Sputnik.com

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In September 1956, before Sputnik and the National Aeronautics and Space Administration, a California Buick dealer wrote to the Air Force attempting to buy exclusive advertising space on all space vehicles which he understood would start flying in the next year or so. He was turned down officially and the historic exchange of correspondence now rests in a file in the NASA archives in Washington, D.C., U.S. The Buick dealer's vision was, however, prophetic in the sense that capitalism would be the ultimate benefactor.

One of the great myths of the space age is that it brought the world little in return; billions were spent and all that came from it was "teflon, Tang, and velcro" (See Appendix). The fact is these products were used but not created by the space program, which brought much, much, more. In reacting to Sputnik and racing with the USSR in arms and space accomplishments, the United States pushed itself into new realms. The billions spent on space flight have also brought extensive beneficial engineering and scientific advances. Fuel cell technology uses oxygen and hydrogen to produce potable water and electricity. Tough, antiflammable fabrics, such as Kevlar, were developed and used for spacesuits and backpacks. Biomedical instrumentation enables doctors at city hospitals to communicate with paramedics in remote areas. Inertial guidance systems, essential to the navigation of spacecraft, are now standard equipment in commercial aviation, while telemetry was used on spacecraft for jobs such as tracking hurricanes. Still another example is remote sensing from orbiting Landsat satellites which has been applied to such diverse jobs as monitoring oil spills, making inventories of forests, water pollution control, and prospecting for mineral deposits.

There is also a more basic level to space technology. Unlike mainline programs in such areas as Earth imaging, communications, and aeronautics which are aimed directly at Earth application, there are other discoveries which are taken and reapplied by corporations, universities, and individual entrepreneurs. NASA often refers to this as "technology twice used." Ingestible, foamless toothpaste, developed for astronauts in a zero-gravity environment where spitting and frothing present a host of housekeeping problems, is being marketed for total-care nursing patients (who can choke on air bubbles), hospital patients and others who are not always near a basin, and young children who often swallow toothpaste.

There are also inorganic paints (which help coastal bridges resist corrosion), collapsible towers (for applications ranging from portable radar to rock concert acoustics), and air tank breathing systems for firefighters (based on breathing systems that were used on the moon). Sputnik-era technology led to watch batteries, food sticks, reservations systems, police radios, robotic systems, measuring instruments, insulation material, heart rate monitors, high-temperature lubricants, ceramic powders, solar panels, poison detectors, heated ski goggles, unscratchable sunglass lenses, Retin A to combat acne and skin wringling, water filters that attach to faucets, the Jarvik artificial heart, cordless tools, the liquid crystal wristwatch, freeze-dried food (first developed for John Glenn's 1962 Mercury orbits), and much more. In fact, sports enthusiasts continue to benefit from the graphite of tennis rackets, golf clubs, and fishing poles.

But the real value is in the large areas of new technology which helped define the last years of the 20th century and are posed to dominate the first decades of the 21st. NASA has had a program of technology development for satellite communications since the agency was established. Part of this program involves flying experimental communications satellites. In reality, NASA points to a remarkable precedent: the communication satellite industry which began as a NASA program in l96l, became fully commercial in l965, and within 20 years had become a US$3 billion a year business directly and indirectly employing more than a million people worldwide, and has grown geometrically since. NASA is quick to point out that the growth period is far from over in this field. The beneficiaries of this have ranged from communications giants new and old to hundreds of smaller companies which did not even exist when the first Telstar communication satellite went into orbit. The communications satellite is the vehicle carrying the wireless revolution now in progress.

The impact of Sputnik was also felt through the institutions it created. In 1958, when the United States formed the Advanced Research Projects Agency (ARPA) its far-flung pool of scientists, laboratories, and consulting firms needed a network that would allow the sharing of mainframe computers which were very, very, expensive and outside the reach of many members of the pool. In 1968, ARPA awarded its first contracts for the ARPANET, the forerunner of the Internet. ARPANET's physical network was constructed in 1969, linking four stations: UCLA, Stanford Research Institute, the University of California at Santa Barbara, and the University of Utah.

The first of these four "nodes" was a tall, white computer installed on 2 September 1969. A small crowd gathered inside professor Len Kleinrock's lab at UCLA to watch flashing white lights as bits of information silently flowed along a 15-foot cable between two bulky computers. It was a test of the technology that remains at the foundation of the Internet. Then on 20 October, a group of computer scientists at UCLA again made history by getting their computer to talk to another at the Stanford Research Institute in northern California (See Appendix). By 1971, there were 15 nodes and in 1972 the first e-mail program was created by Ray Tomlinson (who also hit on the idea of the @ or "at" sign for e-mail addresses) of Bolt Beranak and Newman, a Cambridge Massachusetts consulting firm. Overnight electronic mail was flying in various networks. There was still a problem, however, as people could communicate within separate networks, of which there were several, but not between networks.

In 1962, Paul Baran, an immigrant from Eastern Europe, working for the RAND Corporation was asked by the Air Force to determine how it could maintain control over its missiles and bombers after a nuclear attack. This was to be a secret military network that could survive a nuclear strike, decentralized so that if any targets in the U.S. were

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destroyed, the military would control of nuclear arms through the network for a counter-attack. Baran described several ways in which this could be done but his final recommendation was for a "packet switched network" in which data is broken down into fragments, or packets, each labeled to indicate its origin and destination. The network would forward one of these packets from one computer to another until it arrived at its final destination where it would be decoded and reassembled with the other packets. Baran's system was crucial to the realization of computer networks.

In 1974, Vinton Cerf from Stanford and Bob Kahn from DARPA (ARPA became the Defense Advanced Research Projects Agency in 1972) published "A Protocol for Packet Network Internetworking" contain the design specifications for a Transmission Control Program (TCP). which would created a universal language or "protocol" permitting diverse computer networks to interconnect and communicate with each other (See Appendix).

DARPA's Bob Taylor, networked all of the DARPA network's computers together for a total cost of $1 million, later labeled "the best million bucks ever spent by the Federal government." As worries about the Cold War subsided, the Pentagon let others into the system. In 1991, the government started to let businesses set up home pages on the toll-free system. At first there was disbelief that Web sites were free for the taking and there was no postage for e-mail, but this incredulity soon subsided and the rush was on to sign up. Within two years, the number of commercial users outnumbered the academic ones. In 1995, the U.S. government got out of the business entirely, turning it over to its users. Early in the year 2000, 52% of all American households were connected to the system.

On 2 September 1999, when that first Internet connection turned 30, the handful of pioneers met at UCLA in front that refrigerator-sized first "node" to celebrate what they had wrought. The team of graduate students that took the crucial first step of hooking a computer to a switch in 1969 included future Internet leaders like Vinton Cerf, who later helped create the Internet's common language, Kleinrock, and the late Jonathan Postel, who pioneered its address system.

"In those early days, Len Kleinrock and his colleagues couldn't possibly have foreseen that they were on the ground floor of one of the most life-altering innovations of this century," said UCLA Chancellor Albert Carnesale. Cerf summarized the two events which made the modern Internet a reality: the breakup of AT&T (which he feels would have held its progress in check to maximize profits) and the launch of Sputnik.

Appendix 1. Teflon, Tang, and velcro were actually products of earlier days and all three were, in fact, used by NASA. Teflon was invented by accident as a residue of refrigeration gases in the DuPont chemical company's labs in 1938, by Roy J. Plunkett, a chemist who saw that it had unusual properties. First used only in defense projects, it became a commercial product in 1948. It was mated with the electric frying pan in 1961 and named the "Happy Pan" at about the same time that NASA started using it for a host of applications from space suits to nose cones. Velcro was invented in 1948 by George deMestral, a Swiss engineer who got cockle burrs caught in his heavy wool stockings, saw the principle of tiny hooks and loops at work and reproduced the effect in woven nylon. The name came from a blend of velvet and crochet which is French for hook. NASA has always used it and each Space Shuttle contains about 10 000 square inches of Astro Velcro. Tang, a commercial product of General Foods initially developed for the Army for prepackaged field rations, was bought by NASA for the Apollo astronauts who consumed it on the moon. General Foods made much of this fact in its advertising.

In 1999, UCLA Professor Richard Kleinrock, now 65 and credited as the "Father of the Internet" recalled "We had a guy sitting at the computer console at UCLA wearing a telephone headset and a microphone, talking to another guy at Stanford. When everything was set up he was going to type the word 'log' and the Stanford computer would automatically add 'in' to complete the word 'login.' "So our guy typed the 'L' and asked his counterpart at Stanford 'Did you get the 'L' and Stanford replied, 'Got the 'L.' Then they did the same for 'O,' and then the whole system crashed!" Kleinrock said. But on reflection 30 years later, he told Associated Press science writer Matthew Fordahl that the first message ever sent from one computer to another was symbolic. "Put it into phonetics and you get (h)ello, which is really quite appropriate."

The term "Internet" was short for the "internetworking" in their title. Cerf and Kahn were the first to use the clipped form "Internet" in a paper on Transmission Control Protocol. TLE

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