Information Communication Theory and Technology

Achievement Creation of network architecture and communication protocol for the Internet

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The appearance of the Internet has pioneered the way for the establishment of a network society that has completely transformed the lifestyles of people around the world. Two men in particular were instrumental in the creation of the concept for the basic framework and the TCP/IP communi- cation protocol which has made the Internet possible. These men are Dr. Vinton Gray Cerf and Dr. Robert Elliot Kahn. Known as the "Fathers of the Internet," Dr. Cerf and Dr. Kahn continue to lead advances in information commu- nication.

The Fathers of the Internet

Today, the Internet enables us to communicate by text, audio and video transmissions, which until a short period of time ago, required such specialized types of media as teletype, telephone or television. That we are able to send and receive such a diverse array of data over the Internet is thanks to the communication protocols known as TCP (Transmission Control Protocol) and IP (Internet Protocol), which provide the basic infrastructure for the sending and receiving of data. The term "protocol" was originally associated with the conduct, conventions and formalities observed during diplomatic exchanges. However, in the world of communications, this term has come to mean the established rules that govern the transmission of data. The two TCP and IP communication protocols work together to guarantee the accurate communication of data transmitted between two Internet-connected devices. The creation of these protocols that make the Internet possible is the work of two dedicated research- ers, Dr. Vinton Gray Cerf and Dr. Robert Elliot Kahn.

What are TCP and IP?

Every computer that is connected to the Internet is assigned a number which acts as its Internet Protocol address. All the data sent from one Internet-connected computer to another is broken down into packets of a predetermined size. Each of these packets of data is given a number when transmitted from the sender to the recipi- ent.

The Internet connects the computer networks of companies, research institutes, etc. on a global scale and enables the establishment of a network of networks.. A device known as a router, which connects the networks, identifies the address of the intended recipient and sends the packet of data to another router until the packet finally reaches the intended recipient. The recipient computer restores the original data based on the assigned number.

This mechanism can be likened to freight being transported by containers. The containers act like packets of data, while the router acts as a stopping off point, like a port or railway station. The containers are transported by ship, rail or road, but at the stopping off point, the contents of the containers are not checked and the containers are carried directly to the intended recipient. This set of rules (the rules that instruct the router to send packets to the designated IP address) is the Internet Protocol. When the containers arrive at their intended destinations, the recipient companies check the containers, and if any of the contents are damaged or missing, they contact the original sender to request that the container be re-sent. This set of rules (the rules that control the breakdown and restoration of data) is the Transmission Control Protocol. In short, the TCP performs a role that increases the reliability of data transmission. In the same way as any contents may be freely placed into containers of a predetermined size, many forms of data (i.e. text, audio, or video) can be divided up into separate packets of a predetermined size and transmitted over the Internet.
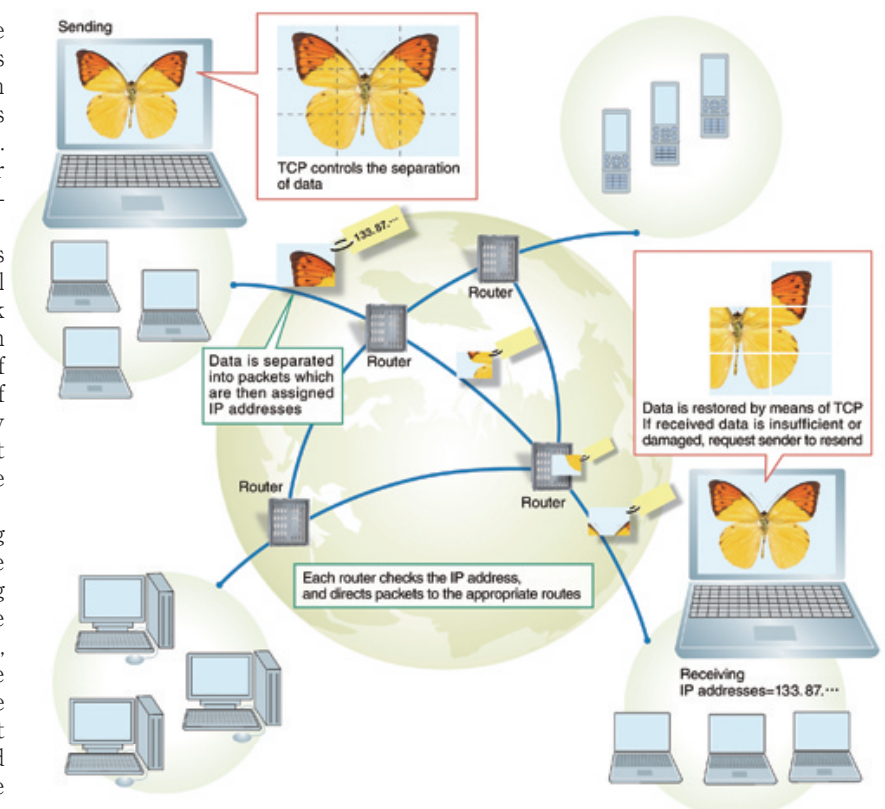
The Origins of TCP and IP

It all started back in 1972. A government-related agency had developed a computer network. Dr. Kahn, who worked at the agency, wondered if it could be possible to link a network connected by telephone line with a wireless communications network. However, the transmission speed, and the content and size of transmitted data differ with telephone and wireless connec-

Sending

TCP controls the separation of data

Data is separated into packets which are then assigned IP addresses

Router

Each router checks the IP address, and directs packets to the appropriate routes

Data is restored by means of TCP If received data is insufficient or damaged, request sender to resend

Receiving IP addresses=133.87.···

tions. In addition, compared to telephone connections, wireless transmissions were prone to problems and deemed unreliable.

To compound the problem, nobody had ever attempted to connect two different types of networks, and therefore there was no precedent or model to follow. Dr. Kahn decided to contact Dr. Cerf, who at the time was at Stanford University, and the pair set out to research the problem together. With a view to connecting different types of networks, they developed a communications protocol that could overcome the perceived problems, designated their protocol "TCP" and in 1974 presented the protocol in a joint paper. In the course of time, this TCP underwent further improvements and emerged as the TCP/IP of today.

The Roles of the Laureates in the Widespread Dissemination of TCP/IP

After finally completing the TCP/IP protocols, Dr. Cerf and Dr. Kahn set about discovering how to put the protocols to more widespread use. Dr. Cerf went to work for a private-sector communications company, while Dr. Kahn founded the Corporation for National Research Initiatives (CNRI), a non-profit organization, to research and develop a national communications infrastructure. With their joint efforts to promote the protocols from their respective positions in both the public and private sectors, TCP/IP became the standard protocols in the United States. At that time, the US led the world in the field of computer sciences, and attracted a large pool of talented researchers from around the globe. These researchers played a prominent role in introducing TCP/IP to their own countries, and the two protocols soon became the global standard.

At around the same time as TCP/IP was completed, several other communication protocols with similar objectives were being developed. However, owing to their stunning simplicity and consequent superiority, TCP/IP was widely adopted as the global standard. Even in the 1970s when the performance of computers was still in its relative infancy, the protocol was of valuable use. Without the foresightedness and creative genius of these two dedicated researchers, the speed of the dissemination and global scale of the Internet as we now know it may not have been possible. Today, the world has come to rely almost totally on the Internet for the communication of information. After laying the basic foundations for the miracle of the Internet, Dr. Cerf, as the Vice-president of Google and, Dr. Kahn, as the Chairman, CEO and President of CNRI, continue to lead the world of information communications.