



# Forty Years Ago . . .

Vinton G. Cerf • Google

**F**orty years ago, in May 1974, *IEEE Transactions on Communications* published a paper Robert Kahn and I wrote titled “A Protocol for Packet Network Intercommunication” (doi: 10.1109/TCOM.1974.1092259). This paper was the result of almost six months of work that began in the spring of 1973, when Bob and I began to explore the possibilities for interconnecting different networks and the computers linked to them. Kahn came equipped with powerful ideas for open network interconnection. In September 1973, the essence of the Internet design was presented at the NATO Advanced Studies Institute on Computer Communications, hosted by Richard Grimsdale at the University of Sussex.

Many network pioneers around the world subsequently worked to develop and demonstrate implementations and applications of packet-switching technologies and their interconnection. A key element of the Internet design was to permit an arbitrary number of packet networks to be interconnected using a global addressing scheme now known as the Internet Protocol (IP). The Transmission Control Protocol (TCP) provided end-to-end reliability, sequencing, flow control, and duplicate detection above the IP layer. The ensemble of protocols developed for the Internet came to be called the TCP/IP Protocol Suite.

From such distant origins, the global Internet has emerged, fed by the ideas and efforts of countless contributors around the globe. Among the key US government agencies most closely associated with the Internet are the Defense Advanced Research Projects Agency (DARPA), where the inter-netting work began, the National Science Foundation, which broadened its application to the larger research and education community in the US and eventually globally; NASA and the Department of Energy, which expanded its use in their application domains; and the National Telecommunications and

Information Agency (NTIA), which helped oversee the transition of responsibility for key aspects of the Internet from the US government to the private sector. These are joined by many other government and private-sector organizations worldwide.

The advent of the World Wide Web in 1991 – developed by Tim Berners-Lee and Robert Cailliau at the European Organization for Nuclear Research (CERN) – propelled the Internet to new heights of demand and utility until, today, some 3 billion people use the Internet, via both wired and wireless devices. New services are constantly arising. The smartphone has added impetus to the Internet’s creative application with no end in sight. We celebrate the 40th anniversary of the first publication of the Internet design and look with great curiosity toward the ever more connected Internet environment of the future.

The year 2014 is proving to be one filled with Internet-related events. In March, the NTIA announced its intention to transfer its oversight responsibilities and authority over the DNS, IP numbers administration, and IP parameter registration to an as-yet-to-be-determined multistakeholder process, with ICANN continuing to carry out implementation in concert with Verisign (for the Domain Name Root Zone maintenance function).

In April, the Brazilian government hosted NETmundial (<http://netmundial.br/about/>), a very large conference with attendance from many countries and high-level participation, including the Brazilian president, Dilma Rousseff. The conference produced a strikingly comprehensive statement of principles and a forward-looking roadmap toward maintaining an open Internet. In May, a High Level Panel – organized by ICANN and chaired by Estonian president, Toomas Ilves – adopted the NETmundial principles and put forward proposals for policy making in the global Internet environment. In September, the Internet Governance Forum will

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be held in Istanbul, where a broad range of Internet policy issues will be discussed at length. Finally, the ITU will hold its Plenipotentiary meeting in Busan, Korea, in October/November, where it will decide its work plan for the next four years.

In 1994, while I was still president of the Internet Society, George Soros gave a speech at the INET conference in Prague. He said that just because the Internet was and had been free and open, there was no guarantee it would stay that way. Coming from a once-Soviet-dominated country, Hungary, he knew what he was talking about, and in the past several years, his prophetic observation has given me much pause. The Internet's freedom and openness is indeed under attack. Authoritarian

regimes use the Internet's underlying technology to track, suppress, censor, and control the free exchange of information. In some cases, the excuse for these actions is the harmful behavior found on the Internet (fraud, bullying, misinformation, and malware), and although finding ways to counter these negative factors is important, we cannot accept the loss of basic human rights in the process.

**I**t is inescapable that the Internet must be made safer for all to use, and technical and legal steps can produce improvements. Freedom from harm must be as much a goal as freedom of speech. But we have personal responsibilities to evaluate the information we obtain (or produce) on the Internet and

to choose what to accept and reject. We must learn and teach "safe networking" behaviors in the same way we teach our children safety rules for a complex society. The global system of the Internet that grew from an idea 40 years ago deserves our best efforts to preserve its freedom and openness while earning our trust in its safe use. Serious work must be done to achieve these goals, and the engineers of the IEEE have an opportunity to fashion an Internet for the next 40 years that can satisfy the aspirations expressed in that paper published four decades ago. □

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