Computer Networking

Network Software: Protocol Hierarchies, Design issues for the layers

Network Software

- The first computer networks were designed with the hardware as the main concern and the software as an afterthought.
- This strategy no longer works. Network software is now highly structured.

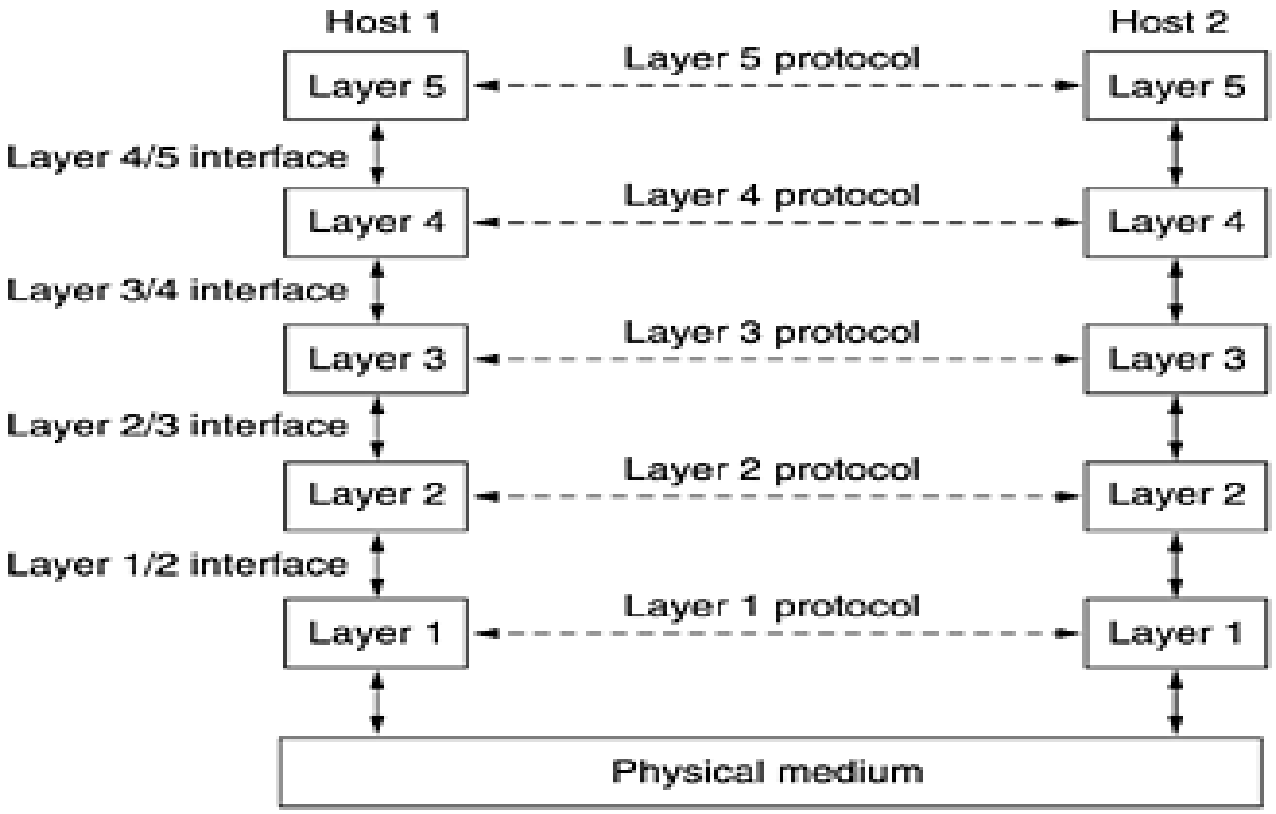
Protocol Hierarchies

- A protocol is a standard set of rules that allow electronic devices to communicate with each other.
- To reduce the design complexity, most networks are organized as a stack of layers or levels, each one built upon the one below it.
- The number of layers, the name of each layer, the contents of each layer, and the function of each layer differ from network to network.

Protocol Hierarchies

- The purpose of each layer is to offer certain services to the higher layers, shielding those layers from the details of how the offered services are actually implemented.
- Layer n on one machine carries on a conversation with layer n on another machine. The rules and conventions used in this conversation are collectively known as the layer n protocol.
- Basically, a protocol is an agreement between the communicating parties on how communication is to proceed. Violating the protocol will make communication more difficult

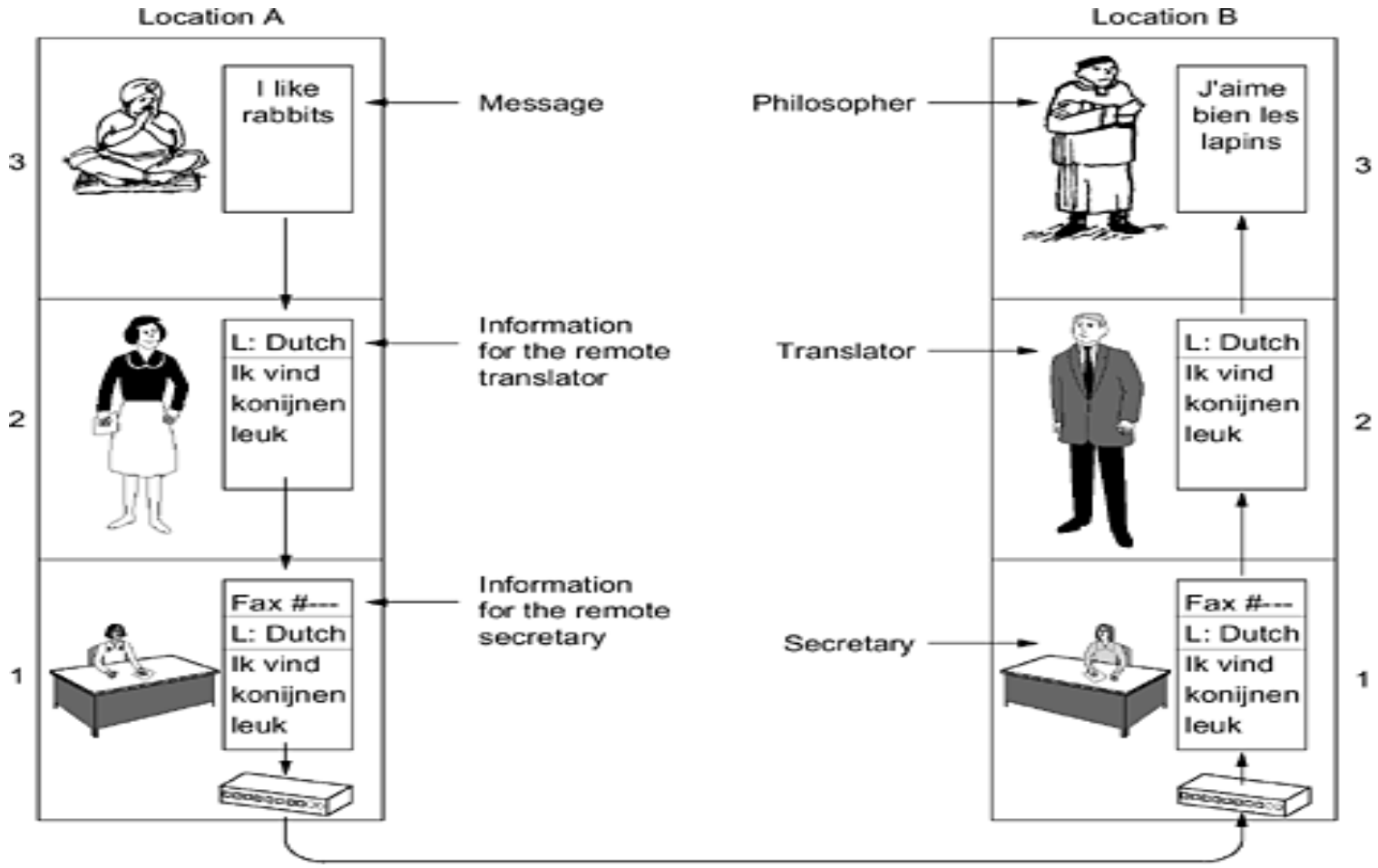
Figure: Layers, protocols, and interfaces.



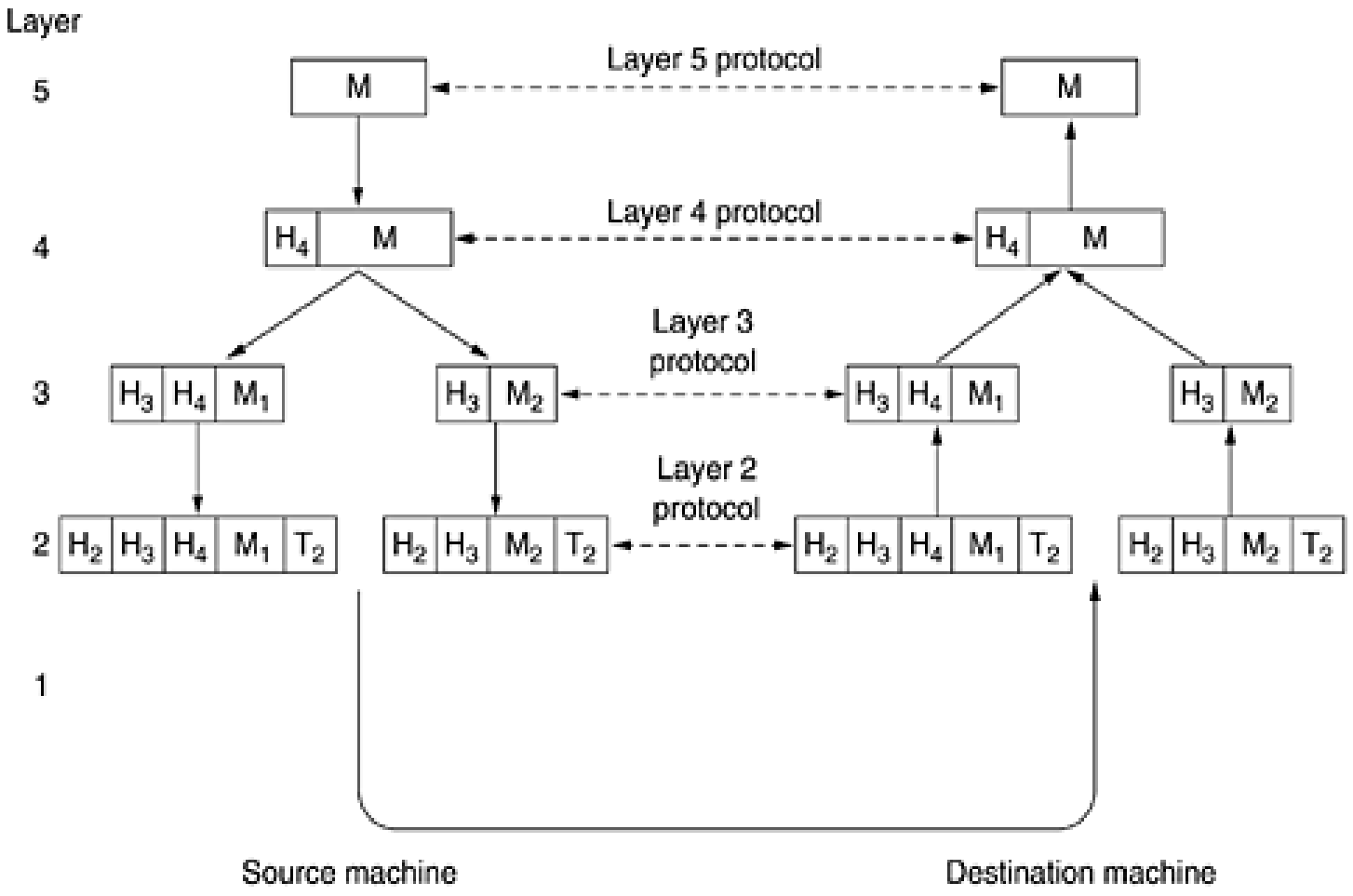
- A five-layer network is illustrated in figure. The entities comprising the corresponding layers on different machines are called peers.
- The peers may be processes, hardware devices, or even human beings. In other words, it is the peers that communicate by using the protocol.
- In reality, no data are directly transferred from layer n on one machine to layer n on another machine. Instead, each layer passes data and control information to the layer immediately below it, until the lowest layer is reached.
- Below layer 1 is the physical medium through which actual communication occurs.

- Between each pair of adjacent layers is an interface. The interface defines which primitive operations and services the lower layer makes available to the upper one.
- **A set of layers and protocols is called a network architecture.** The specification of an architecture must contain enough information to allow an implementer to write the program or build the hardware for each layer so that it will correctly obey the appropriate protocol.
- A list of protocols used by a certain system, one protocol per layer, is called a **protocol stack.**

- **Idea of multilayer communication: The philosopher-translator-secretary architecture**



- Example information flow supporting virtual communication in layer 5.



Design Issues for the Layers

- Every layer needs a mechanism for identifying senders and receivers.
- Another set of design decisions concerns the rules for data transfer.
- Error control is an important issue because physical communication circuits are not perfect.
- Not all communication channels preserve the order of messages sent on them.
- An issue that occurs at every level is how to keep a fast sender from swamping a slow receiver with data.
- Another problem that must be solved at several levels is the inability of all processes to accept arbitrarily long messages.
- When there are multiple paths between source and destination, a route must be chosen. Sometimes this decision must be split over two or more layers.