

# 1

## INTRODUCTION

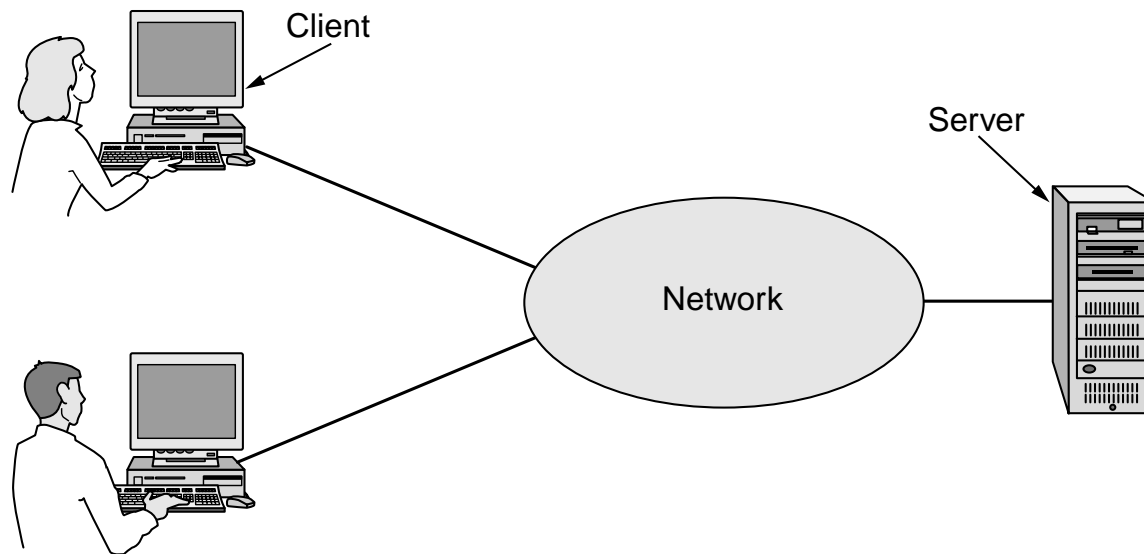


Fig. 1-1. A network with two clients and one server.

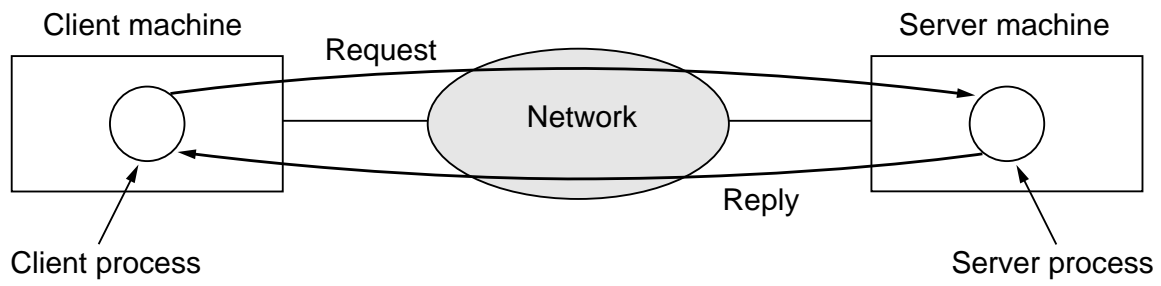


Fig. 1-2. The client-server model involves requests and replies.

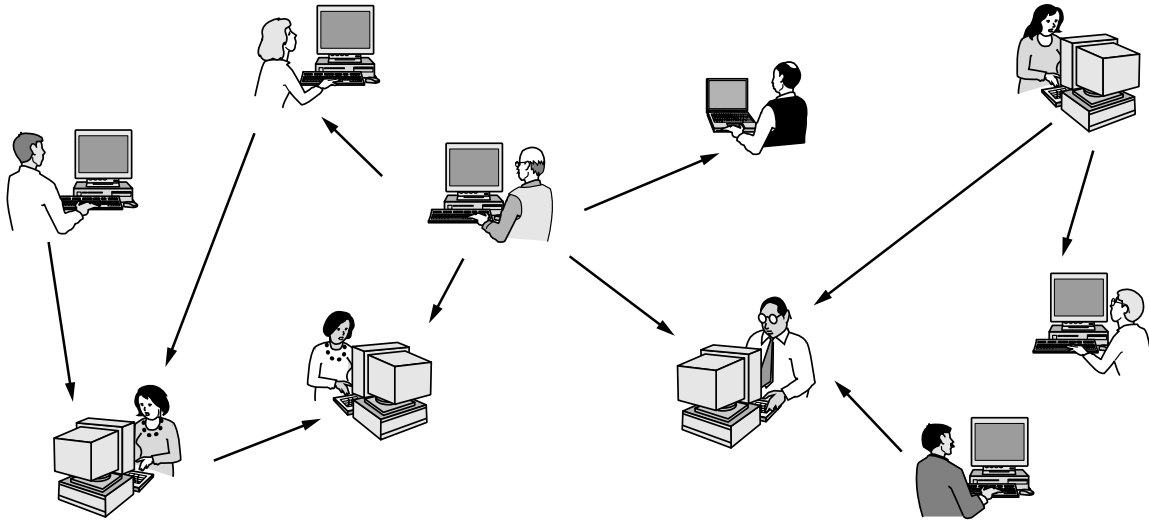


Fig. 1-3. In a peer-to-peer system there are no fixed clients and servers.

<b>Tag</b>	<b>Full name</b>	<b>Example</b>
B2C	Business-to-consumer	Ordering books on-line
B2B	Business-to-business	Car manufacturer ordering tires from supplier
G2C	Government-to-consumer	Government distributing tax forms electronically
C2C	Consumer-to-consumer	Auctioning second-hand products on line
P2P	Peer-to-peer	File sharing

Fig. 1-4. Some forms of e-commerce.

<b>Wireless</b>	<b>Mobile</b>	<b>Applications</b>
No	No	Desktop computers in offices
No	Yes	A notebook computer used in a hotel room
Yes	No	Networks in older, unwired buildings
Yes	Yes	Portable office; PDA for store inventory

Fig. 1-5. Combinations of wireless networks and mobile computing.

Interprocessor distance	Processors located in same	Example
1 m	Square meter	Personal area network
10 m	Room	Local area network
100 m	Building	
1 km	Campus	
10 km	City	Metropolitan area network
100 km	Country	Wide area network
1000 km	Continent	
10,000 km	Planet	The Internet

Fig. 1-6. Classification of interconnected processors by scale.

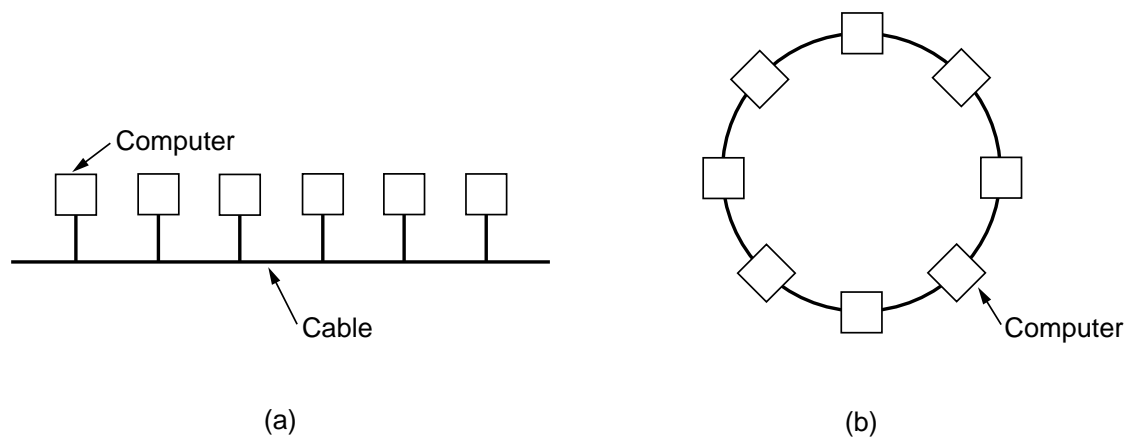


Fig. 1-7. Two broadcast networks. (a) Bus. (b) Ring.



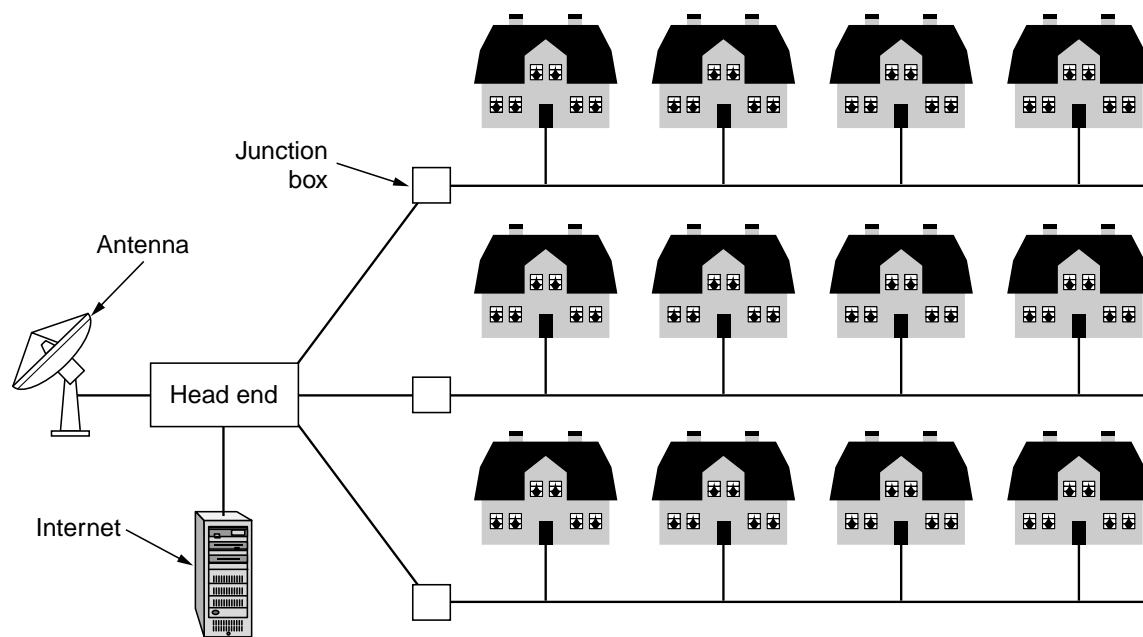


Fig. 1-8. A metropolitan area network based on cable TV.

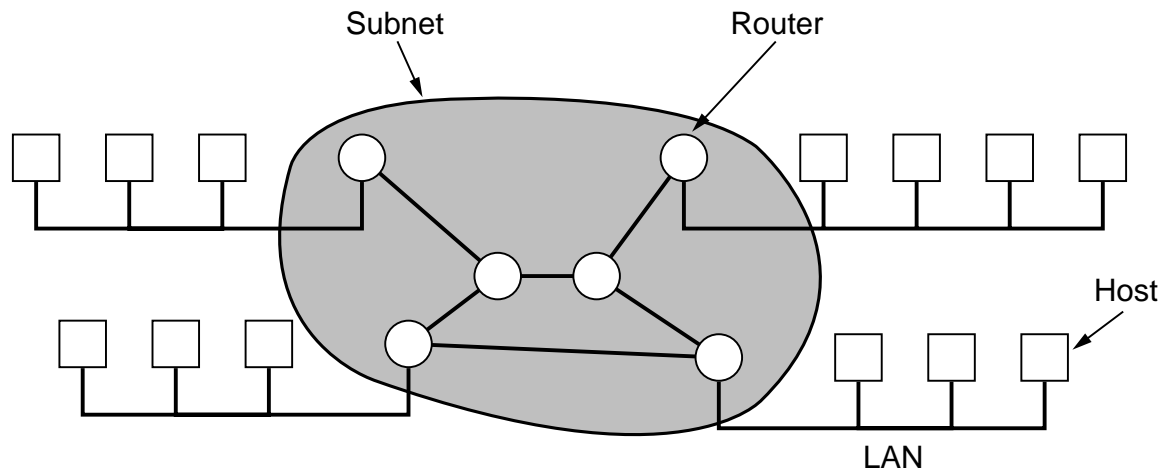


Fig. 1-9. Relation between hosts on LANs and the subnet.

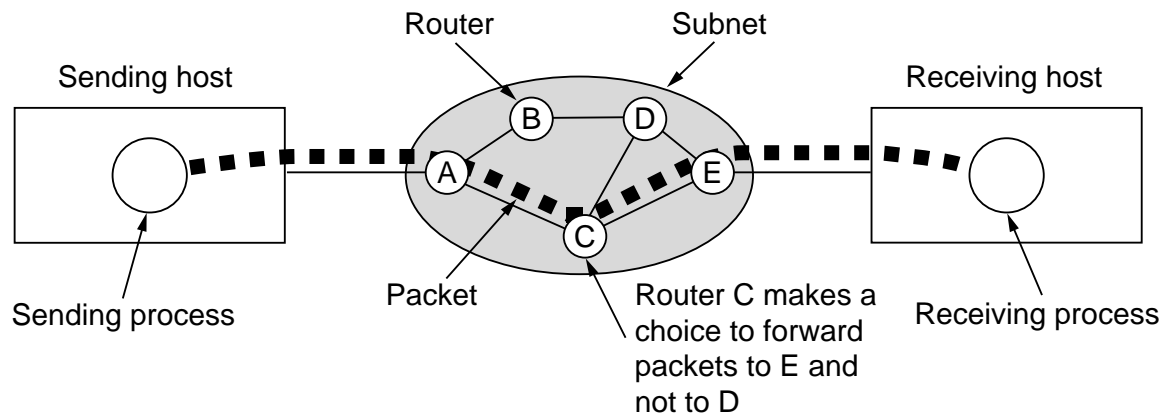


Fig. 1-10. A stream of packets from sender to receiver.

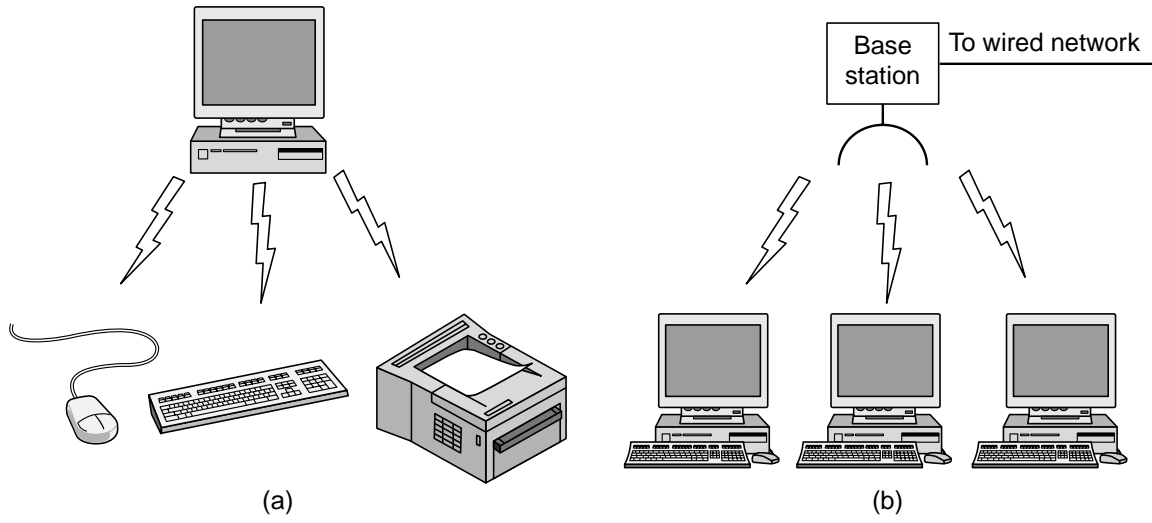


Fig. 1-11. (a) Bluetooth configuration. (b) Wireless LAN.

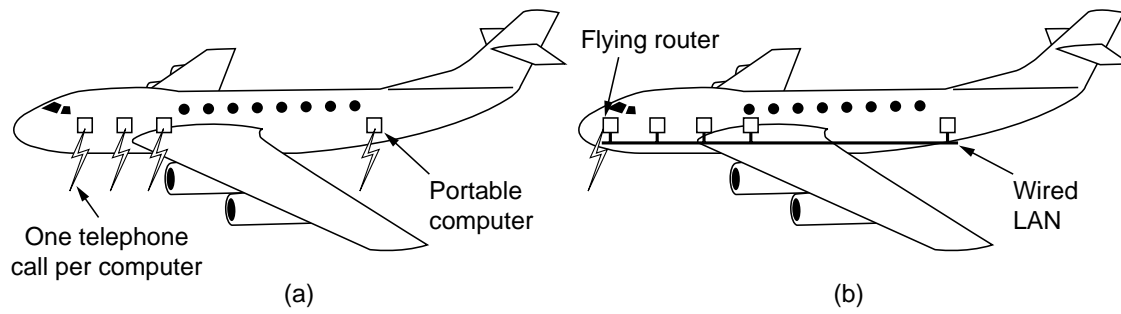


Fig. 1-12. (a) Individual mobile computers. (b) A flying LAN.

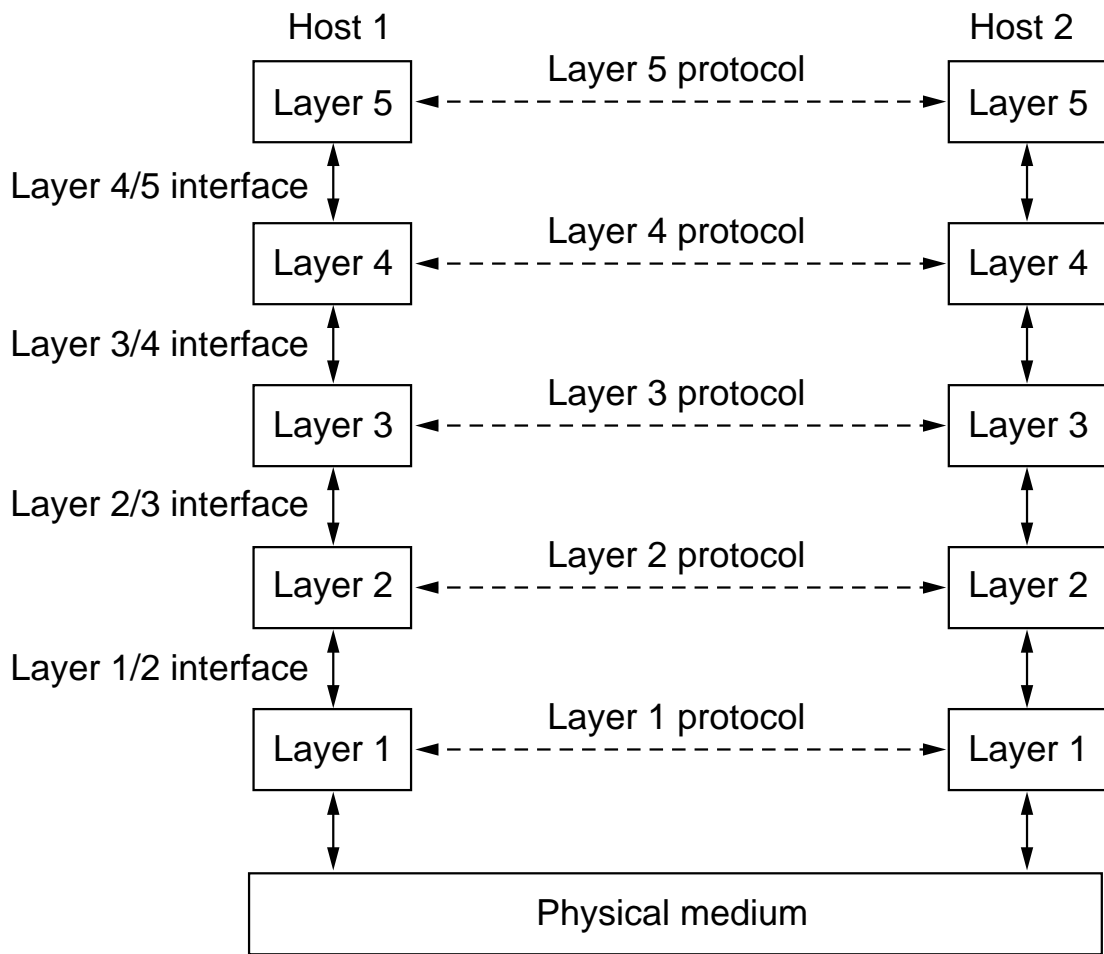


Fig. 1-13. Layers, protocols, and interfaces.

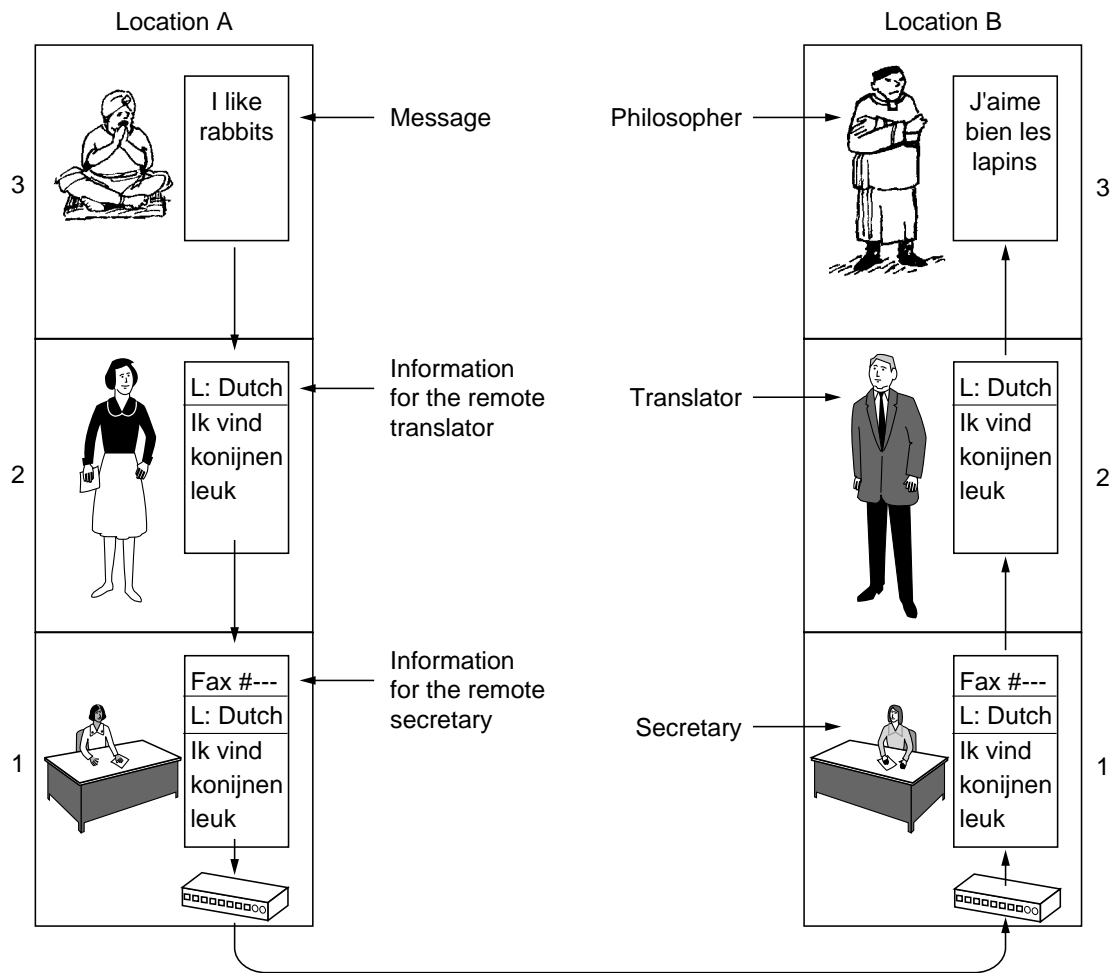


Fig. 1-14. The philosopher-translator-secretary architecture.

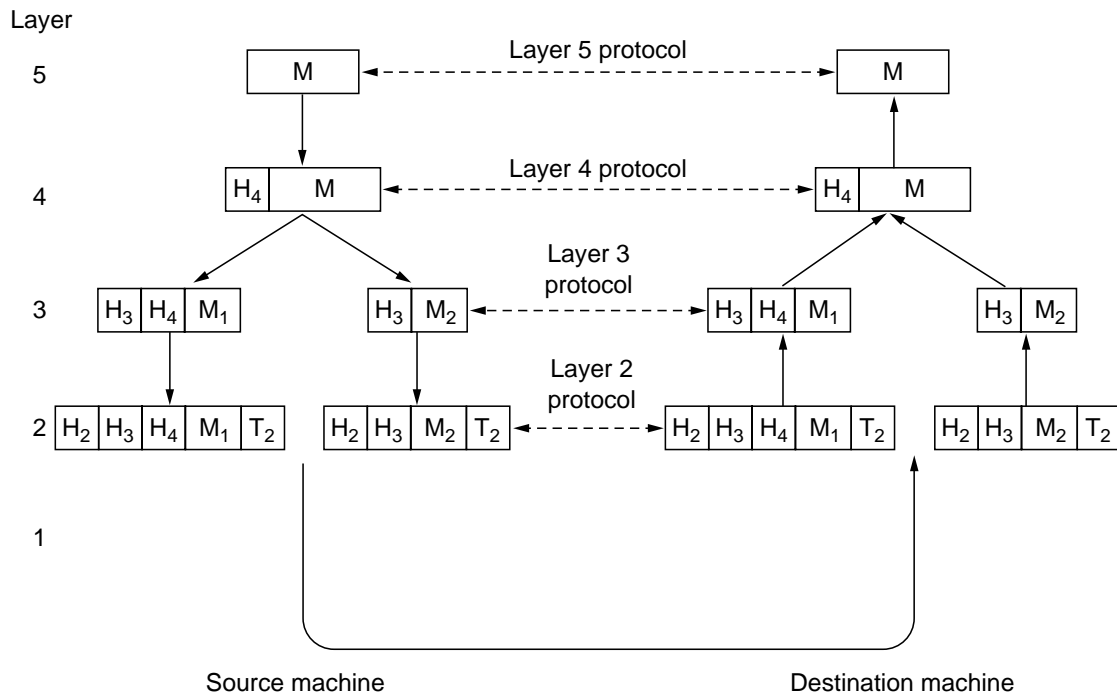


Fig. 1-15. Example information flow supporting virtual communication in layer 5.



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

Fig. 1-16. Six different types of service.

<b>Primitive</b>	<b>Meaning</b>
LISTEN	Block waiting for an incoming connection
CONNECT	Establish a connection with a waiting peer
RECEIVE	Block waiting for an incoming message
SEND	Send a message to the peer
DISCONNECT	Terminate a connection

Fig. 1-17. Five service primitives for implementing a simple connection-oriented service.

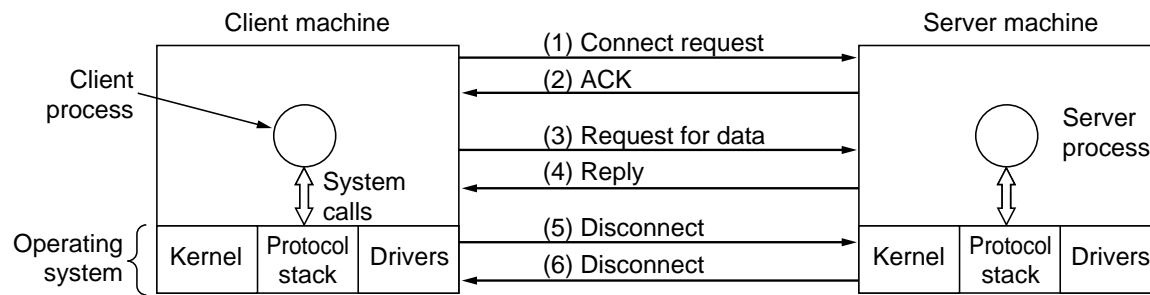


Fig. 1-18. Packets sent in a simple client-server interaction on a connection-oriented network.

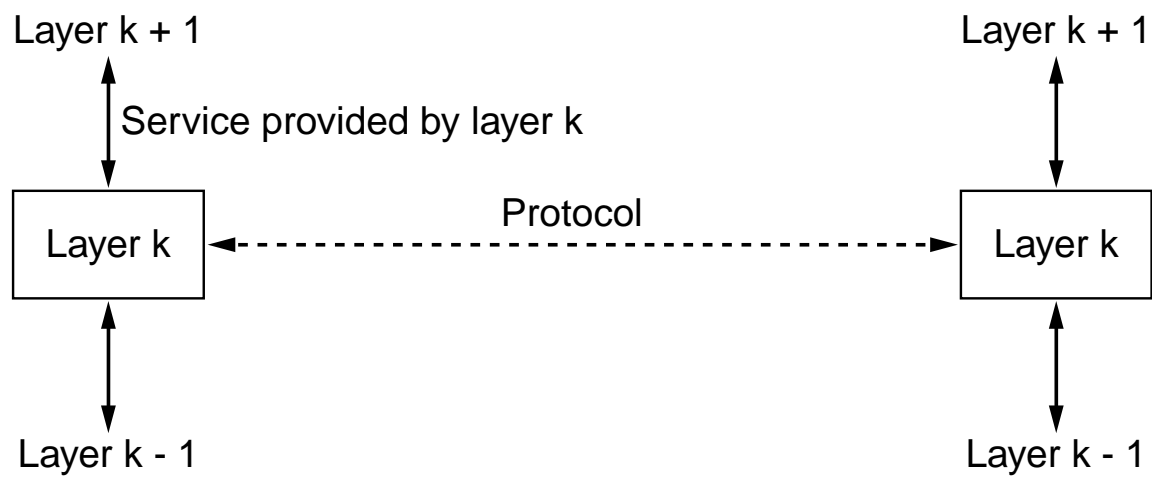


Fig. 1-19. The relationship between a service and a protocol.

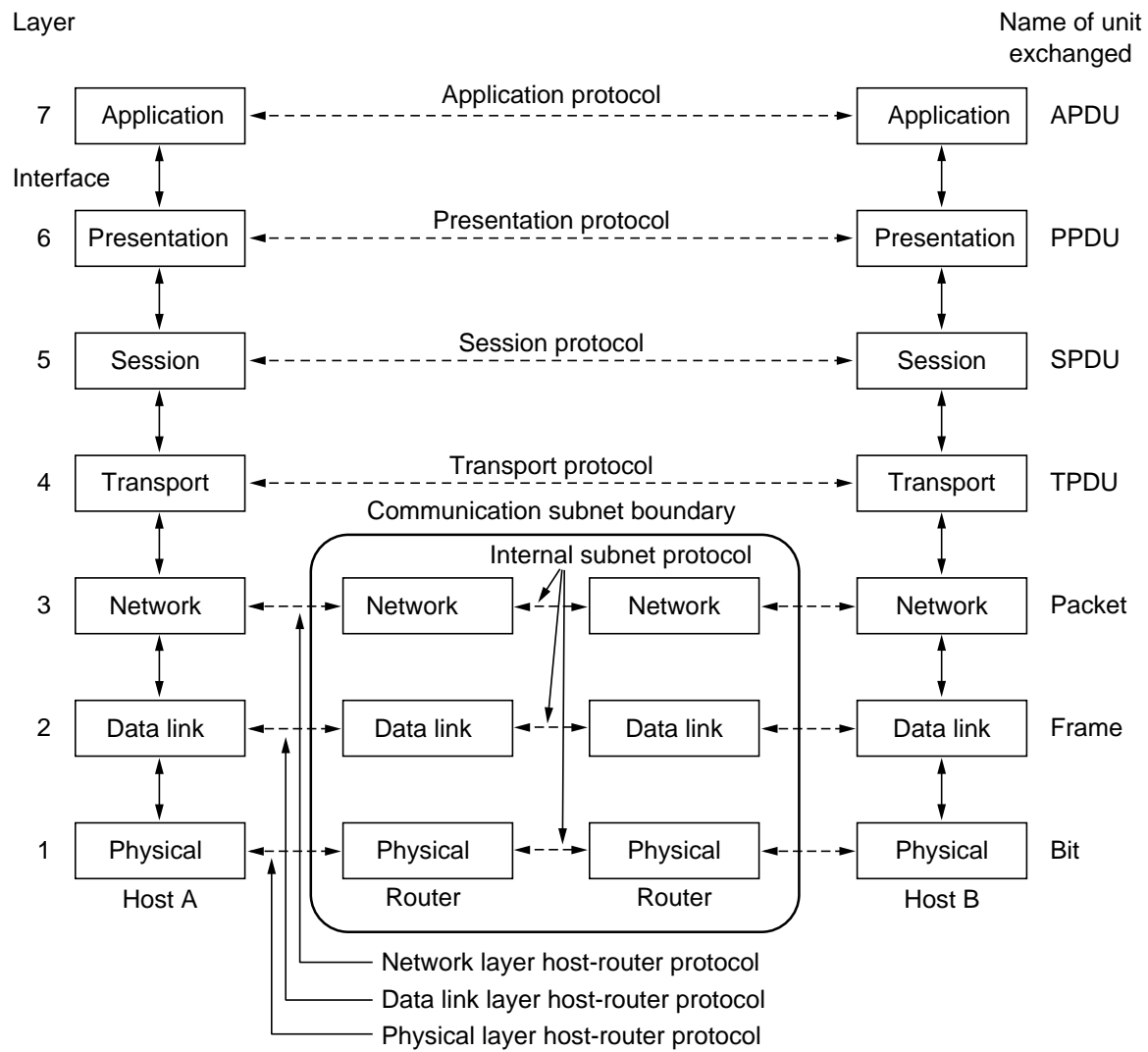


Fig. 1-20. The OSI reference model.

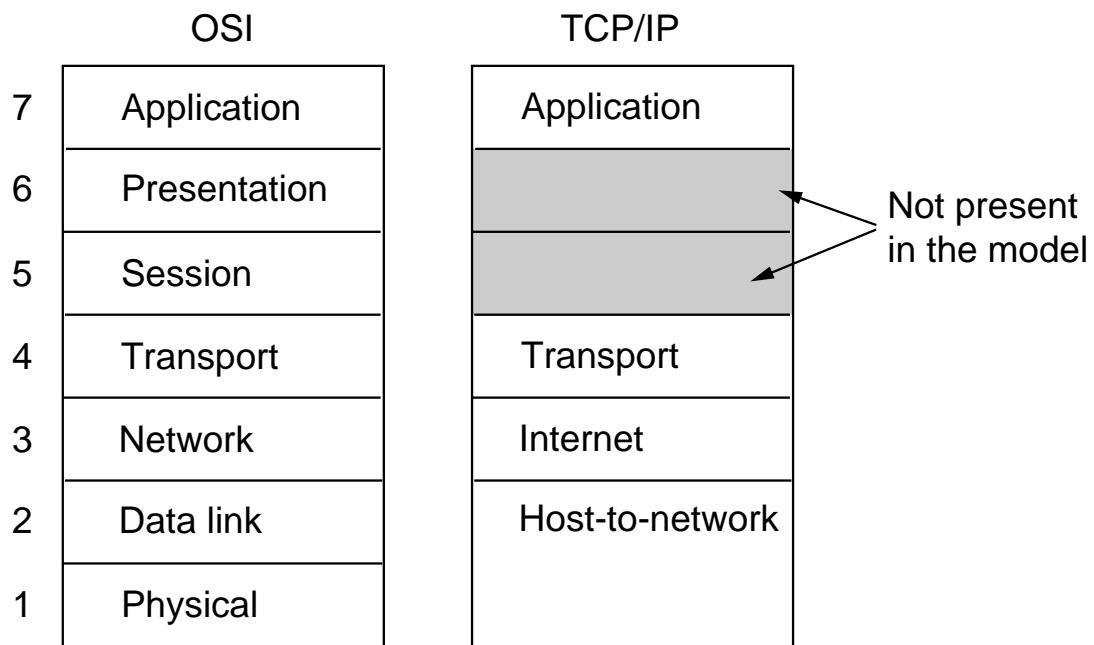


Fig. 1-21. The TCP/IP reference model.

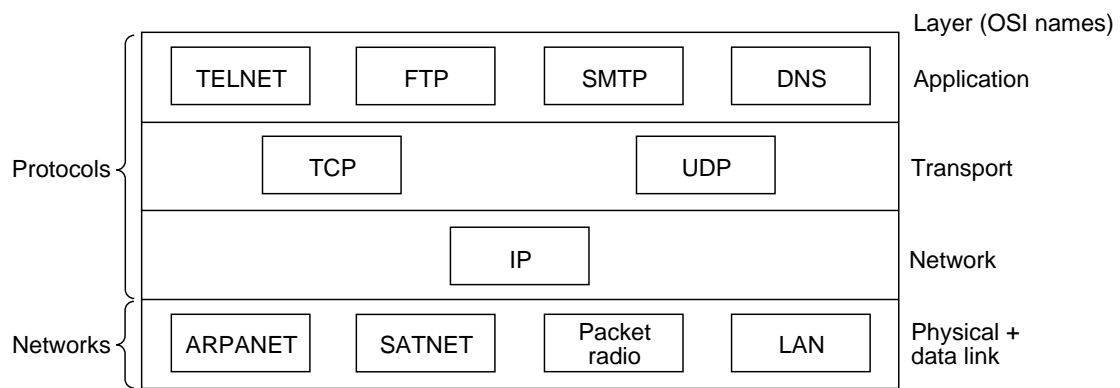


Fig. 1-22. Protocols and networks in the TCP/IP model initially.

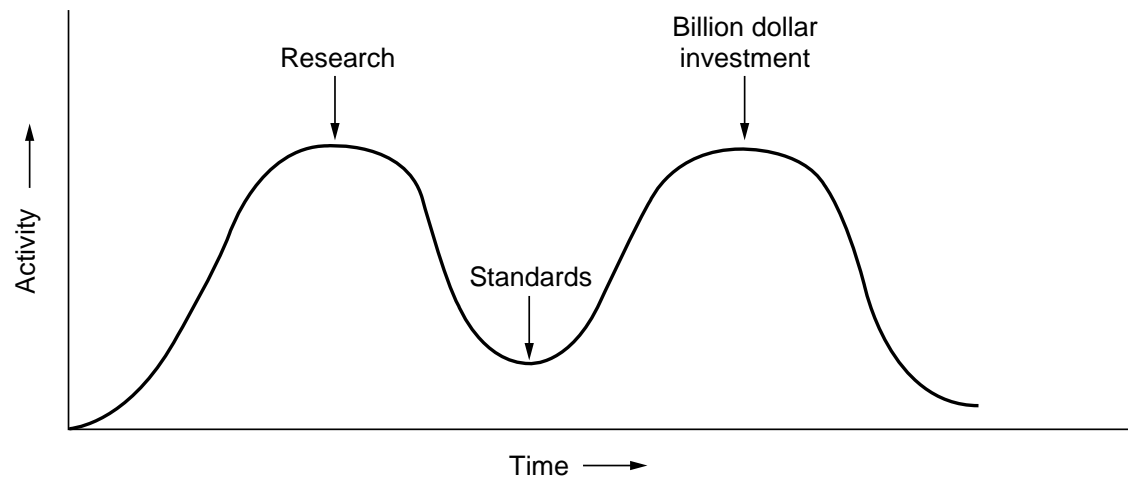
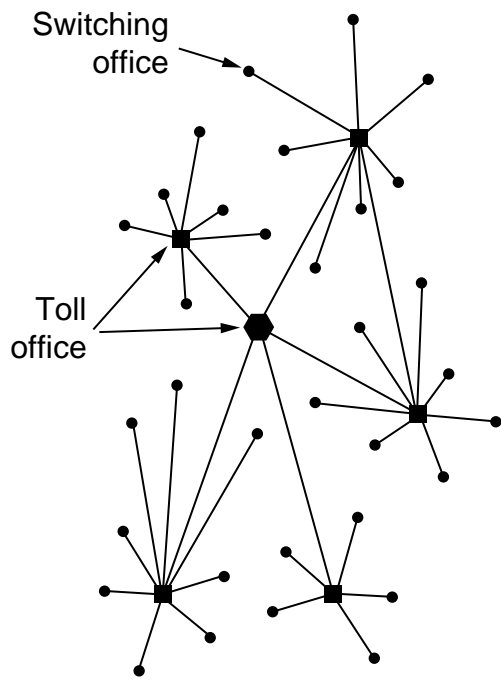


Fig. 1-23. The apocalypse of the two elephants.

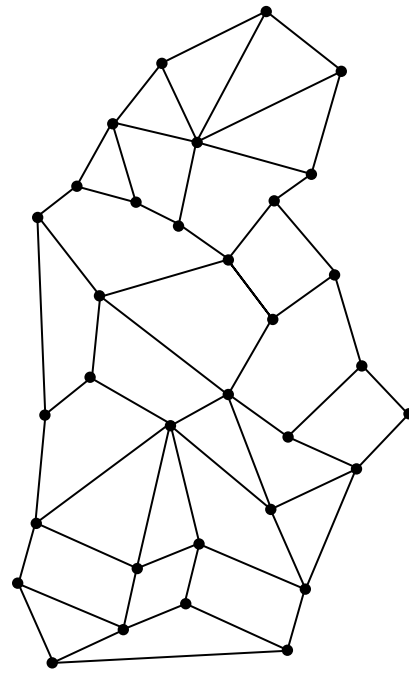


5	Application layer
4	Transport layer
3	Network layer
2	Data link layer
1	Physical layer

Fig. 1-24. The hybrid reference model to be used in this book.



(a)



(b)

Fig. 1-25. (a) Structure of the telephone system. (b) Baran's proposed distributed switching system.

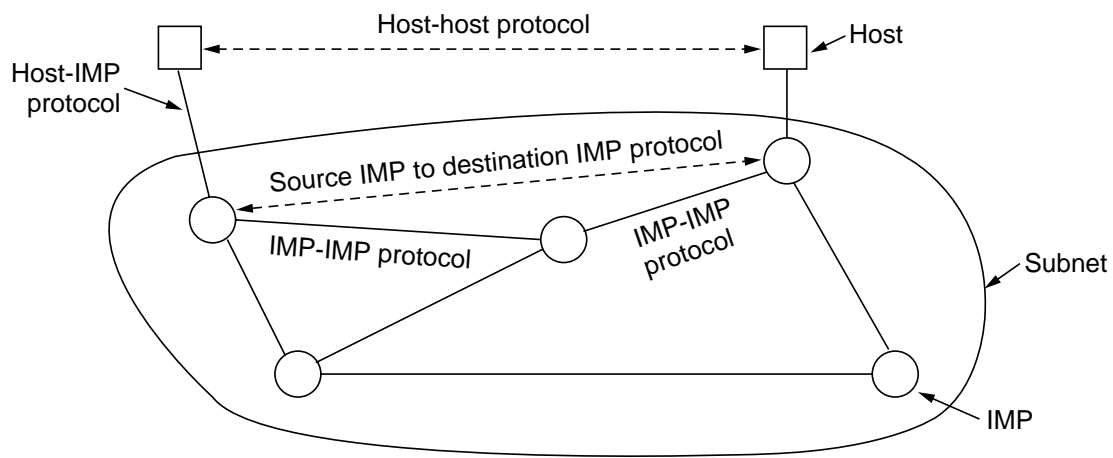


Fig. 1-26. The original ARPANET design.



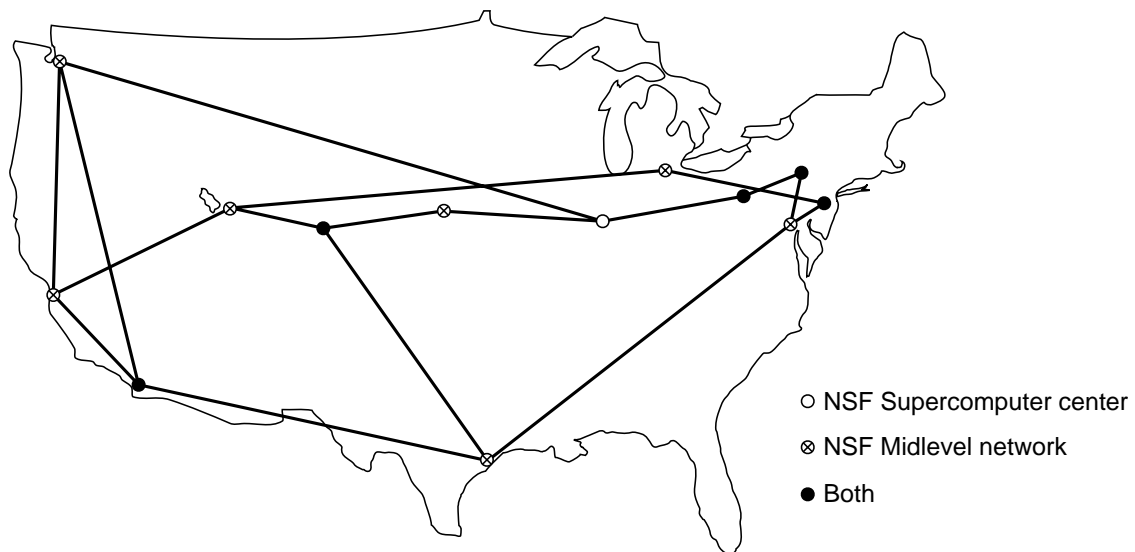


Fig. 1-28. The NSFNET backbone in 1988.

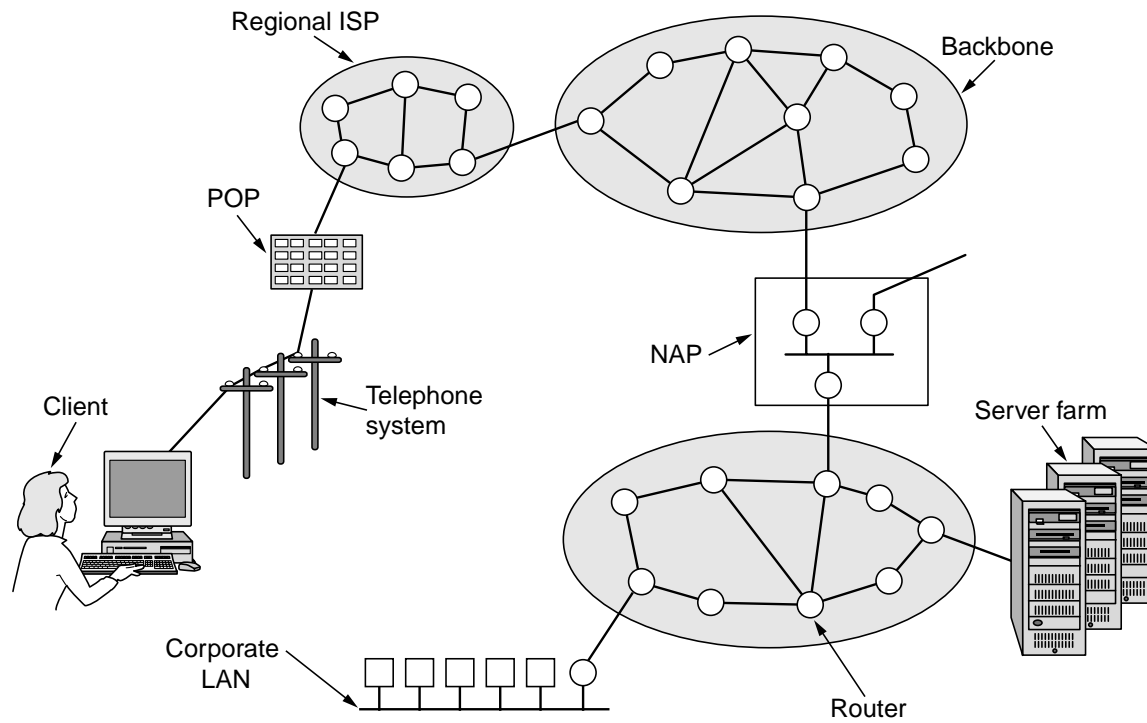


Fig. 1-29. Overview of the Internet.

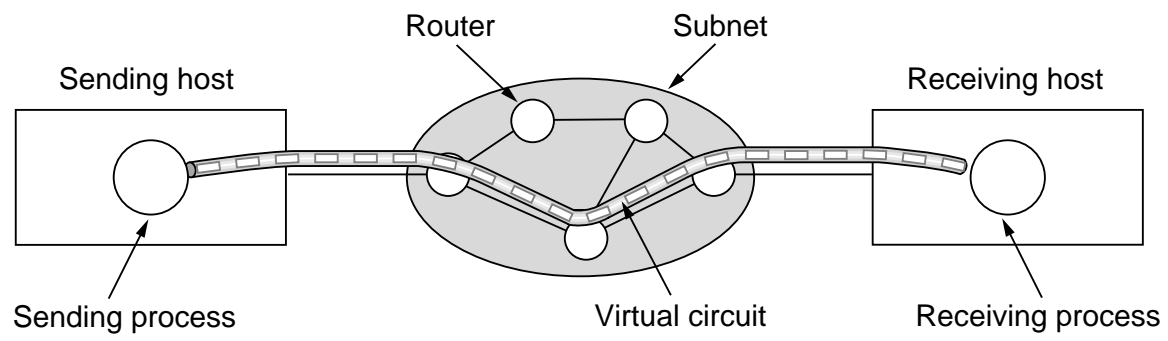


Fig. 1-30. A virtual circuit.

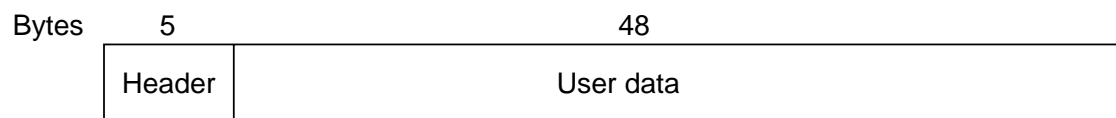


Fig. 1-31. An ATM cell.



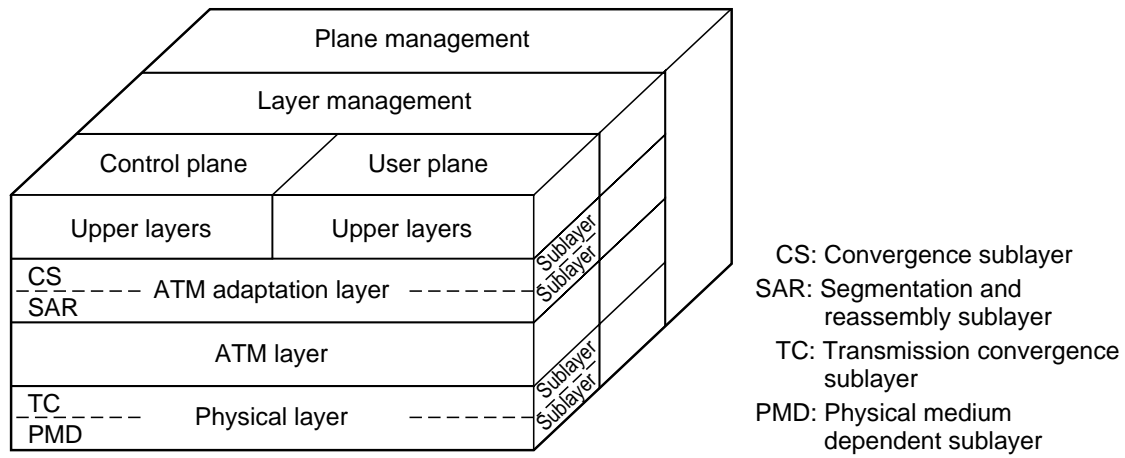


Fig. 1-32. The ATM reference model.

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. 1-33. The ATM layers and sublayers, and their functions.

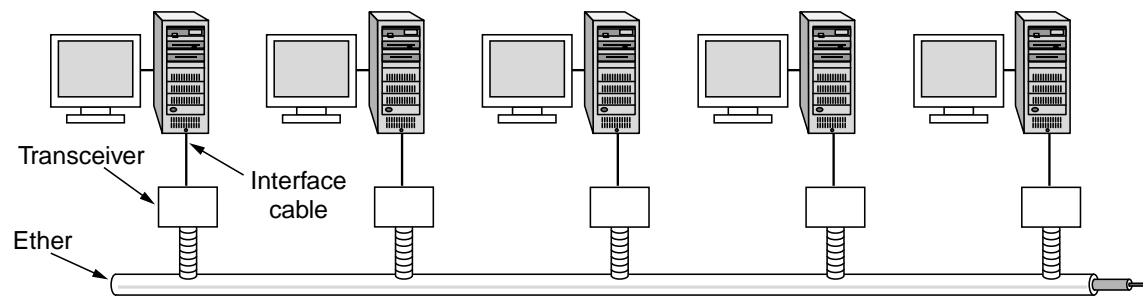


Fig. 1-34. Architecture of the original Ethernet.

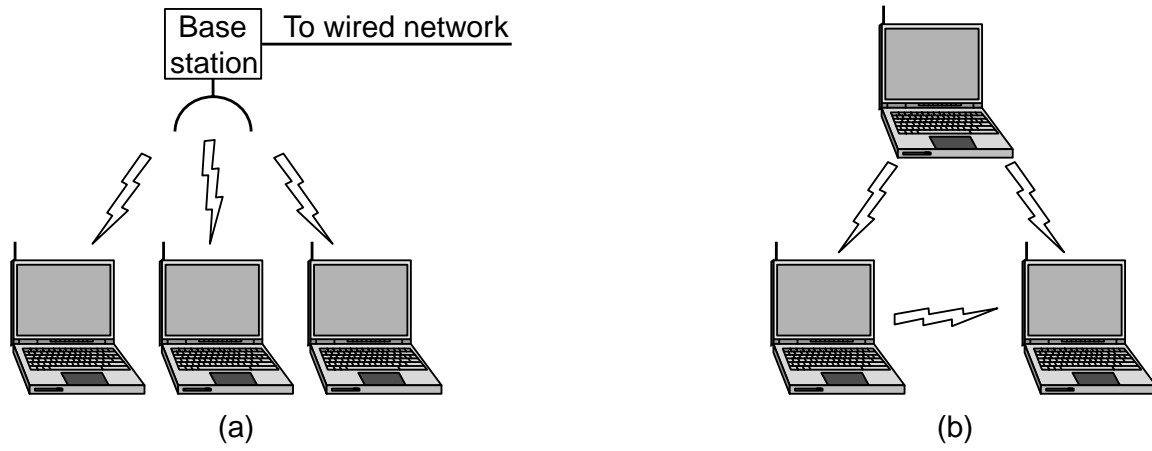


Fig. 1-35. (a) Wireless networking with a base station. (b) Ad hoc networking.

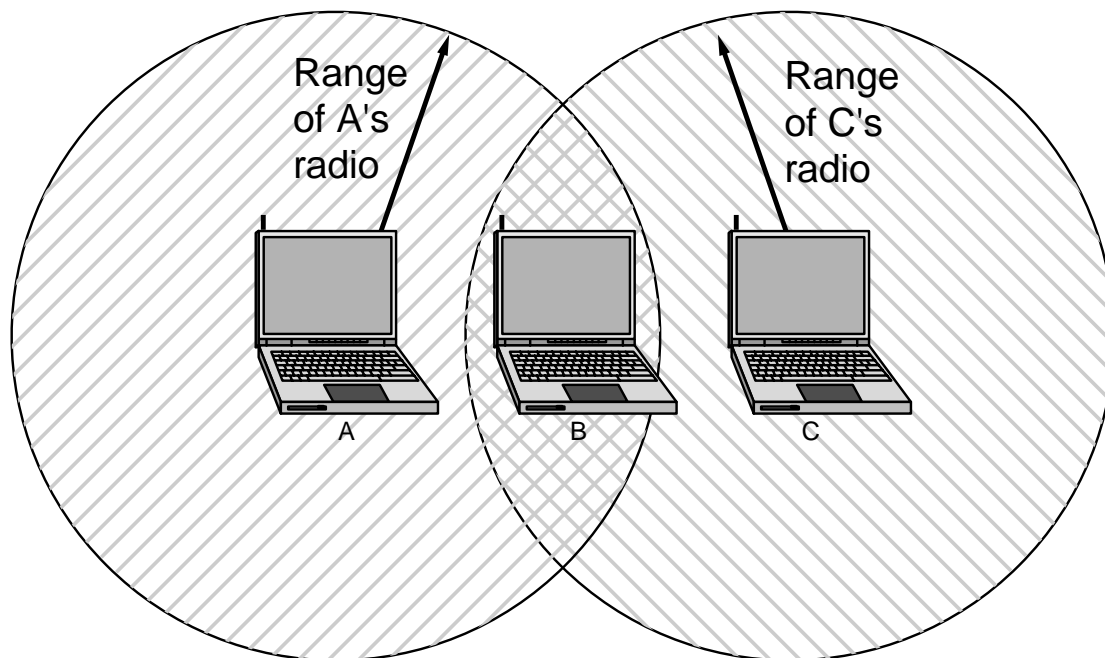


Fig. 1-36. The range of a single radio may not cover the entire system.

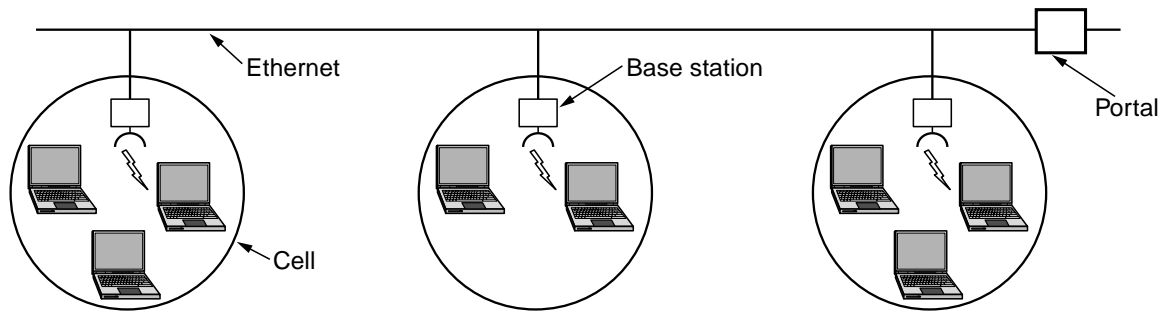


Fig. 1-37. A multicell 802.11 network.

Number	Topic
802.1	Overview and architecture of LANs
802.2 ↓	Logical link control
802.3 *	Ethernet
802.4 ↓	Token bus (was briefly used in manufacturing plants)
802.5	Token ring (IBM's entry into the LAN world)
802.6 ↓	Dual queue dual bus (early metropolitan area network)
802.7 ↓	Technical advisory group on broadband technologies
802.8 †	Technical advisory group on fiber optic technologies
802.9 ↓	Isochronous LANs (for real-time applications)
802.10 ↓	Virtual LANs and security
802.11 *	Wireless LANs
802.12 ↓	Demand priority (Hewlett-Packard's AnyLAN)
802.13	Unlucky number. Nobody wanted it
802.14 ↓	Cable modems (defunct: an industry consortium got there first)
802.15 *	Personal area networks (Bluetooth)
802.16 *	Broadband wireless
802.17	Resilient packet ring

Fig. 1-38. The 802 working groups. The important ones are marked with \*. The ones marked with ↓ are hibernating. The one marked with † gave up and disbanded itself.

Exp.	Explicit	Prefix	Exp.	Explicit	Prefix
$10^{-3}$	0.001	milli	$10^3$	1,000	Kilo
$10^{-6}$	0.000001	micro	$10^6$	1,000,000	Mega
$10^{-9}$	0.000000001	nano	$10^9$	1,000,000,000	Giga
$10^{-12}$	0.0000000000001	pico	$10^{12}$	1,000,000,000,000	Tera
$10^{-15}$	0.0000000000000001	femto	$10^{15}$	1,000,000,000,000,000	Peta
$10^{-18}$	0.0000000000000000001	atto	$10^{18}$	1,000,000,000,000,000,000	Exa
$10^{-21}$	0.0000000000000000000001	zepto	$10^{21}$	1,000,000,000,000,000,000,000	Zetta
$10^{-24}$	0.000000000000000000000001	yocto	$10^{24}$	,000,000,000,000,000,000,000,000	Yotta

Fig. 1-39. The principal metric prefixes.