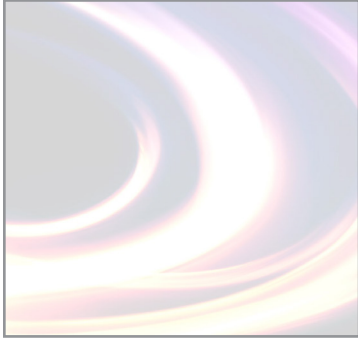# Persistent Innovation

The History of BBN Technologies

BBN has been providing advanced technology research and development— especially development—for over 60 years. From the ARPANET, to the first email, to the first stereo digital mammography system, through the first metro network protected by quantum cryptography, BBN has consistently transitioned advanced research to produce innovative, practical technology solutions for our customers. Today, BBN's innovations allow for ubiquitous networking and speech understanding in any language or format. BBN scientists and engineers continue to take risks and challenge conventions to create new and fundamentally better solutions.

More than half a century has passed since Richard Bolt, Leo Beranek, and Robert Newman set up shop as a small, architectural acoustics consulting firm in Cambridge, MA, known as Bolt, Beranek, and Newman, or BBN (now Raytheon BBN Technologies). From the very beginning, BBN surpassed all reasonable expectations for an unknown organization with modest resources. The new partnership won the contract for the acoustics design of the United Nations facilities, including the General Assembly Hall, and quickly earned international recognition. Later, BBN was called on to analyze the Kennedy assassination tape and the Kent State tapes.

Leo Beranek had an interesting philosophy: every new hire should significantly enhance the capabilities of the organization. Because of its location just a short distance from two renowned universities — Harvard and M.I.T. — BBN was able to draw its employees from the brightest, best-trained scientists and engineers, so that Beranek's directive was satisfied and BBN became known as "Cambridge's third university." The caliber of BBN's staff, combined with its reputation for tackling tough, interesting problems, increasingly made it the place where other smart people chose to work and resulted in the hiring of bright people outside the field of acoustics. One of the new employees, J.C.R. Licklider, recommended that BBN buy a computer, which was a rather unusual acquisition in the late 1950s, and Beranek agreed. Sure enough, the computer became the focus of much original work at BBN.

In the early sixties, BBN staff started working more and more in the computer science field. When the Advanced Research Projects Agency sent out the request for proposals for the ARPANET, notable players in the communications industry were highly skeptical that such a network could work. They were even more surprised that the very significant contract went to a small firm in Cambridge rather than to one of the communications or computer giants. At that time, the notion of breaking messages into small packets and reassembling them at their destination was revolutionary. However, with the implementation of the first four nodes of the ARPANET nine months later in 1969, BBN proved that breaking messages into packets was not only possible but that it could be applied to high speed networks transmitting messages across varied routes to dispersed destinations — the concept underlying today's Internet.

During the next decade, one of BBN's scientists, Ray Tomlinson (who is still with the company inventing new technologies), invented network email and established the @ sign protocol, creating the icon of the digital age. At the same time,

BBN was already anticipating the security requirements of the network technology on the horizon. Still others at BBN were making breakthroughs in speech recognition applications that would enable the disabled and deliver new convenience to everyday tasks. BBN's accomplishments over 60 years have been many and varied; following are some of the highlights:

1948 Two professors at MIT, Richard Bolt and Leo Beranek, decided to start a small acoustics consulting firm, adding a former student of Bolt's, Robert Newman, shortly thereafter.

1949 BBN won its first major consulting contract, designing the acoustics for the United Nations General Assembly Hall.

1950 Discovered noise masking as a technique for privacy design of offices and libraries.

1957 Developed theory of structural damping due to a layer of viscoelastic material between two layers of structural material.

1958 Purchased the company's first computer, an LPG-30 manufactured by the Royal McBee Company.

1961 Developed Composite Noise Rating (CNR) for airport noise, which was adopted by the DoD and FAA for military and civilian airports.

1962 Performed first public demonstration of computer time-sharing.

1963 Designed and demonstrated the first voice modem, called DataDial, to enable remote communication with computers by telephone.

1964 Developed Statistical Energy Analysis (SEA) for solving problems of structural vibration in aerospace vehicles and Surface ships

1969 Launched the ARPANET.

1970 Developed TENEX, the first virtual memory operating system for Digital Equipment Corporation computers.

1971 Sent first person-to-person email using the @ sign.

Performed acoustical analysis of Kent State University audiotapes for the Department of Justice.
 Developed a geographically distributed facility for the monitoring and control of a packet-switch computer network.

Performed initial development of INTERLISP, a list processing programming language useful in artificial Intelligence research.

1972 Assessed Environmental Protection Agency Report to Congress, which led to the Noise Control Act of 1972.

1973 Developed the Private Line Interface (PLI) to encrypt messages over the ARPANET, demonstrating the first secure traffic sent over a packet-switched network.

1974 Implemented TELENET, a commercial network service, which later became part of SPRINT.

1977 Developed the first Transmission Control Protocol (TCP) for Unix.

Developed first Internet routers in collaboration with Stanford University and University College, London.

Performed initial development of the first long-range low frequency active underwater surveillance system using an array of modified seismic-industry air guns.

1978 Demonstrated Packet Broadcast Satellite communications over the Atlantic Ocean.

Demonstrated the feasibility of long-range automatic detection and recognition of airborne targets from submerged acoustic sensors in the open ocean using the AUSEX system sponsored by DARPA.

Deployed the Black-Crypto-Red (BCR), the first IP-based network encryption system to implement remote re-keying and dynamic access control.

1985 Developed SIMNET (Simulation Network) to interconnect microcomputer-based combat vehicle simulators on a common network.

1986 Developed Byblos™, BBN's high-performance, continuous speech recognition system.

1988 Completed the acoustic design of NATO's research vessel, Alliance.

1989 Created New England Academic and Research Network (NEAR-net), a regional data communications network that operated at speeds up to 10Mb/s using microwave and leased communication links.

Formed Acentech, the only acoustical company to be incorporated directly from a division of BBN Technologies.

Developed the Defense Simulation Internet to carry data, voice, image, and video traffic used in military intelligence, operations, planning, and logistics in simulations and exercises.

1991 Performed the first demonstration of an interactive, multistatic active acoustic processing and display system operated by Navy operators aboard an ASW aircraft.

Developed a unique representation for genetic algorithm schedulers, making it possible for computers to produce highly optimized solutions to extremely complex scheduling problems.

1992 Won DARPA's outstanding Performance by a Contractor award for the Dynamic Analysis and Replanning Tool (DART) for rapid modification and transportation feasibility analysis for Time-Phased Force and Deployment Data employed by the military during Desert Storm.

1993 Implemented CO-NECT (Cooperative Networked Community of Tomorrow), a prototype school design program that used computer and networked communications technology as part of a project-based curriculum.

Demonstrated the first large vocabulary (20,000-words) continuous speech recognition system in real time on a commercial, off-the-shelf computer.

1994 Formed BBN Planet, which later became one of the world's largest Internet Service Providers.

1995 Developed the Gigabit Satellite Network for the provision of OC-3/0 C-12 (I55Mps/622Mps) services via NASA's experimental Advanced Communications Technology Satellite (ACTS).

1996 Formed Parlance Corporation, which uses BBN's advanced speech recognition technology in its turn key call routing service.

Completed development of the Certificate Authority Workstation for supporting several critical Defense Message System (DMS) functions, including secure messaging, certification hierarchy support, cryptocard management, and DMS certificate creation and revocation.

1997 Inducted into the U.S. Space Foundation's Space Technology Hall of Fame in recognition of work performed on the DARPA/NSA Gigabit Satellite Network.

Developed Distant Thunder, demonstrating the operational feasibility of autonomous multistatic active detection, classification, and localization of submarine targets using a field of acoustic sensors.

Developed and demonstrated Speak'n'Surf, a speech recognition and search capability system for use over the Internet.

Purchased by GTE.

Developed Rough'n'Ready™, incorporating many speech and language processing technologies to extract information from speech and create indexed, searchable audio archives.
Refined genetic algorithm scheduling technology to accelerate the process of optimizing very large scheduling problems with complex restraints.

1998 Refined genetic algorithm scheduling technology to accelerate the process of optimizing very large scheduling problems with complex restraints.

1999 Won the IEEE Corporate Innovation Recognition "For pioneering contributions to computer networking technology through the development of the first packet switches, the ARPANET Interface Message Processor (IMP), and Terminal Interface Message Processor (TIP).

2000 BBN Technologies' parent company merged with Bell Atlantic, forming a new corporation, Verizon.

2004 Delivered the first 50 Boomerang shooter detection systems to meet an urgent need for sniper detection in Iraq just 66 days after receiving the request to develop such a system from the U.S. government.

2004 Regained independent status as a result of management-led buyout with venture capital support.

2006 Smashed speed barriers with world's fastest detector for practical quantum cryptography, enabling faster, supersecure communications over greater distances.

2007 BBN's Stereoscopic Digital Mammography system showed significant improvement in the early detection of suspicious lesions in a clinical trial conducted at Emory University's Breast Imaging Center.

2008 Named one of the Top Places to Work in Massachusetts by The Boston Globe.

2009 Delivered over 5000 Boomerang shooter detection systems to U.S. Army to protect soldiers in Iraq and Afghanistan.

BBN Principal Engineer Ray Tomlinson named Prince of Asturias Laureate for Technical and Scientific Research for the development of email and its advancement of human communications.

BBN Chief Scientist John Makhoul received IEEE's highest award in speech, the IEEE James L. Flanagan Speech and Audio Processing Award, for making unparalleled strides in speech modeling and language processing.

Developed Boomerang Warrior, a soldier-wearable shooter detection system to protect dismounted soldiers.

Named one of the best places to work in Massachusetts by the Boston Globe.

Purchased by Raytheon.

2010 Named one of the best places to work in Massachusetts by the Boston Globe.

2011 Chief Scientist James Barger elected to National Academy of Engineering.

2012 Principal Engineer Ray Tomlinson inducted into the Internet Hall of Fame

2013 Awarded National Medal of Technology and Innovation

Chief Scientist Steve Kent inducted into the Internet Hall of Fame

2014 Generated a state-of-the-art qubit with 40-microsecond coherence through a unique optical lithography process.

Today Raytheon BBN continues to solve difficult problems and remains an engaging collection of puzzle solvers and pioneers infused with the same entrepreneurial spirit that motivated Bolt, Beranek, and Newman more than sixty years ago.

To learn more about advanced technologies from Raytheon BBN Technologies, please call or write:

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