Chapter 7. The Application Layer

The Application Layer

- The layers below the application layer are there to provide reliable transport, but they do not do real work for users.

- In the application layer there is a need for support protocols, to allow the applications to function.

- **DNS** (The Domain Name System), which handles naming within the Internet.

- **Three real applications:** electronic mail, the World Wide Web, and finally, multimedia.

DNS—The Domain Name System

- Although programs theoretically could refer to hosts, mailboxes, and other resources by their network (e.g., IP) addresses, these addresses are hard for people to remember.

- Also, sending e-mail to *joy@128.111.24.41 means that if joy's ISP or organization moves the mail server* to a different machine with a different IP address, her e-mail address has to change.

- In ARPANET, there was simply a file, *hosts.txt, that listed all the hosts and their* IP addresses. Every night, all the hosts would fetch it from the site at which it was maintained.

- For a network of a few hundred large timesharing machines, this approach worked reasonably well.

- However, when thousands of computers were connected to the net, everyone realized that this approach could not continue to work forever.

- For one thing, the size of the file would become too large.

- However, even more important, host name conflicts would occur constantly unless names were centrally managed, something unthinkable in a huge international network.

- To solve these problems, **DNS** (the Domain Name System) was invented.

- The essence of DNS is the invention of a hierarchical, domain-based naming scheme and a distributed database system for implementing this naming scheme.

- It is primarily used for mapping host names and e-mail destinations to IP addresses but can also be used for other purposes.

- Very briefly, the way DNS is used is as follows. To map a name onto an IP address, an application program calls a library procedure called the **resolver**, passing it the name as a parameter.

- An example of a resolver: *The resolver sends* a UDP packet to a local DNS server, which then looks up the name and returns the IP address to the resolver, which then returns it to the caller. Armed with the IP address, the program can then establish a TCP connection with the destination or send it UDP packets.

The DNS Name Space

- Managing a large and constantly changing set of names is a nontrivial problem.

- In the postal system, name management is done by requiring letters to specify the country, state or province, city, and street address of the addressee.

- By using this kind of hierarchical addressing, there is no confusion in locating the addressee.

- DNS works the same way.

- Conceptually, the Internet is divided into over 200 top-level **domains**, where each domain covers many hosts.

- Each domain is partitioned into subdomains, and these are further partitioned, and so on. All these domains can be represented by a tree.

- The leaves of the tree represent domains that have no subdomains (but do contain machines, of course).

- A leaf domain may contain a single host, or it may represent a company and contain thousands of hosts.

Figure 7-1. A portion of the Internet domain name space.
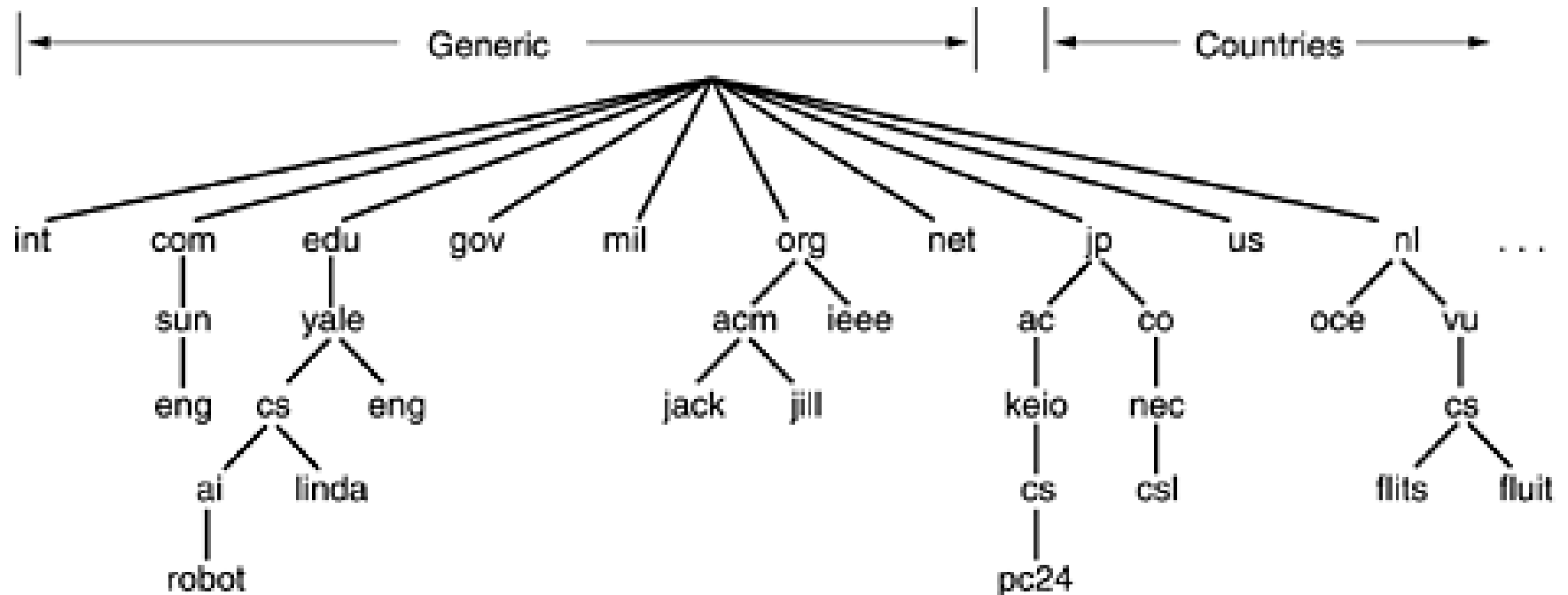
- The top-level domains come in two flavors: generic and countries.

- The original generic domains were *com (commercial), edu (educational institutions), gov (the* Government), *int (certain international organizations), mil (the U.S. armed forces), net* (network providers), and *org (nonprofit organizations).*

- *The country domains include one entry* for every country.

- In November 2000, ICANN approved four new, general-purpose, top-level domains, namely, biz (businesses), info (information), name (people's names), and pro (professions, such as doctors and lawyers).

- In addition, three more specialized top-level domains were introduced at the request of certain industries. These are aero (aerospace industry), coop (co-operatives), and museum (museums). Other top-level domains will be added in the future.

- In general, getting a second-level domain, such as *name-of-company.com, is easy. It merely* requires going to a registrar for the corresponding top-level domain (*com in this case) to check* if the desired name is available and not somebody else's trademark.

- If there are no problems, the requester pays a small annual fee and gets the name.

- By now, virtually every common (English) word has been taken in the *com domain. Try household articles, animals, plants,* body parts, etc. Nearly all are taken.

- Each domain is named by the path upward from it to the (unnamed) root. The components are separated by periods (pronounced ''dot'').
- Thus, the engineering department at Sun Microsystems might be *eng.sun.com.*
- Notice that this hierarchical naming means that *eng.sun.com.* does not conflict with a potential use of eng in *eng.yale.edu.*, which might be used by the Yale English department.
- Domain names are case insensitive, so *edu, Edu, and EDU mean the same thing.*
- Component names can be up to 63 characters long, and full path names must not exceed 255 characters.