

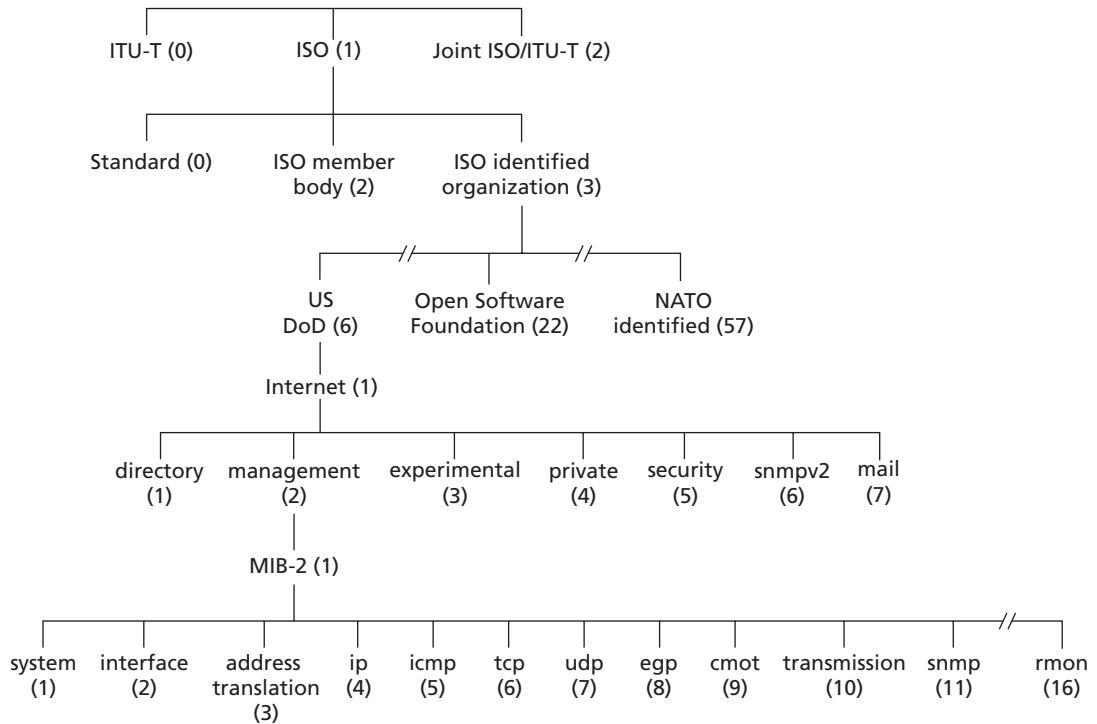
### 9.3.2 Management Information Base: MIB

As noted previously, the **Management Information Base, MIB**, can be thought of as a virtual information store, holding managed objects whose values collectively reflect the current “state” of the network. These values may be queried and/or set by a managing entity by sending SNMP messages to the agent that is executing in a managed device on behalf of the managing entity. Managed objects are specified using the OBJECT-TYPE SMI construct discussed above and gathered into **MIB modules** using the MODULE-IDENTITY construct.

The IETF has been busy standardizing the MIB modules associated with routers, hosts, and other network equipment. This includes basic identification data about a particular piece of hardware, and management information about the device’s network interfaces and protocols. As of 2006 there were more than 200 standards-based MIB modules and an even larger number of vendor-specific (private) MIB modules. With all of these standards, the IETF needed a way to identify and name the standardized modules as well as the specific managed objects within a module. Rather than start from scratch, the IETF adopted a standardized object identification (naming) framework that had already been put in place by the International Organization for Standardization (ISO). As is the case with many standards bodies, the ISO had “grand plans” for its standardized object identification framework—to identify every possible standardized object (for example, data format, protocol, or piece of information) in any network, regardless of the network standards organization (for example, Internet IETF, ISO, IEEE, or ANSI), equipment manufacturer, or network owner. A lofty goal indeed! The object identification framework adopted by ISO is part of the ASN.1 (Abstract Syntax Notation One) [ISO X.680 2002] object definition language that we’ll discuss in Section 9.4. Standardized MIB modules have their own cozy corner in this all-encompassing naming framework, as discussed below.

As shown in Figure 9.3, objects are named in the ISO naming framework in a hierarchical manner. Note that each branch point in the tree has both a name and a number (shown in parentheses); any point in the tree is thus identifiable by the sequence of names or numbers that specify the path from the root to that point in the identifier tree. A fun, but incomplete and unofficial, Web-based utility for traversing part of the object identifier tree (using branch information contributed by volunteers) may be found in [OID Repository 2012].

At the top of the hierarchy are the ISO and the Telecommunication Standardization Sector of the International Telecommunication Union (ITU-T), the two main standards organizations dealing with ASN.1, as well as a branch for joint efforts by these two organizations. Under the ISO branch of the tree, we find entries for all ISO standards (1.0) and for standards issued by standards bodies of various ISO-member countries (1.2). Although not shown in Figure 9.3, under (ISO member body, a.k.a. 1.2) we would find USA (1.2.840), under which we would find a number of IEEE, ANSI, and company-specific standards. These include RSA (1.2.840.11359) and Microsoft (1.2.840.113556), under which we find the Microsoft File Formats (1.2.840.113556.4) for various Microsoft products, such as



**Figure 9.3** ♦ ASN.1 object identifier tree

Word (1.2.840.113556.4.2). But we are interested here in networking (*not* Microsoft Word files), so let us turn our attention to the branch labeled 1.3, the standards issued by bodies recognized by the ISO. These include the U.S. Department of Defense (6) (under which we will find the Internet standards), the Open Software Foundation (22), the airline association SITA (69), NATO-identified bodies (57), as well as many other organizations.

Under the Internet branch of the tree (1.3.6.1), there are seven categories. Under the private (1.3.6.1.4) branch, we find a list [IANA 2009b] of the names and private enterprise codes of many thousands of private companies that have registered with the Internet Assigned Numbers Authority (IANA) [IANA 2009a]. Under the management (1.3.6.1.2) and MIB-2 branches (1.3.6.1.2.1) of the object identifier tree, we find the definitions of the standardized MIB modules. Whew—it's a long journey down to our corner of the ISO name space!

### Standardized MIB Modules

The lowest level of the tree in Figure 9.3 shows some of the important hardware-oriented MIB modules (`system` and `interface`) as well as modules associated