MEMORIAM: Fred Pfost

The Birth of the VTR and Its Ampex Inventors

BY PETER HAMMAR

The 1952-to-1956 saga of the six-member Ampex R&D engineering team creating the world's first broadcast-quality videotape recorder ended on 4 December 2023, with the death of the last surviving VTR team member, R. Fred Pfost, at age 95.

Pfost was the final hire of the five engineers chosen by Ampex video project leader Charles P. Ginsburg to help design the world's first practical, commercially available, broadcast-quality videotape recorder introduced in 1956 as the Ampex VR-1000.

Ginsburg's VTR team ultimately consisted of machinist Shelby Henderson, Ray Dolby—later of tape and film noise-reduction fame—FM signal expert Charles Anderson, mechanical engineer Alex Maxey, and principal video-head designer Fred Pfost.

In 1950, the new medium of commercial television broadcasting triggered what became a four-way race to develop a practical video recorder using magnetic tape that could affordably capture and reproduce live-looking pictures. Archiving and time-shifting programming for different time zones was still limited to cumbersome and expensive film-based "kinescopes" or "kines" with poor visual quality.

The four VTR research and development teams entering that race were: Bing Crosby Enterprises Electronics Division in Hollywood under John T. ("Jack") Mullin in 1950, showing a prototype by 1951; RCA in Princeton, New Jersey, in 1951 with their "Simplex" videotape system, demonstrating a prototype in 1953; in early 1952, BBC engineers in London led by Dr. Peter Axon, with their "Vision Electronic Recording Apparatus" ("VERA"); and starting in 1951 and the eventual winner, Ampex Corporation, with their VR-1000, first publicly demonstrated in 1956.

To achieve the 4-MHz bandwidth required for broadcast-quality video and a one-hour recording time, three of the four potential systems—Crosby, RCA, and the BBC—pulled the tape longitudinally past fixed video heads at high speeds, requiring large amounts of tape on huge reels. The prototype Crosby video recorder pulled tape at 100 ips with an 8,000-ft-long reel recording 16 min of monochrome video.

Mullin's later recorders had color capability and longer record/playback times. The RCA prototype employing a different signal processing system, also color, flew along at 360 ips on a 17-in. diameter reel offering only 4 min of recording. BBC VERA pulled a 15-min, 21-in. reel of 1/2-in. tape at 200 ips. All were working on eventually extending their running time to a full hour in color, a feature Ampex had from the beginning with their spinning head design and 15 ips tape speed, although only in monochrome.

The Ampex VTR design team. (L-R): Fred Pfost, Shelby Henderson, Ray Dolby, Alex Maxey, Charles Ginsburg, and Charles Anderson.

Already a leader in audio and data tape recording, Ampex jumped into the VTR fray in 1952 by hiring Charles P. Ginsburg to assemble an R&D team to find the best way to record 4 MHz of video. To get the project started, the engineers consulted magnetic recording pioneer Marvin Camras of the Armour Research Institute of the Illinois Institute of Technology in Chicago, the inventor in 1939 of AC bias for all magnetic recording. Camras suggested Ampex should consider using an Armour patent he had experimentally developed, but never productized: 2-in.-wide tape moving at only 15 ips past a small disc spinning at up to 15,000 revolutions per minute (RPM) on which were mounted three video record/playback heads scribing magnetic arcs across the flat surface of the tape—so-called

Fred Pfost at the 2006 Technical Achievements Emmy Awards program.

"arcuit-scan recording"—providing the necessary 4 MHz bandwidth.

The Ampex team modified the original Camras design, mounting four video heads on the edge of an equally small disc spinning at 14,400 RPM, scanning the two-in. tape *transversely* to the tape path with an effective 1920 ips tape-to-head speed, a practical impossibility for the three competitors with their fixed-head designs. Based on using four heads, the Ampex team gave their design the nicknames of "quad VTR" and "transverse-scan recording".

The four heads made a total of 32 two-in.-long vertical scans per frame. Playback was achieved by a challenging balance—the same video head had to "find" the first track of the first field and stay locked on subsequent tracks. Before Ampex introduced improved "quadrature" with each of the four heads adjustable, along with analog "time error correction," VTR-to-VTR interchange was impossible, so when shipping a tape for playback on another VR-1000, the removable head assembly was sent in its custom shipping box with the tape it had recorded. Tracking the audio and control-tracks was no problem, with their fixed heads recording two narrow longitudinal tracks along the edge of the tape. The resulting four MHz video bandwidth on 2-in.-wide tape in a 14-in. National Association of Broadcasters (NAB) tape reel could record an hour of monochrome video.

On 14 April 1956, Ampex showed its winning design at the annual convention in Chicago of the National Association of Radio and Television Broadcasters (now the NAB). As keys to their success, Ginsburg credited the unique contributions of each of his team members during their four years of R&D work. He also praised the first successful videotape formulation—the basis for the future Scotch No. 179—created by a 3M team under W.W. ("Bill") Wetzel.

Head designer Fred Pfost got the honor of being at the controls of the dramatic unveiling of the "Mark IV" prototype that went on to become the VR-1000, with the Ampex group receiving a wild ovation from the amazed TV executives and engineers who never expected such a television recording breakthrough. After that first standing-room-only demonstration and during non-stop demos over the next four days, the company wrote a year's worth of orders for the $50,000 machines, adjusted for inflation at a cost of over $500,000 today, with the first units delivered in early 1957.

The next year, Ampex Corporation received the Emmy® award for "The World's First Video Tape Recorder."

The inventions and patents behind that first Ampex VTR advanced the state of the magnetic-recording art worldwide, with Ampex patents used in videotape, videocassette, and video disc machines of all kinds, and even today in digital video streaming applications.

The six VTR R&D team members—all of whom received an Emmy Lifetime Achievement Award in 2005—moved on to related fields, including Ray Dolby at his Dolby Laboratories with audiotape and film noise reduction and other audio and video innovations. Charles Ginsburg, Charles Anderson, and Shelby Henderson stayed on at Ampex, as did Alex Maxey, who developed the world's first commercially available helical-scan VTR, the Ampex VR-8000 using 2-in. tape, introduced in January 1961, at the National Association of Educational Broadcasters (NAEB) convention, followed just weeks later by helical VTRs from Toshiba, JVC, and Sony. Maxey went on at other companies to develop one-in. helical recorders for portable and studio use, the patents for which ended up as the Bosch-Fernseh SMPTE-standard "Type B" format.

Fred Pfost joined Kurt Machein's MVR Corporation, where another of his inventions made possible the world's first video instant-replay and stop-action recorder, the monochrome MVRVDR-210CF video disc machine, a broadcast-TV innovation for which the company received an Emmy award. Pfost's design came out of his earlier work at Data Disc on high-density recorders, the precursor of all hard-disc drives.

Pfost continued helping make video history with his work on a cartridge-based videotape playback-only machine, launched in 1972 as "Cartrivision," the world's first home video format to offer feature films for consumer rental. As with other American electronics, Cartrivision was eclipsed by offshore companies, including the Japanese with Sony's Betamax, JVC's Video Home System (VHS), and the Dutch Philips Video Cassette Recording (VCR) format, all of which required numerous Ampex video patents.

Pfost and teammates Ginsburg, Dolby, Anderson, and Maxey were SMPTE Fellows.

—Peter Hammar, Ampex Historian

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