TCP/IP: The Backbone of the Internet

By Scott Holstad

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Who would have thought that a little military skirmish in Granada would be the event that served to "firm up" the Internet? It actually does appear to be the case, but more on that later. First we have to cover the basics.

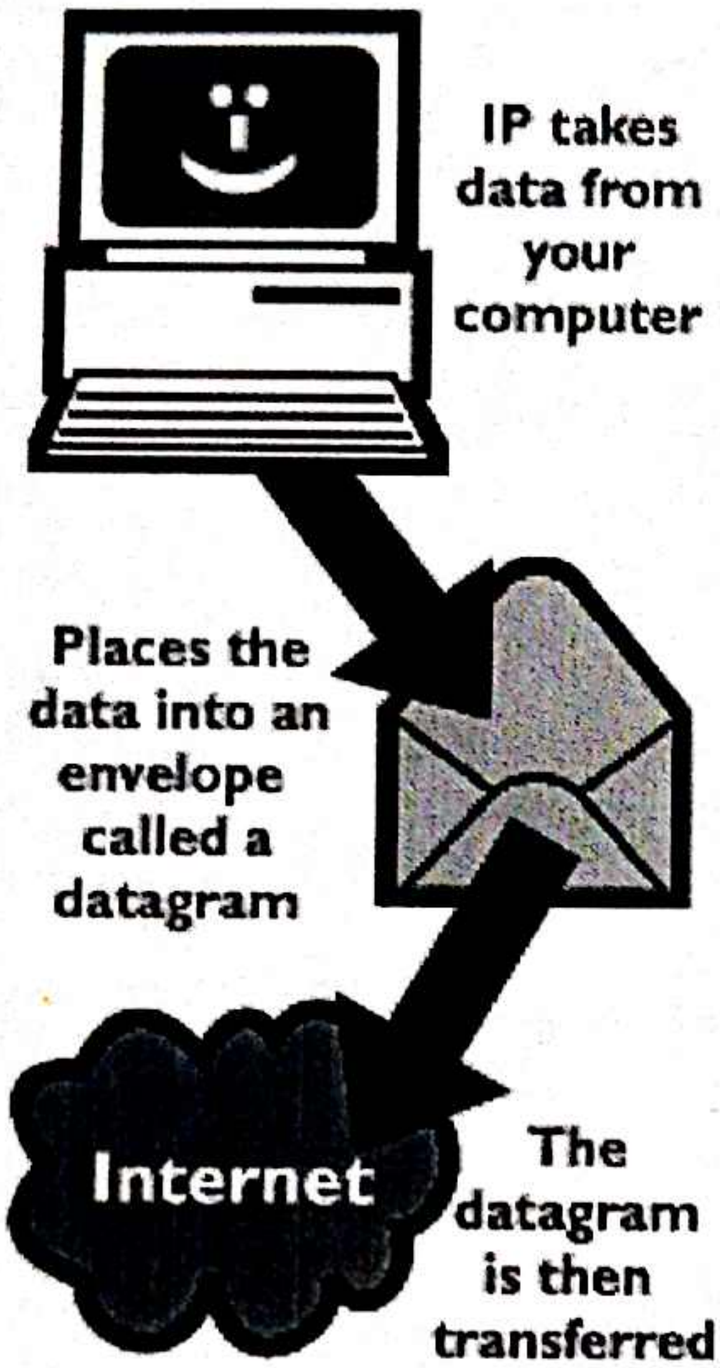
"Reading this piece, sending email to your buddy in Tennessee, doing everything you do online -- you owe it all to TCP/IP."

Many of you have probably heard or seen the term "TCP/IP." Maybe because it was yet another Internet acronym, you ignored it. Or maybe you saw it so often that you've simply come to ignore it. Maybe you think that it isn't important. But, it is. You see, TCP/IP is the thing that makes the Internet work. Reading this piece, sending email to your buddy in Tennessee, doing everything you've become accustomed to doing online -- you owe it all to TCP/IP.

Definition

TCP/IP is an acronym for the "Transmission Control Protocol/Internet Protocol" suite. I know it sounds like geek-speak, but it's really very simple. TCP/IP is a suite, or set, of protocols that allows computers to share resources across a network. Still lost? Basically, it's a bunch of programs thrown together which help you connect to and exchange information with other computers (especially helpful when you're dealing with a bunch of different kinds of computers -- Win95 systems don't naturally communicate with Macs, DEC boxes don't naturally communicate with OS/2 machines, and so on).

A Little History



The roots of TCP/IP can be traced back to the '60s, when it became apparent to many researchers that sharing resources was better (and just plain smarter) than duplicating research efforts. In 1964, a Rand Corporation researcher named Paul Baran devised a computer networking scheme called "packet switching." This method of transferring information did not depend on a centralized hub -- large pieces of information were cut up into smaller pieces and stuffed into electronic "packets," each of which could be sent to its intended destination via a number of different routes. When the packets reached their destination, they were reassembled (kind of like the transporter on **Star Trek**). This technique became, and remains, the foundation of network data transmission.

Around 1974, Vinton Cerf and Robert E. Kahn proposed the TCP/IP standard. Developed around packet-switching, TCP/IP became most the common means of transmitting data via the relatively new Internet (which was then known as the ARPANET). It was built around the UNIX OS, and freely distributed by UC Berkeley, which resulted in its rapid spread through university network systems.

Still, it wasn't used by everyone on the Internet. Here's where the Granada stuff comes in. Rumors abound that when the various branches of the armed forces were buying computer systems, their efforts were not coordinated. The Army put out a bid, which DEC won. The Air Force put out a bid, and IBM won. Meanwhile, the Navy bid was won by Unisys. So, then the government invades Granada, and the Armed Forces discover that their computers can't communicate with each other, because, at that point, TCP/IP was NOT a requirement. Thus, by 1983, DARPA (the Defense Advanced Research Projects Agency -- the organization originally in charge of the Internet) mandated that all computers connected to the ARPANET were required to use TCP/IP, and it remains the standard for today's Internet.

TCP/IP: Working for You

So, TCP/IP. Acronym. Cuts up data into packets and puts it back together again. How? Well, computers represent data (everything from a word processing document to that picture of your kid

you're trying to send online) using binary digits called "bits." While they're in their host computer, the bits remain controlled. But, when they pass through who knows how many other computers (routers, gateways, servers, hosts ... blah, blah, blah), well, they can get jumbled. The protocols within TCP/IP package the bits into packets, and headers are included on each packet to provide routing information.

TCP/IP, as a series of protocols, is broken down into different layered levels: this is referred to as the "TCP/IP stack." There are four layers, each dependent upon the other. The bottom layer is the **Subnetwork protocol**, which manages the physical aspect of the stack, such as your modem, or an Ethernet card.

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The next protocol layer is **TCP**. It's responsible for breaking up files or messages, and then later reassembling them. Each segment can range from 21 and 64,000 bytes in size (a byte is equivalent to eight bits). TCP affixes a header to the data, consisting of a TCP sequence number, acknowledgment number, an error checking code, destination and source info, and other tidbits. It's then routed to the next protocol layer, the **Internet Protocol**, or IP.

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IP is responsible for routing your data. Each IP router makes a decision about where to send datagrams. At the next stop (and at every stop), the router examines the IP header and destination address before passing it along. When the destination address matches the router address, the packet is admitted into the intended network (where TCP starts reassembling).

The final layer is the **Application protocol**. This is simply the interface you use to interact with the data -- essentially the programs you're using on the Internet. Such programs could include email, telnet, FTP, and others.

Now, think about it. By this point, you've probably downloaded or uploaded a file via FTP. You've certainly sent and received email. Think about how quick the process can be. When you start thinking about it, isn't it amazing how quick this process is when you realize how many things go on under the hood in order to make it happen?

So, next time you get email from your buddy in Tennessee, stop to think about Vinton Cerf and the others, and thank them.

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