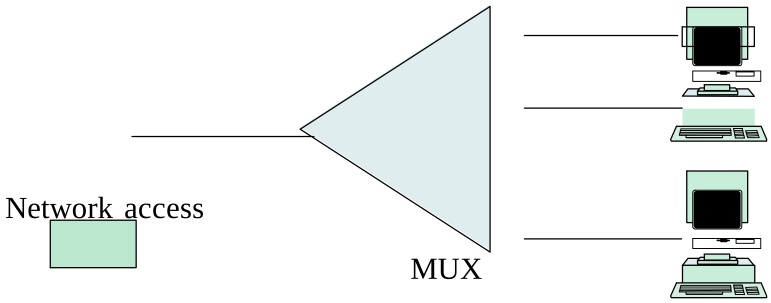
PACKET NETWORK TOPOLOGY

Let us consider the way in which users access packet networks. Figure 1.4 shows an access multiplexer where the packets from a number of users share a transmission line. This system arises for example, in X.25, frame relay, and ATM networks, where a single transmission line is shared in the access to a wide area packet-switching network. The multiplexer combines the typically bursty flows of the individual computers into aggregated flows that make efficient use of the transmission line. Note that different applications within a single computer can generate multiple simultaneous flows to different destinations. From a logical point of view, the link can be viewed as carrying either a single aggregated flow or a number of separate packet flows. The network access node forwards packets into a backbone packet network.



LANs provide the access to packet-switching networks in many environments. As shown in Figure 1.5a, computers are connected to a shared transmission medium. Transmissions are broadcast to all computers in the network. Each computer is identified by a unique physical address, and so each station listens for its address to receive transmissions. Broadcast and multi- cast transmissions are easily provided in this environment.

Multiple LANs in an organization, in turn, are interconnected into campus networks with a structure such as that shown in Figure 1.6. LANs for a large group of users such as a department are interconnected in an extended LAN through the use of LAN switches, identified by lowercase s in the figure.

Resources such as servers and databases that are primarily of use to this department are kept within the subnetwork. This approach reduces delays in accessing the resources and contains the level of trafic that leaves the subnetwork. Each subnetwork has access to the rest of the organization through a router R that accesses the campus backbone network. A subnetwork also uses the campus backbone to reach the ``outside world'' such as the Internet or other sites belong- ing to the organization through a gateway router. Depending on the type of organization, the gateway may implement firewall functions to control the traffic that is allowed into and out of the campus network.

Servers containing critical resources that are required by the entire organization are usually located in a data center where they can be easily maintained and

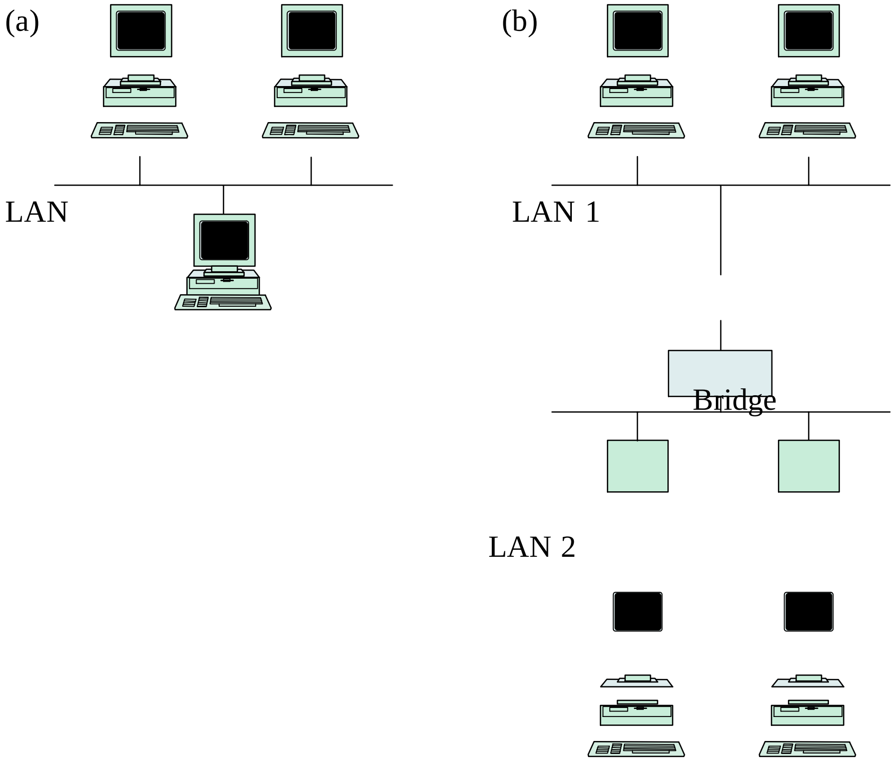


FIGURE 1.5 Local area networks

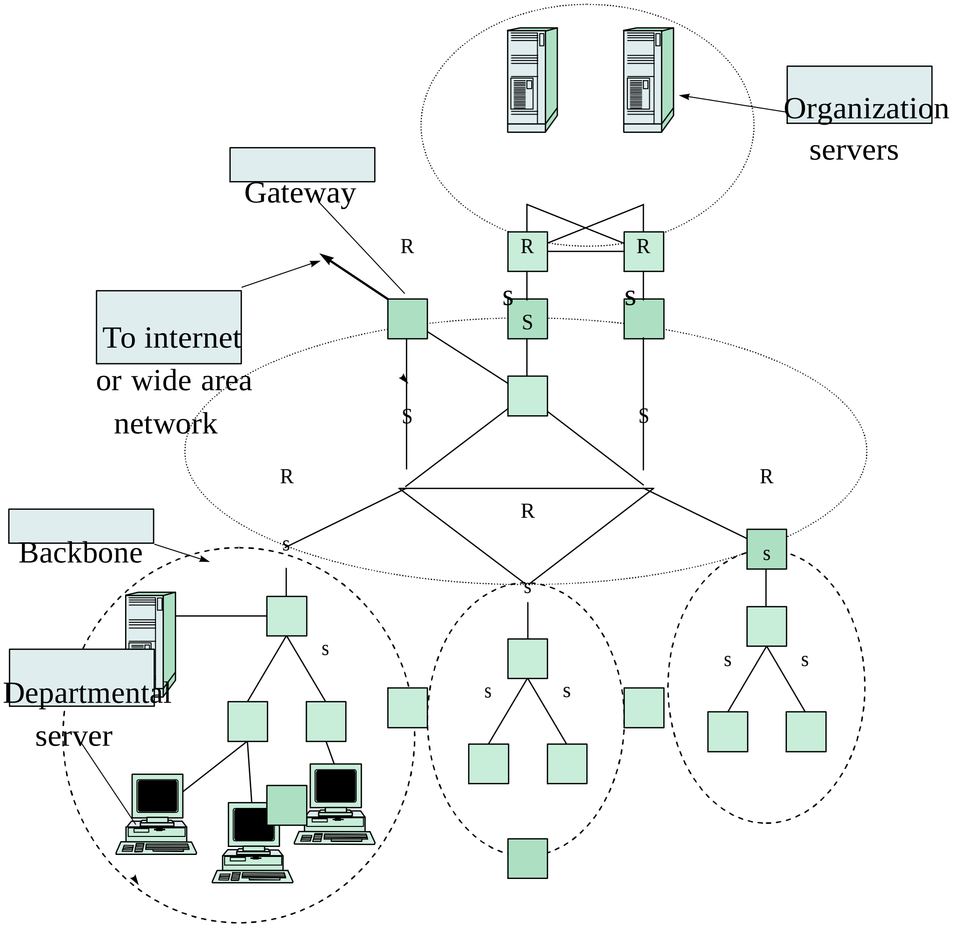


FIGURE 1.6 Campus network

Where security can be enforced. As shown in Figure 1.6, the critical servers may be provided with redundant paths to the campus backbone network. These servers are usually placed near the backbone network to minimize the number of hops required to access them from the rest of the organization.

The trafic within an extended LAN is delivered based on the physical LAN addresses. However, applications in host computers operate on the basis of logical IP addresses. Therefore, the physical address corresponding to an IP address needs to be determined every time an IP packet is to be transmitted over a LAN. This address resolution problem can be solved by using IP address to physical address translation tables.

The routers in the campus network are interconnected to form the campus backbone network, depicted by the mesh of switches, designated S, in Figure 1.6. Typically, for large organizations such as universities these routers are interconnected by using very high speed LANs, for example, Gigabit Ethernet or an ATM network. The routers use the Internet Protocol (IP), which enables them to operate over various data link and network technologies. The routers exchange information about the state of their links to dynamically calculate routing tables that direct packets across the campus network. The routers in the campus network form a domain or autonomous system. The term domain indicates that the routers run the same routing protocol. The term autonomous system is used for one or more domains under a single administration.

Organizations with multiple sites may have their various campus networks interconnected through routers interconnected by leased digital transmission lines or frame relay connections. In this case access to the wide area network may use an access multiplexer such as the one shown in Figure 1.4. In addition the campus network may be connected to an Internet service provider through one or more border routers as shown in Figure 1.7. To communicate with other networks, the autonomous system must provide information about its network routes in the border routers.

A national ISP provides points of presence in various cities where customers can connect to their network. The ISP has its own national network for interconnecting its POPs. This network could be based on ATM; it might use IP over SONET; or it might use some other network technology. The ISPs in turn exchange traffic as network access points (NAPs), as shown in Figure 1.8a. A NAP is a high-speed LAN or switch at which the routers from different ISPs

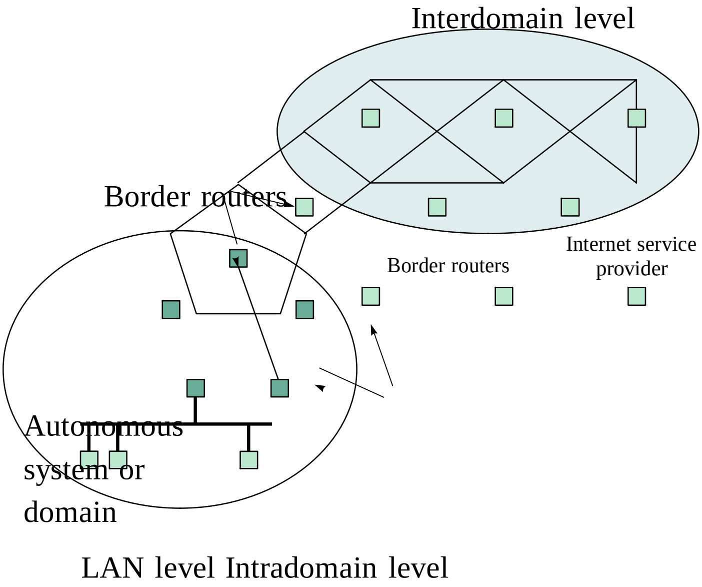

Interdomain level
Border routers
Border routers
Internet service provider
Autonomous system or domain
LAN level Intradomain level

FIGURE 1.7 Intradomain and interdomain levels

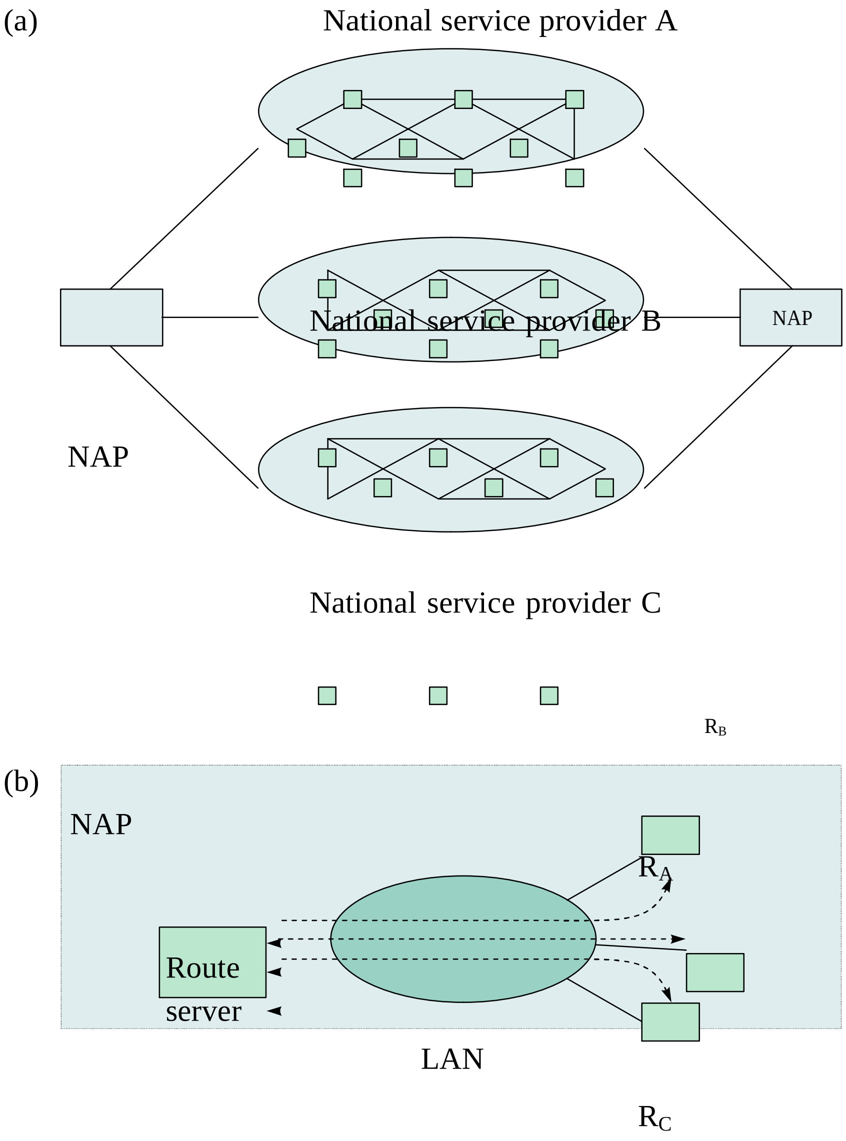

(a)
National service provider A
National service provider B
NAP
NAP
National service provider C
R_B
(b)
NAP
R_A
Route
server
LAN
R_C

FIGURE 1.8 National ISPs exchange traffic at NAPs

Routing information is exchanged through route servers can exchange trafic, and as such NAPs are crucial to the interconnectivity provided by the Internet.

Thus we see that a multilevel hierarchical network topology arises for the Internet which is much more decentralized than traditional telephone networks. This topology comprises multiple domains consisting of routers interconnected by point-to-point data links, LANs, and wide area networks such as ATM. The principal task of a packet-switching network is to provide connectivity among users. The routing protocols must adapt to changes in network topology due to the introduction of new nodes and links or to failures in equipment. Different routing algorithms are used within a domain and between domains.

Source : http://elearningatria.files.wordpress.com/2013/10/cse-vi-computer-networks-ii-10cs64-notes.pdf