The Electronic Tower of Babel*

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Have you ever tried to transfer data between two computers, only to find that they supported incompatible network protocols?

In the words of a popular advertising campaign, "You will!" And as computers and computer networks become increasingly pervasive you are likely to find yourself faced with this problem more and more. It is easy to assume that the problem of incompatible protocols is going away. Indeed, the networking world has made great progress in recent years toward the development of standard communication protocols. Standards bodies like the International Standards Organization and the Internet Engineering Task Force have created protocols that are supported by many different vendors.

Unfortunately, as Andrew Tanenbaum said, "The nice thing about standards is that you have so many to choose from." The result is that even though a system supports a "standard protocol", there is no guarantee that the user will be able to communicate with all other computer systems.

A network engineer from a major manufacturing company recently listed 25 different protocol standards that are currently used within his corporate network. This list includes popular standards like TCP/IP and OSI protocols, widely used proprietary protocols like Novell Netware and SNA, and a multitude of legacy protocols that are not widely available today. In this kind of multi-vendor, multiprotocol network, achieving interoperability between different systems becomes a serious problem. In many cases, multiprotocol interoperability is more critical and more challenging than any other problem faced by today's network administrators.

One traditional approach to dealing with the multiprotocol problem is to perform protocol conversion through protocol translators or gateways. The most popular application of this approach is found in the plethora of electronic mail gateways that convert mail messages between different formats. For instance, a gateway is used to exchange mail between the Internet and CompuServe mail environments. One problem with using gateways to achieve interoperability is the additional time required to perform the protocol conversion. While this is not a major concern for applications like electronic mail that can tolerate some delay, protocol conversion is less suited for other protocols that have stricter performance requirements.

At Georgia Tech we are exploring an alternative approach to achieving interoperability that utilizes multiprotocol end-systems. Since it now seems likely that there will never be a single, ubiquitous communication protocol, we are working to develop mechanisms that facilitate the development and operation of systems that support several different protocols at the same time.

The goal of our research is find ways to develop systems that can provide the communication services required by a user regardless of the protocols actually used. These multiprotocol systems can take a user's service request and automatically determine which protocols are supported on the systems involved in the request. Once the correct protocols are determined, the system invokes those protocols and proceeds to perform the requested task.

As an example, consider the case of trying to transfer a file from your computer to that of a co-worker in another department. If your company is a large one, there is a reasonable chance that the two computers were purchased at different times, from different vendors, and support incompatible network protocols. In this situation, you will be unable to transfer the file.

However, if your computer included support for several different protocols it could include both the protocols used by your department network as well as those of your co-worker's department. Your computer would automatically determine which protocols were needed to perform the file transfer and then carry it out for you. Of course, you would still be able to communicate with the other computers in your own department

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using the protocols selected for that network.

As networking grows and new protocol technologies develop, the problem of achieving interoperability in a heterogeneous environment will continue to increase. Multiprotocol systems are one way of improving the utility of networks for users and reducing the challenges faced by network administrators.