data reaches the lowest layer, usually the physical layer, where the information is actually transmitted.

On the receiving computer, the information then moves progressively upwards through the layers until it reaches layer *n*.

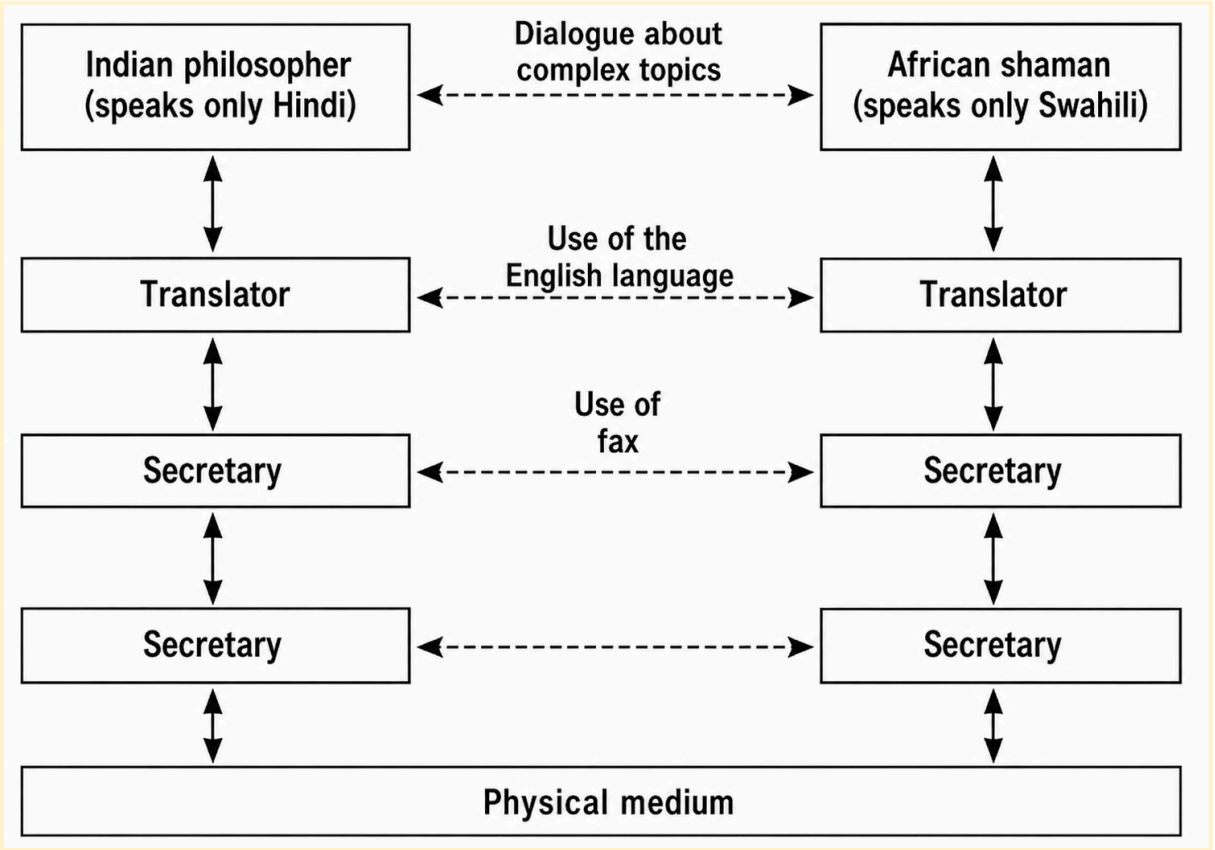
The complete set of layers and protocols is called a **network architecture**.

Example

To understand the basic mechanisms of a network architecture, we can use a human analogy in which an Indian philosopher wants to communicate with an African shaman.

The Indian philosopher does not speak Swahili, the language spoken by the shaman. The philosopher therefore communicates with a translator who knows English and translates the message into English. The message is then passed to a secretary, who sends it by fax.

It is important to note that communication would not be possible without an agreement between the parties—English as their common language. This agreement represents the use of protocols.



The translator could be a machine or a human operator, just as a function may be implemented through hardware or software. This distinction does not affect the interface: its input and output always involve translating the message into or from English according to the protocol rules.

The Internet is structured into the following layers, from highest to lowest:

- **Application layer**
- **Transport layer**
- **Network layer**
- **Link layer**
- **Physical layer**

When data moves from one layer to the layer below it, it undergoes a process called **encapsulation**.

This means that each layer takes the data received from the layer above and adds its own **header**, an initial section containing control information.

The content received from the upper layer becomes the **payload** of the new data unit.

In this way, each layer adds the information required to perform its particular task.

The resulting data unit is then passed to the layer below for transmission.