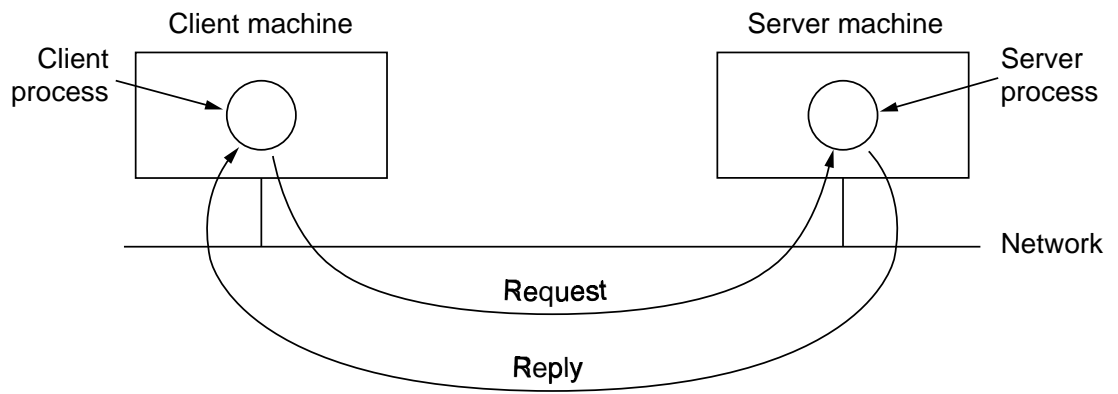


# 1

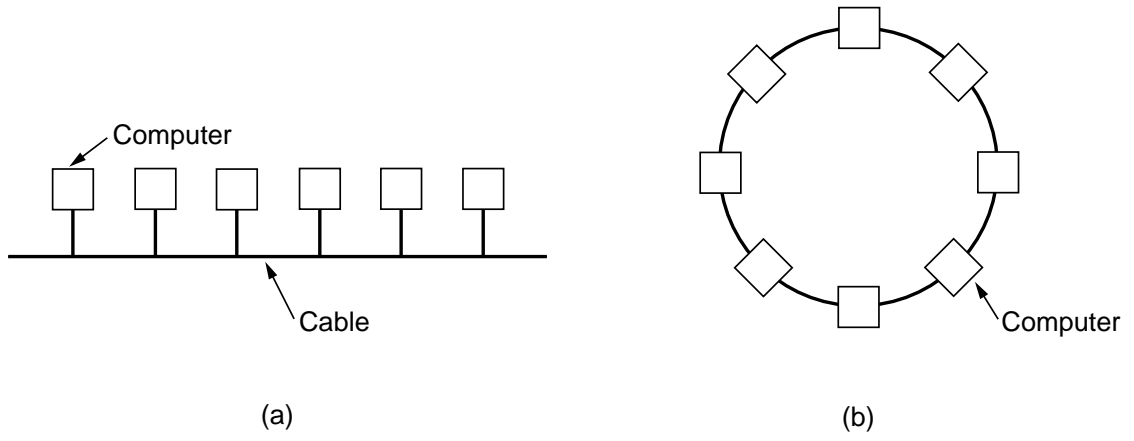
## INTRODUCTION



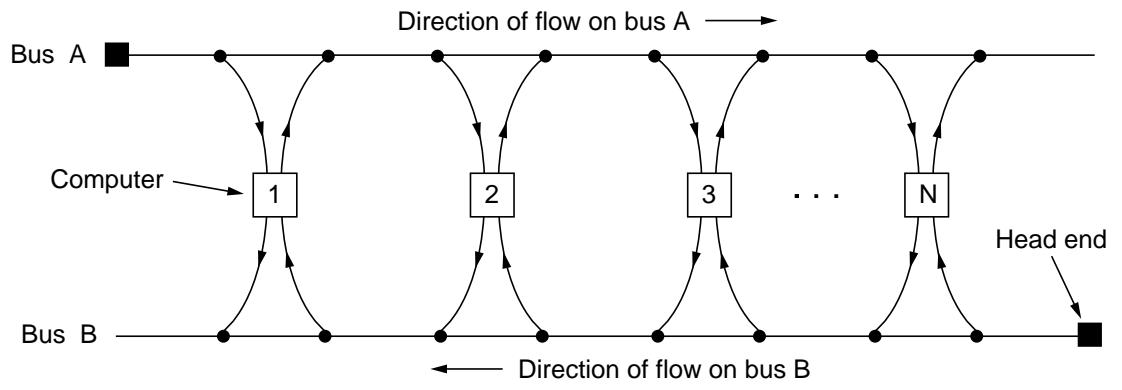
**Fig. 1-1.** The client-server model.

Interprocessor distance	Processors located in same	Example
0.1 m	Circuit board	Data flow machine
1 m	System	Multicomputer
10 m	Room	} Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	} Wide area network
1,000 km	Continent	
10,000 km	Planet	The Internet

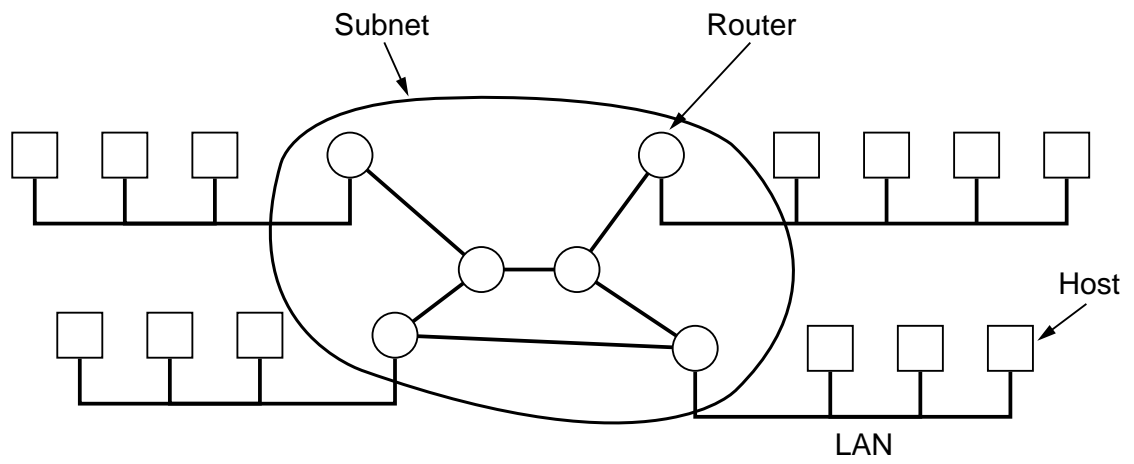
**Fig. 1-2.** Classification of interconnected processors by scale.



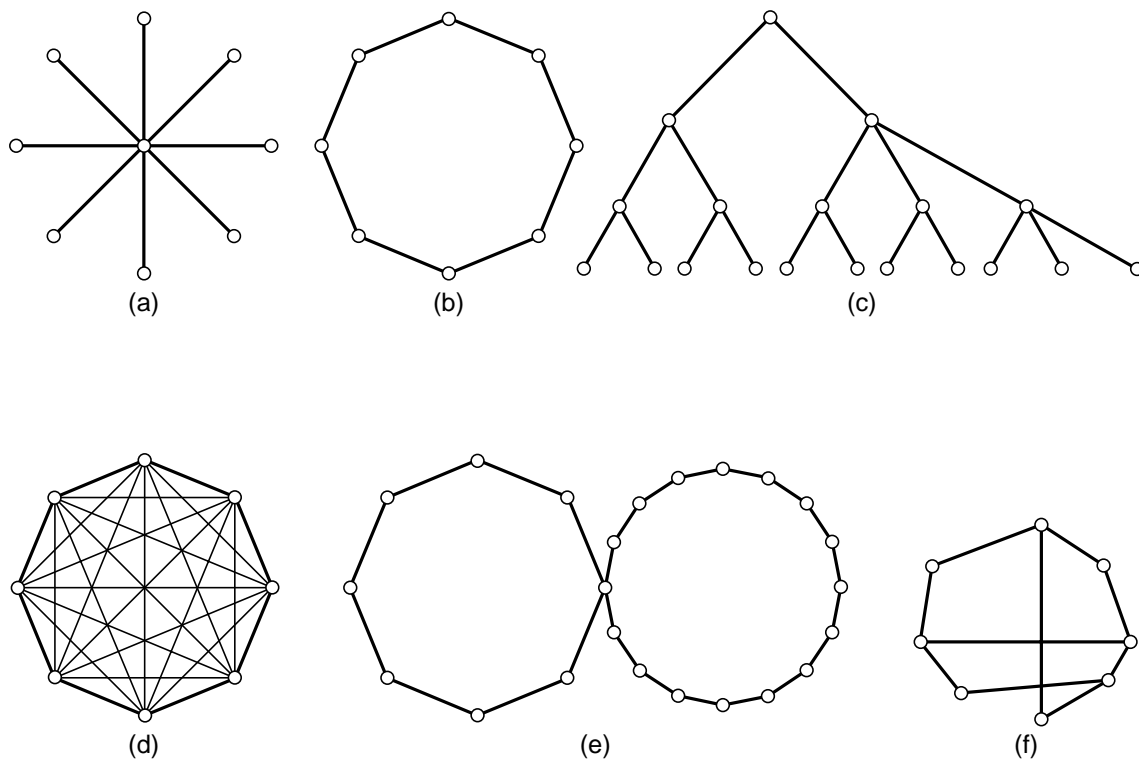
**Fig. 1-3.** Two broadcast networks. (a) Bus. (b) Ring.



**Fig. 1-4.** Architecture of the DQDB metropolitan area network.



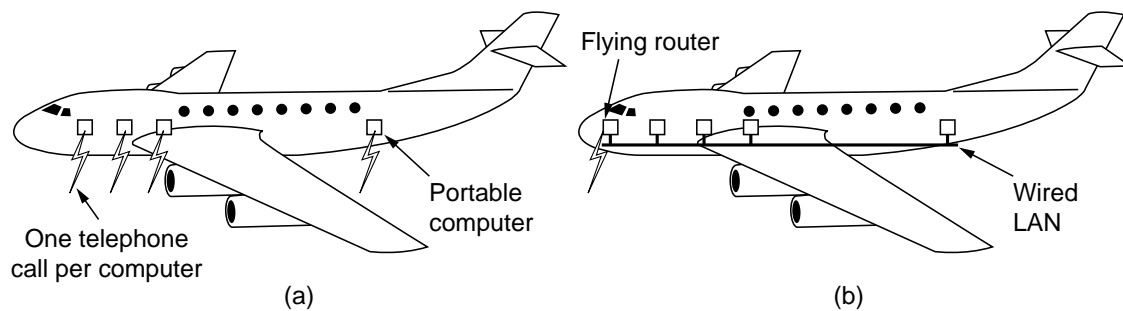
**Fig. 1-5.** Relation between hosts and the subnet.



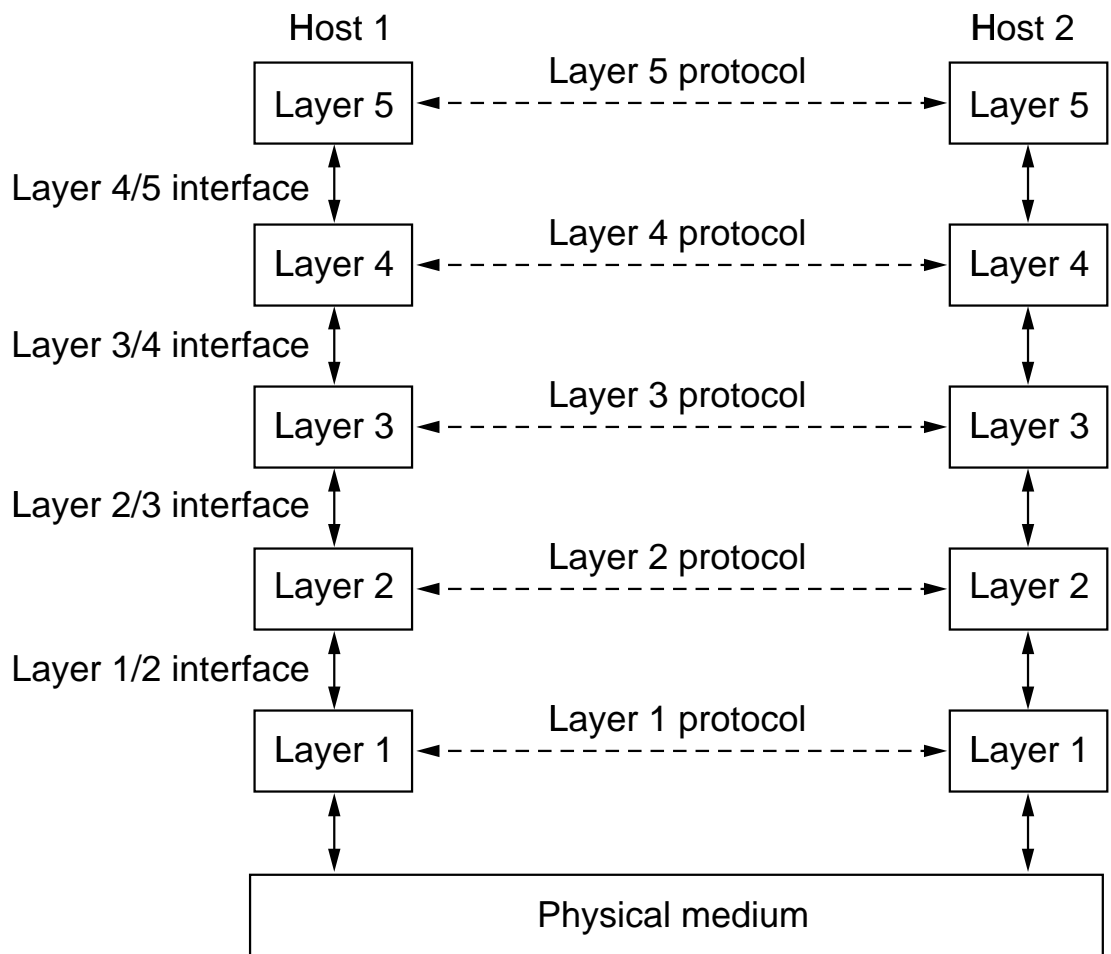
**Fig. 1-6.** Some possible topologies for a point-to-point subnet.  
 (a) Star. (b) Ring. (c) Tree. (d) Complete. (e) Intersecting rings. (f) Irregular.

<b>Wireless</b>	<b>Mobile</b>	<b>Applications</b>
No	No	Stationary workstations in offices
No	Yes	Using a portable in a hotel; train maintenance
Yes	No	LANs in older, unwired buildings
Yes	Yes	Portable office; PDA for store inventory

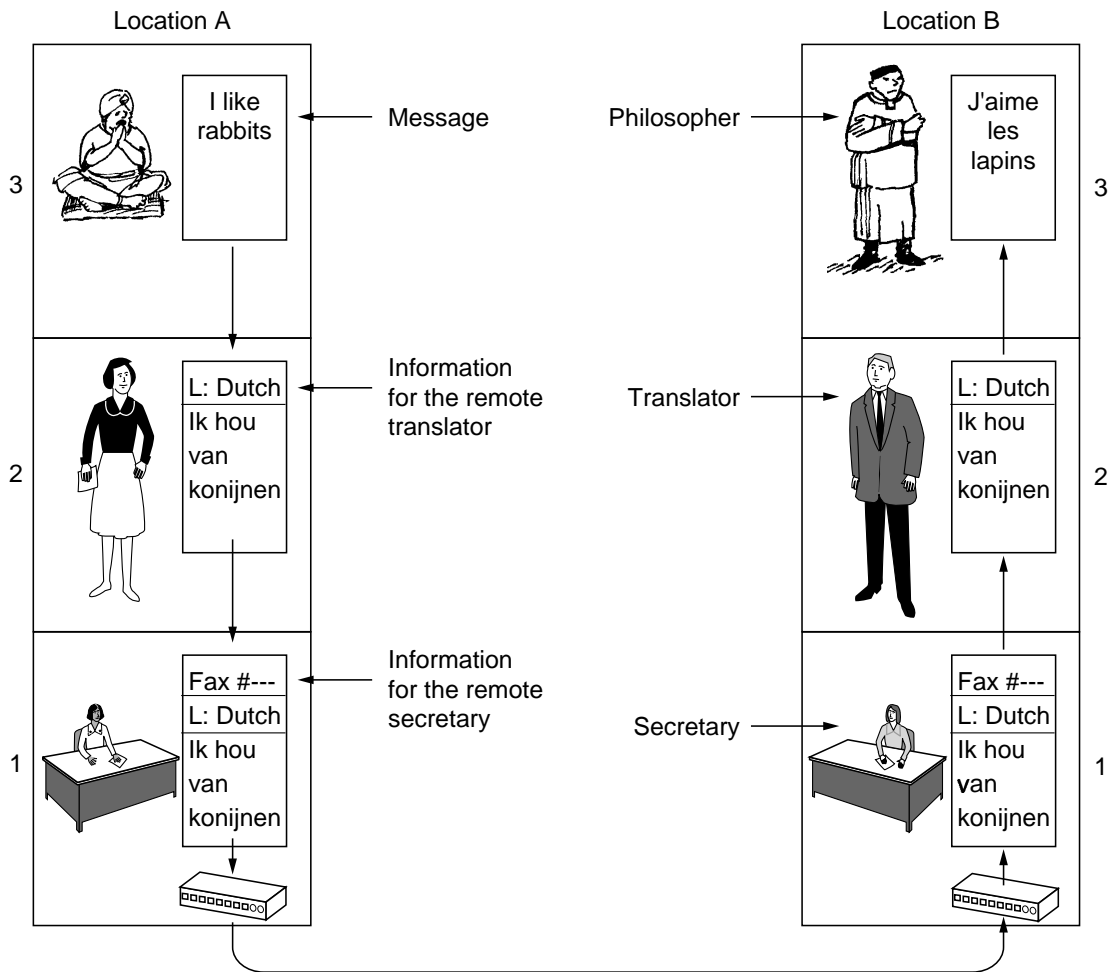
**Fig. 1-7.** Combinations of wireless networks and mobile computing.



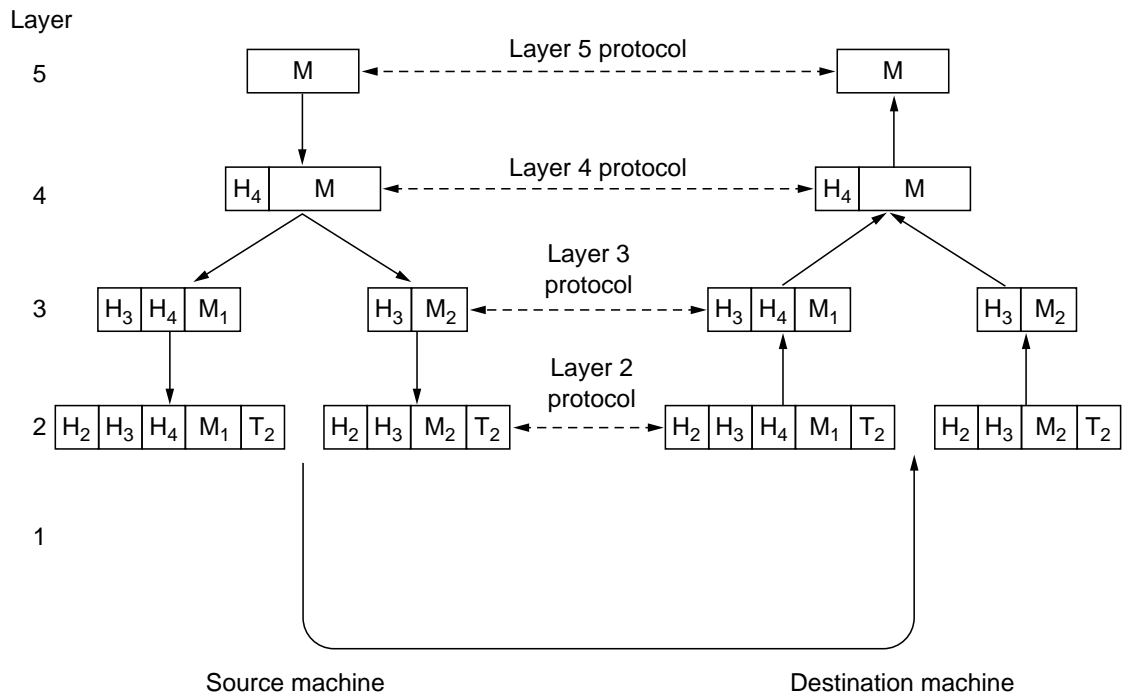
**Fig. 1-8.** (a) Individual mobile computers. (b) A flying LAN.



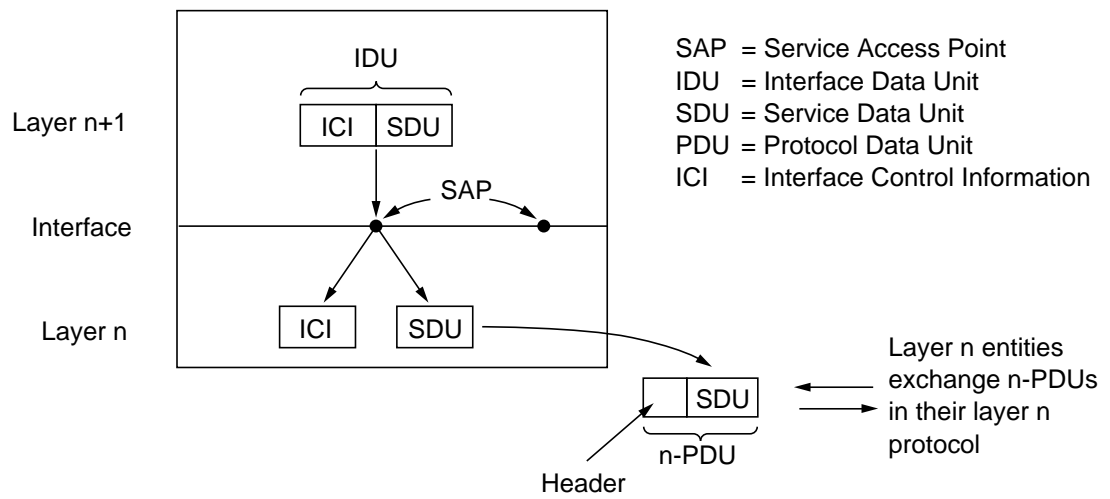
**Fig. 1-9.** Layers, protocols, and interfaces.



**Fig. 1-10.** The philosopher-translator-secretary architecture.



**Fig. 1-11.** Example information flow supporting virtual communication in layer 5.



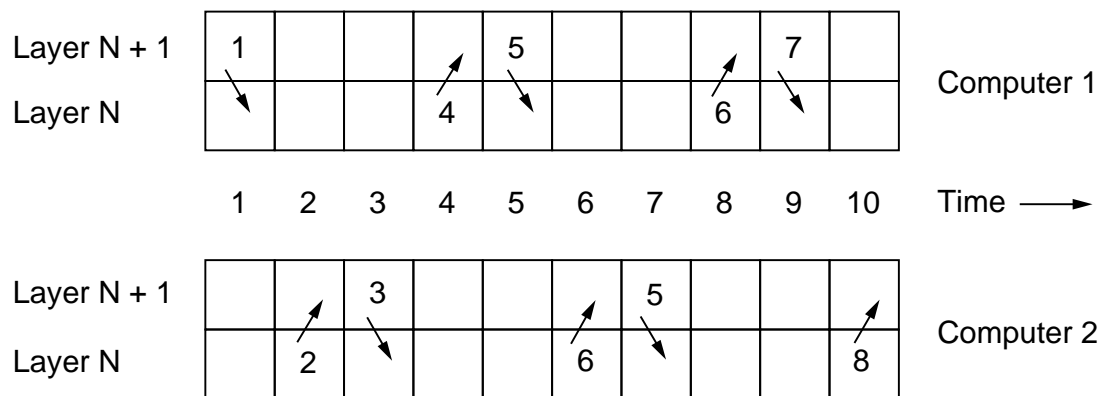
**Fig. 1-12.** Relation between layers at an interface.

	<b>Service</b>	<b>Example</b>
Connection-oriented	Reliable message stream	Sequence of pages
	Reliable byte stream	Remote login
	Unreliable connection	Digitized voice
Connection-less	Unreliable datagram	Electronic junk mail
	Acknowledged datagram	Registered mail
	Request-reply	Database query

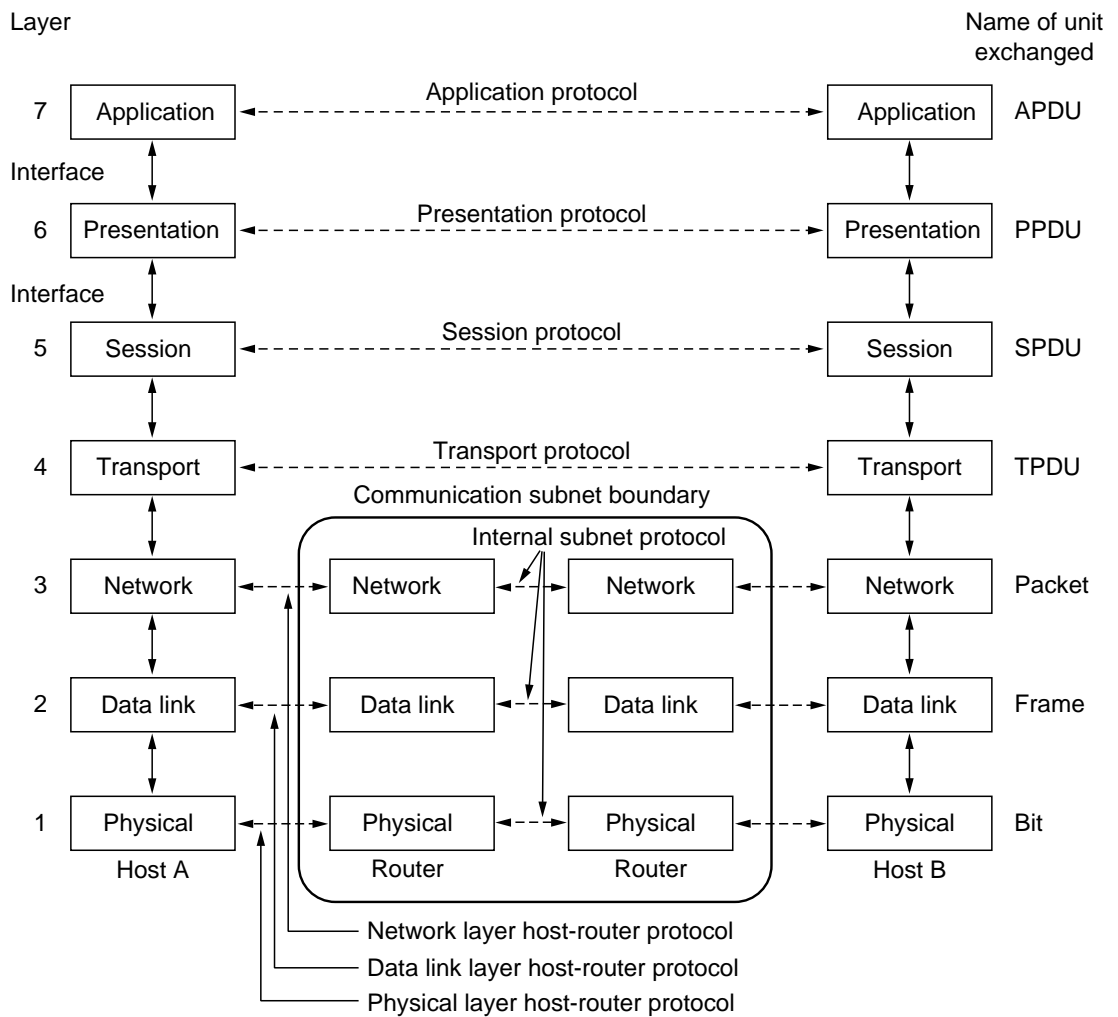
**Fig. 1-13.** Six different types of service.

<b>Primitive</b>	<b>Meaning</b>
Request	An entity wants the service to do some work
Indication	An entity is to be informed about an event
Response	An entity wants to respond to an event
Confirm	The response to an earlier request has come back

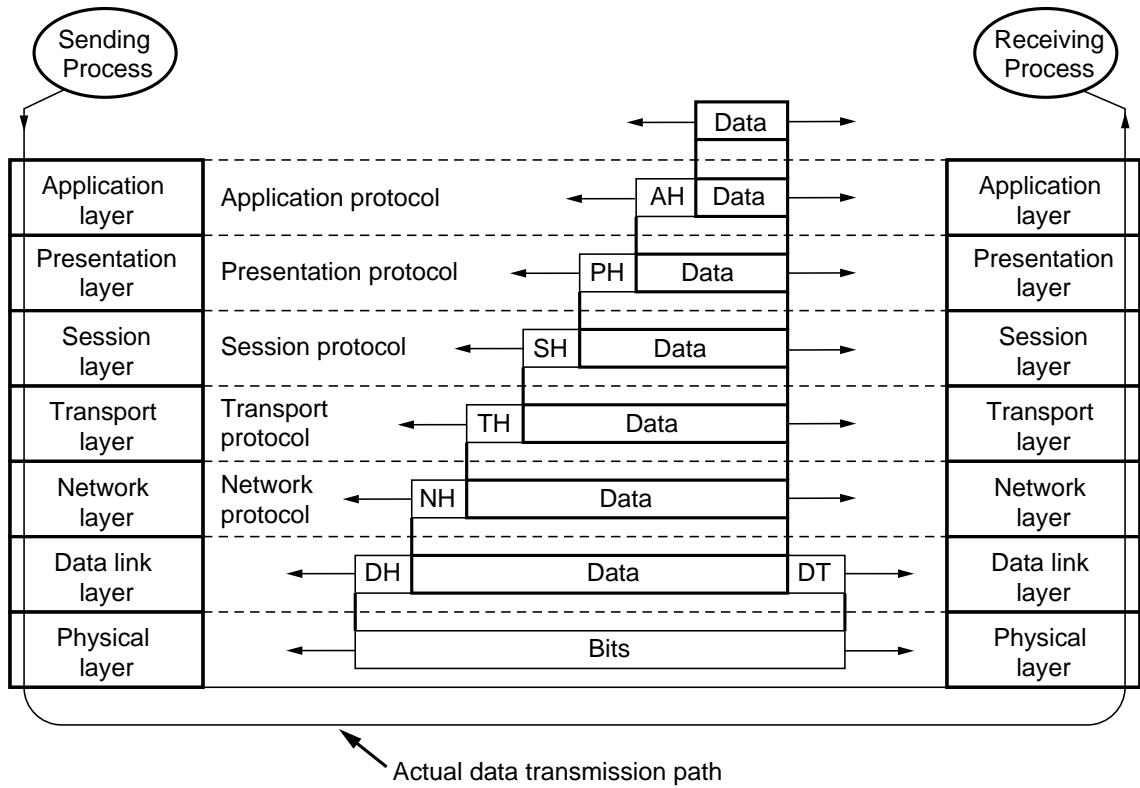
**Fig. 1-14.** Four classes of service primitives.



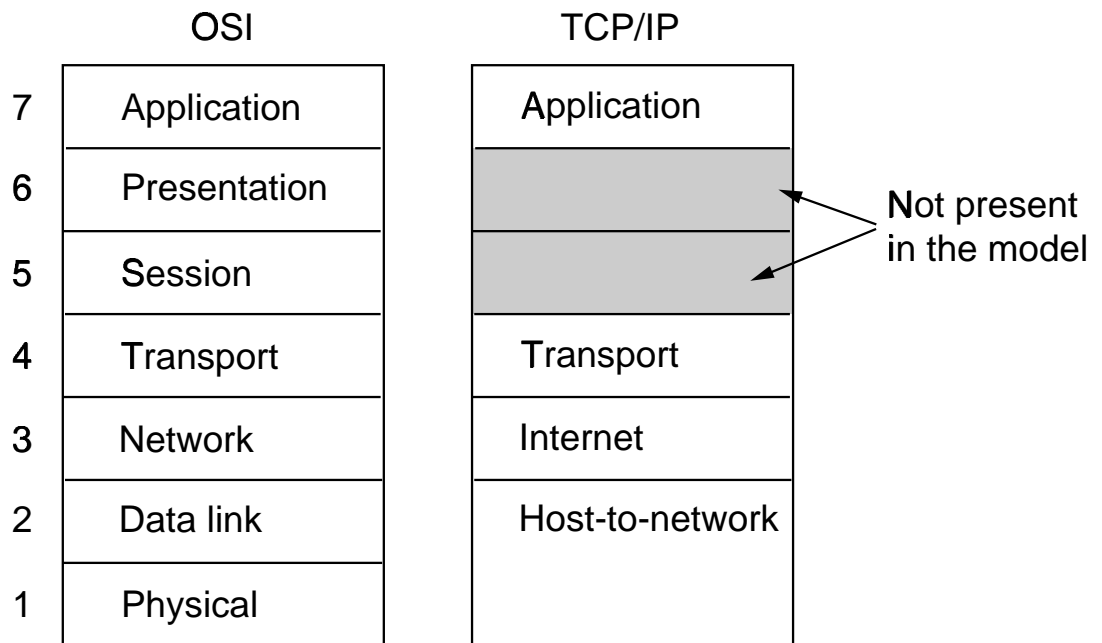
**Fig. 1-15.** How a computer would invite its Aunt Millie to tea. The numbers near the tail end of each arrow refer to the eight service primitives discussed in this section.



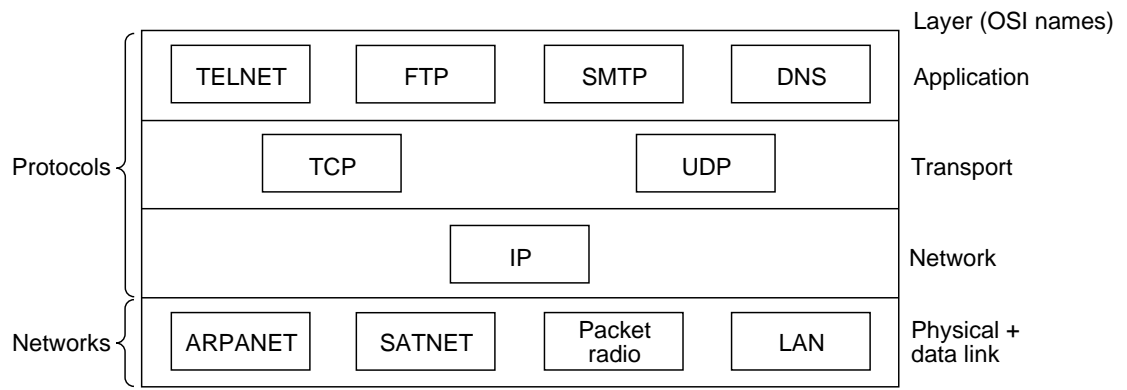
**Fig. 1-16.** The OSI reference model.



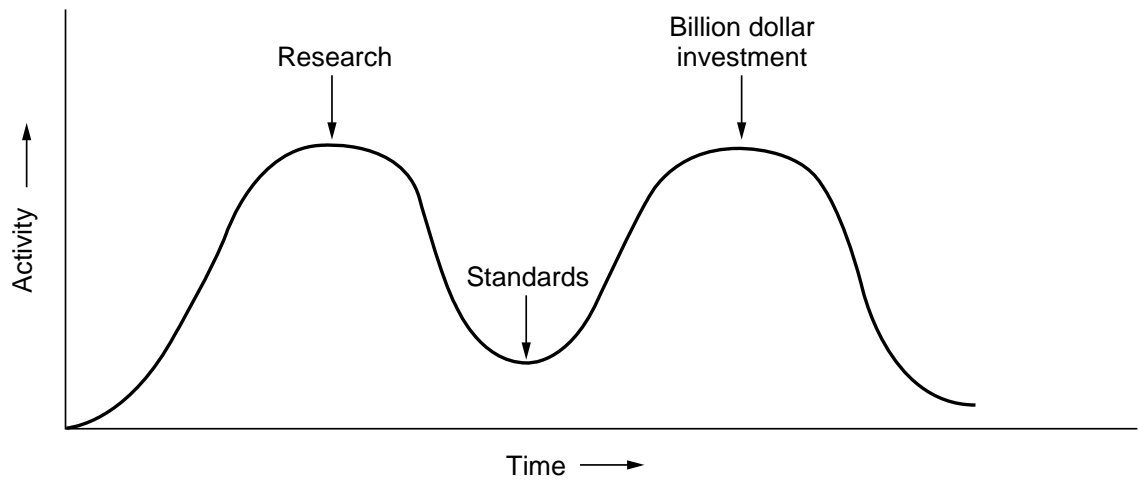
**Fig. 1-17.** An example of how the OSI model is used. Some of the headers may be null. (Source: H.C. Folts. Used with permission.)



**Fig. 1-18.** The TCP/IP reference model.



**Fig. 1-19.** Protocols and networks in the TCP/IP model initially.



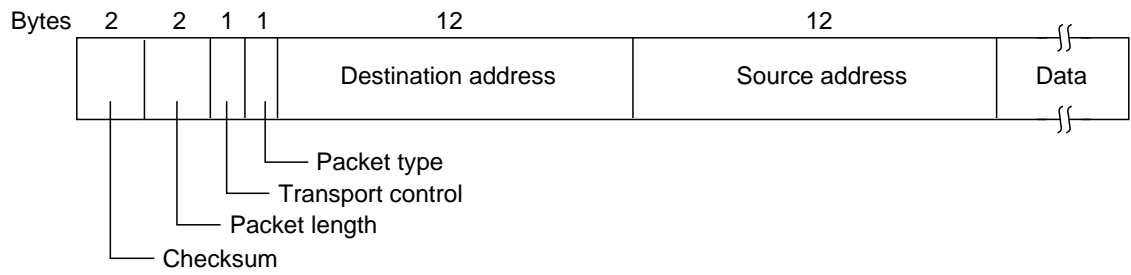
**Fig. 1-20.** The apocalypse of the two elephants.

5	Application layer
4	Transport layer
3	Network layer
2	Data Link layer
1	Physical layer

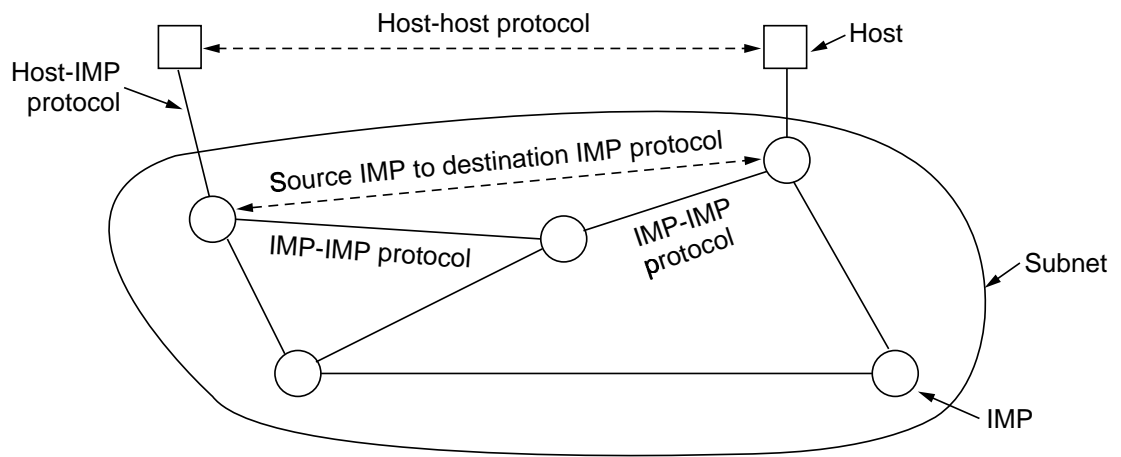
**Fig. 1-21.** The hybrid reference model to be used in this book.

Layer			
Application	SAP	File server	...
Transport	NCP		SPX
Network	IPX		
Data link	Ethernet	Token ring	ARCnet
Physical	Ethernet	Token ring	ARCnet

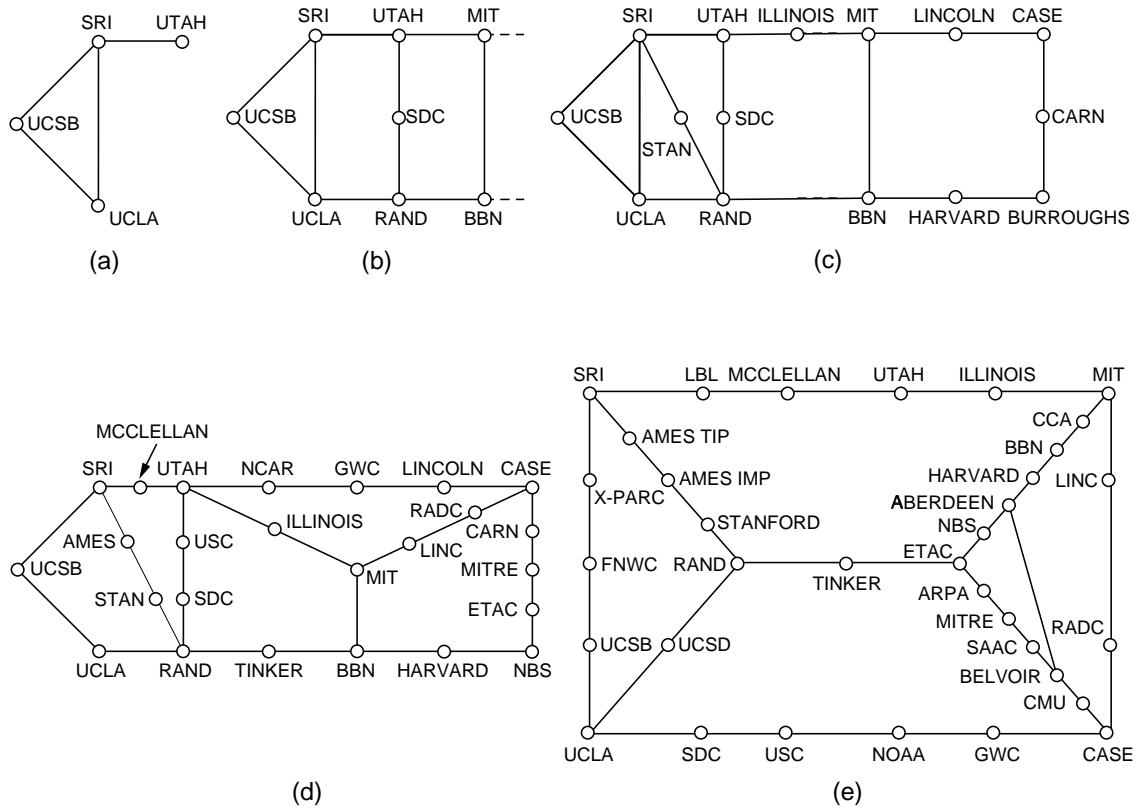
**Fig. 1-22.** The Novell NetWare reference model.



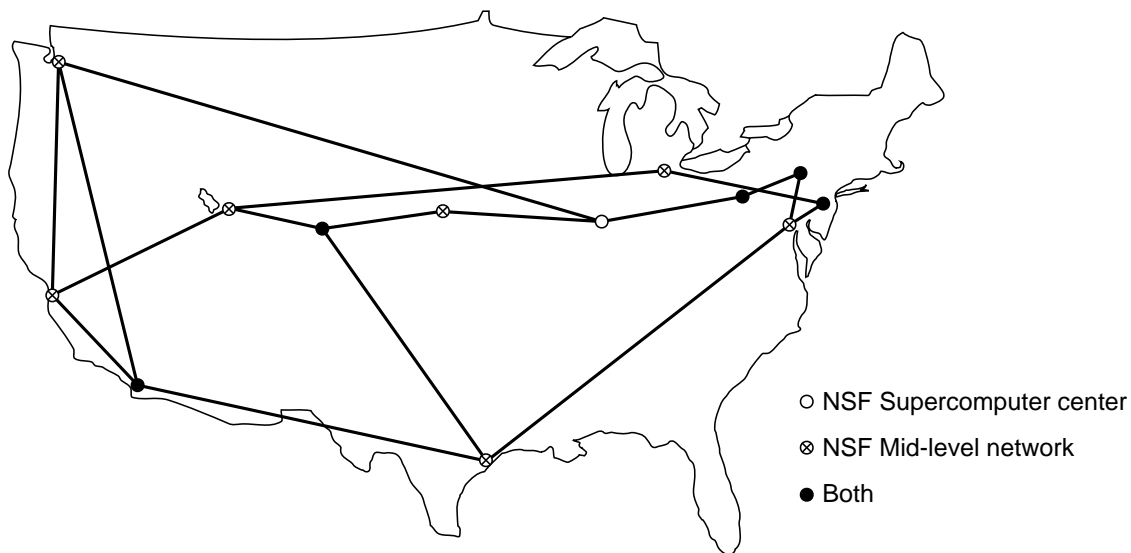
**Fig. 1-23.** A Novell NetWare IPX packet.



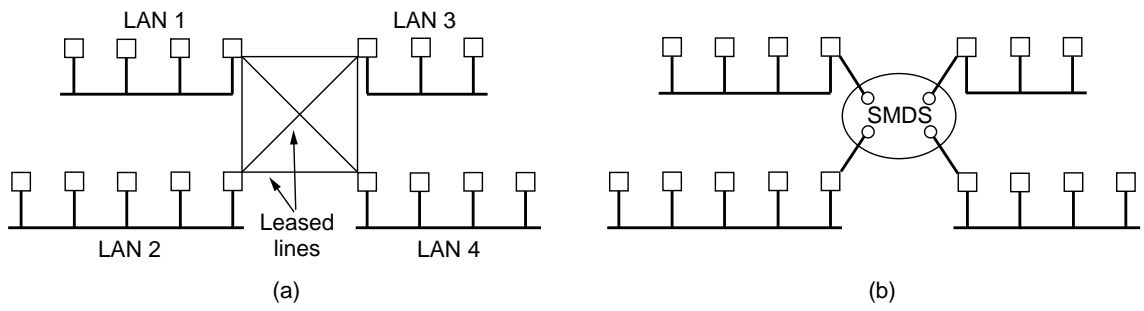
**Fig. 1-24.** The original ARPANET design.



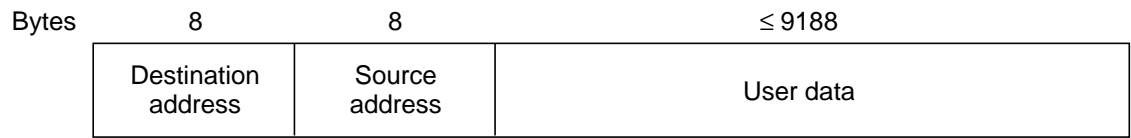
**Fig. 1-25.** Growth of the ARPANET. (a) Dec. 1969. (b) July 1970. (c) March 1971. (d) April 1972. (e) Sept. 1972.



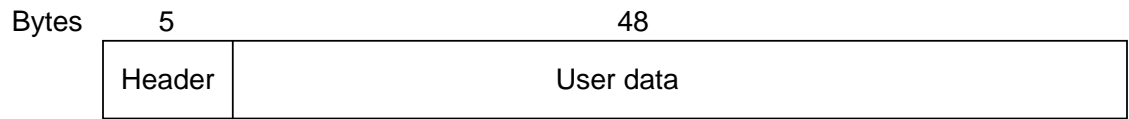
**Fig. 1-26.** The NSFNET backbone in 1988.



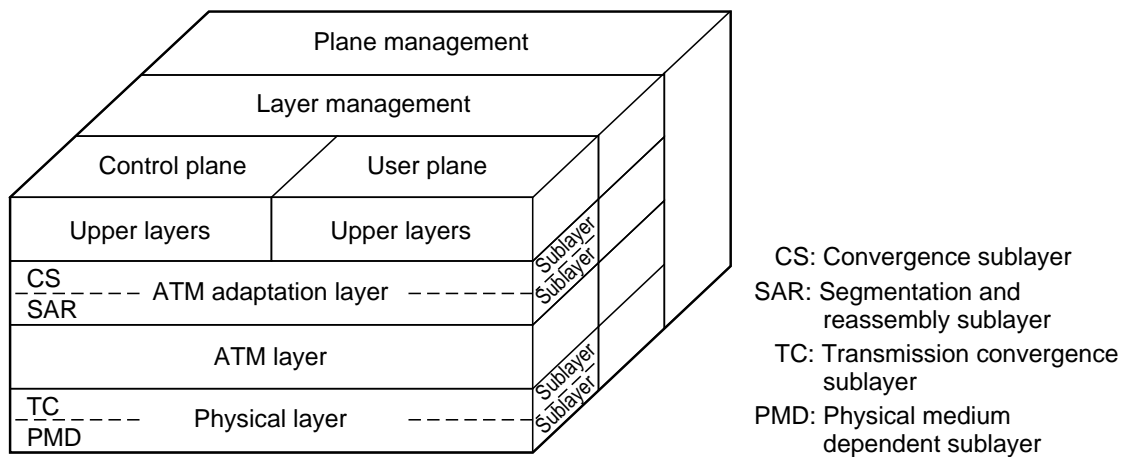
**Fig. 1-27.** (a) Four LANs interconnected with leased lines. (b) Interconnection using SMDS.



**Fig. 1-28.** The SMDS packet format.



**Fig. 1-29.** An ATM cell.



**Fig. 1-30.** The B-ISDN ATM reference model.

OSI layer	ATM layer	ATM sublayer	Functionality
3/4	AAL	CS	Providing the standard interface (convergence)
		SAR	Segmentation and reassembly
2/3	ATM		Flow control Cell header generation/extraction Virtual circuit/path management Cell multiplexing/demultiplexing
2	Physical	TC	Cell rate decoupling Header checksum generation and verification Cell generation Packing/unpacking cells from the enclosing envelope Frame generation
1		PMD	Bit timing Physical network access

**Fig. 1-31.** The ATM layers and sublayers, and their functions.

<b>Issue</b>	<b>DQDB</b>	<b>SMDS</b>	<b>X.25</b>	<b>Frame Relay</b>	<b>ATM AAL</b>
Connection oriented	Yes	No	Yes	Yes	Yes
Normal speed (Mbps)	45	45	.064	1.5	155
Switched	No	Yes	Yes	No	Yes
Fixed-size payload	Yes	No	No	No	No
Max payload	44	9188	128	1600	Variable
Permanent VCs	No	No	Yes	Yes	Yes
Multicasting	No	Yes	No	No	Yes

**Fig. 1-32.** Different networking services.