Dr. Harry L. Van Trees

EDUCATION

Sc.D.E.E., Massachusetts Institute of Technology (1961)

At M.I.T. he was a National Science Fellow while studying for his doctoral degree. My academic average was a 4.96 out of 5.00, and my doctoral thesis was published as an M.I.T. Press monograph.

His doctoral thesis advisor was Professor Yuk Wing Lee, a protégé of Norbert Wiener, who led the Statistical Communications Group. Professor Amar Bose, whose acoustic research was in its early stages, was a member of his committee. He was one of a small number of graduates offered a position as an Assistant Professor.

B.Sc., U.S. Military Academy, West Point (1952)

He graduated first in a class of 525 students. At graduation he was awarded nine prizes for standing first in the class of Mathematics, Physics, Chemistry, Electricity, Mechanics, Military Topography and Graphics, Military Art and Engineering, Psychology and Leadership (The Eisenhower Award), and overall class standing. This is the largest number of prizes awarded to a single graduate in the history of West Point

EXPERIENCE

The experience summary is divided into four sections: academic, government, industrial, and entrepreneurial. Within each section, the entries are chronological.

Academic

June 1961-June 1972: Professor of Electrical Engineering, Massachusetts Institute of Technology.

Dr. Van Trees joined the M.I.T. faculty after receiving his Sc.D. in 1961, received tenure in 1968, and was appointed a full Professor in 1969. He formed a new research group in the area of signal processing. He and his students made major contributions in detection and estimation theory. Many of his students became leaders in government, industry and academia.

One of his most important professional contributions during this period was a three-volume set of books on *Detection, Estimation, and Modulation Theory*. These books contained a number of new research results in addition to a unified approach to communications, radar, sonar, and seismic applications. The first volume is the classic in its field, is used in graduate schools throughout the world, and has been translated into Russian and Chinese. Part I had thirty printings through 1998 and has been used to

educate an several generations of engineers and is one of the most widely-referenced books in the field. The second and third volumes are widely used as references in the communications and radar/sonar area. The three parts were reprinted in paperback in 2001. Almost all of the current radar, sonar and navigation systems rely on the theory developed in these books. I would estimate that at least 25% of the graduate engineers who developed the systems essential to modern warfare used my books.

He also produced two comprehensive videotaped courses in Applied Probability and Random Processes, which were widely used in universities and industry.

Sept. 1988- June 2012: George Mason Institute Professor of Electrical Engineering and Director, Center for Excellence in Command, Control, Communications, and Intelligence, George Mason University. University Professor Emeritus

The focus of my activities at George Mason University can be divided into three time periods.

1988-1997

Dr. Van Trees joined the George Mason University faculty with an Endowed Chair and a joint appointment in the Electrical Engineering Department and Systems Engineering Department.

He founded the Center of Excellence in Command, Control, Communications, and Intelligence (C3I) in June 1989 with grants from the Virginia Center for Innovative Technology and several government agencies and private companies. The Center grew rapidly and, at its peak had 15 faculty members associated with it and an annual budget exceeding 5 million dollars. The mission is to create a theoretical basis for the C4I area.

He led the development of a C3 curriculum as an option under the M.Sc. System Engineering program. This curriculum was the only quantitative program in this area in the world. As part of this curriculum, he developed and taught a two-semester course, "Principles of C3," laying the quantitative foundations for the area.

1997-2005

During this period, Dr. Van Trees continued to direct the C3I Center but de-emphasized further growth. He focused his attention on his own research and writing in the statistical signal and array processing area.

In collaboration with Professor Kristine Bell, he supervised a number of doctoral students and co-authored a large number of journal articles and conference papers.

His most important contribution during this period was his book, "Optimum Array Processing", Part IV of the Detection, Estimation, and Modulation Theory series which was published in 2002. It has received wide acceptance throughout the world and has been translated into Chinese. All of the phased arrays used in military systems (e.g. Aegis, Pave Paws, fighter radars) utilize the theory developed in this book.

Dr. Van Trees retired from George Mason University on September 1 , 2005 and is a University Professor Emeritus and a consultant in the areas of detection and estimation theory and array processing.

2005-2012

Dr. Van Trees is currently a University Professor Emeritus and has continued writing books. The book, "Bayesian Bounds for Parameter Estimation and Nonlinear Filtering/ Tracking "was edited with Dr. Kristine Bell and was published by Wiley Interscience /IEEE Press in September 2007. The book develops techniques to bound the performance of estimation and tracking systems. This area of research evolved from theory that Dr. Van Trees invented in 1965.

He is currently finishing a second edition of his first book on Detection and Estimation Theory. The 980 page manuscript was submitted to the publisher on June 20, 2012. The development of many new results in the 44 years since the first edition resulted in a book with 60% new material. It should become the text to educate several more generations of engineers.

Government

In June 1972, M.I.T. loaned Dr. Van Trees to the Defense Department. This led to a sequence of increasingly responsible government positions.

He held four senior level positions in DoD: Chief Scientist of the Defense Communications Agency (now DISA), Chief Scientist of the US Air Force, Principal Deputy Assistant Secretary of Defense for C3I, Acting Assistant Secretary of Defense for C3I.

June 1972-Feb. 1975: Chief Scientist and Associate Director, Technology, Defense Communications Agency.

Dr. Van Trees was the Chief Scientist and Associate Director, Technology, Defense Communications Agency. He was the first person to occupy this new position. In this position he was the primary scientific and technical authority for the director and provided policy guidance to the various directorates on the technical matters. He was in charge of the Defense Communications Agency Research and Development Programs. He was responsible for the establishment of a centralized engineering center at the Defense Communications Agency, The implementations of Military Satellite Office and

was a major contributor to the worldwide military command and control systems program.

He was instrumental in moving defense communications from analog technology to digital technology.

He organized the first DCA Advisory Committee and used his contacts to get a group of senior communications experts to advice DCA. This group played a major role in many important policy decisions, including the evolution of ARPANET.

He was the senior civilian in the agency and the primary scientific and technical authority for the Director. He assumed responsibility for the DCA and DCS R&D program, established a centralized engineering center, organized the military satellite office, and acted as a major contributor to the WWMCCS efforts of the DCA. He was instrumental in moving defense communications from analog technology to digital technology.

He organized the first DCA Advisory Committee and used his contacts to get a group of senior communications experts to advise DCA. This group played a major role in many important policy decisions, including the evolution of ARPANET.

Nov. 1978-June 1979: Chief Scientist, United States Air Force.

Dr. Van Trees was the chief scientific advisor to the Chief of Staff, USAF, and to the Air Force in all areas of research, development, and acquisition and as such, interacted with Air Force agencies and staffs involved in research and development.

Dr. Van Trees contributed significantly to the vitality of today's Air Force basic and exploratory research programs. Immediately after taking office, he undertook, at his own initiative, a review of USAF R&D efforts in order to evaluate their technical merit and assess the overall management direction. Because of his involvement, he became the first Air Force Chief Scientist to be given the official responsibility of advocating and overseeing the USAF's basic research and advanced development budgets. His efforts were well known and appreciated by the USAF's basic research and advanced development budgets. His efforts were well known and appreciated by the USAF's scientific and technical community and contributed greatly to a new sense of spirit and dedication among these key professionals.

Dr. Van Trees also spearheaded a drive to focus the USAF's C3 programs into a unified and cohesive plan to enhance connectivity and survivability. Since he was a recognized national leader in the C3 area, he was invited to participate as a special advisor to the Defense Science Board's (DSB) investigation into the connectivity of the United States strategic forces and their ability to communicate during a nuclear crisis. Not only did his participation add immeasurably to the results of the DSB study, but he was also able to provide feedback to Air Force leadership which assisted them in aligning their programs to met total DoD needs. Dr. Van Trees served as a major interface between the Air Staff

and the Air Force Scientific Advisory Board and initiated several important study efforts. He also conducted several internal studies which had significant impact on Air Force decision makers. In each case he integrated diverse elements of the Air Force into a coherent team.

He played a key role on the Air Staff for many communications and C2 programs. In particular, he helped shape the military satellite program and the evolution of JTIDS (joint tactical information distribution system).

June 1979-Jan. 1981: Principal Deputy Assistant Secretary of Defense C3I.

Dr. Van Trees served as the Assistant Secretary's alter ego and was involved in all major actions of the office. In this capacity, he shared with the Assistant Secretary responsibility for a total program consisting of about 400 program elements, which spans all ten major program areas of the DoD and all five appropriation accounts. Resources managed under this cognizance amount to approximately $14 billion annually and 140,000 military and 42,000 civilian personnel. These resources are employed to provide command, control, communications, and intelligence support to U.S. military forces at all echelons – The National Command Authorities and the Joint Chiefs of Staff on a world-wide basis; the Unified and Specified Commands in their areas of Responsibility; and individual units operating separately or as part of joint or multi-national operations. These C3I programs are key elements required to assure timely, efficient and effective structuring and utilization of U.S. forces, alone or with those of allies in the interest of national security. Together with the Assistant Secretary, Dr. Van Trees was responsible for assuring a proper balance of C3I capabilities through the DoD planning, programming, and budgeting process and serves as a key participant in the justification of resource requirements to the Congress.

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Dr. Van Trees was responsible for the internal management of the C3I staff which includes four Deputy Assistant Secretaries, nine Directors, and a total of 83 people. He defined clear areas of responsibility, improved internal communications and initiated weekly program review. These actions resulted in improved staff productivity and improved staff morale. By emphasizing continuing coordination with the Services he generated an unusually high level of cooperation between the Services and the Office of the Secretary of Defense (OSD). In addition to the internal staff, he provides supervision on a frequent basis to the Military Satellite Office (MSO) and the World- Wide Military Command and Control System (WWMCCS) System Engineer in the Defense Communications Agency. He refocused the activities of the MSO to give them a key role in military satellite decisions. In the WWMCCS area, he developed an innovative management structure involving the Joint Chiefs of staff (JCS), Defense Communications Agency (DCA), and the Services to modernize the WWMCCS Information System. A new C3I organization became affective when Dr. Van Trees took office. He has

spearheaded the effort to recruit high quality senior people for Deputy Assistant Secretary and Director positions.

Dr. Van Trees was in charge of all U.S. C3I activities in the NATO area. His primary responsibility was Chairman of the Four-Power C3 Senior National Representatives (U.S., UK, Germany, and France). This group provides a forum for innovative initiatives in the NATO arena. Under his leadership they laid the basis for a NATO System Engineering capability, agreed upon forming an international air command and control system team, and agreed on several cooperative development programs in the tactical radio field. These actions have required extensive and skilful negotiations with the other governments, Supreme Headquarters Allied Powers Europe (SHAPE) , and industry. In his second role, as the U.S. representative to the NATO Joint Communications and Electronics Committee (the senior NATO committee) he has forced a realistic reappraisal of the NATO IV satellite program and a plan to improve the program. Once again this required skillful negotiation with other NATO representatives. His third major NATO role was the U.S. representative to the "Board of Directors" of the SHAPE Technical Center (STC). Working with the Director, STC, and with SHAPE Headquarters, he has taken the lead in re-orienting the STC program to make it more responsive to SHAPE needs. In addition to satellite area, Dr. Van Trees negotiated significant agreements as the secure voice and IFF area.

In all, DoD executive positions, Dr. Van Trees played a major role in the planning, programming, and budgeting process. He initiated an improved structure for C3I Mission Areas which allows better program visibility and provides a basis for improved understanding of the C3I area. He initiated a long range planning process in C3I to provide an improved basis for program decisions. He initiated two new efforts which will provide major benefits in the long term: the first is a C3I system research program to develop a conceptual framework for C3I; the second is a program to develop quantitative evaluation procedures to assess the utility of C3I systems. Toward this goal Dr. Van Trees chaired an extensive conference on the Quantitative Assessment OF the Utilization of Command and Control Systems which included the participation of major military, contractor, academic, and senior Defense civilian personnel.

Dr. Van Trees made a major contribution to national security in conjunction with the NORAD false alarms on 3 and 6 June 1980.

On June 3, 1980, NORAD sent messages to SAC and the NMCC that 200 SLBMs had been launched. SAC took survivability measures by ordering bomber pilots and crews to their station at alert bombers and tankers and to start the engines. The Pacific commands airborne command post took off and the NEACP taxied into position at Andrews a FB. However, the missile warning sensors DSP, BMEWS, etc. shower nothing on their screens so the military commanders were able to call off further military action. Dr. Van Trees flew to SAC and NORAD on June 4 and lead the DoD effort to find the cause of the problem and find a way to fix it. He organized a small task force of leading computer experts lead by Bob Evans of IBM to solve the problem. It turned out that the problem

was the failure of a $.46 computer chip. This was highlighted in the press. However the real issue was the necessity to redesign the signal processing algorithms so that single failures could not result in system failures. The task force developed solutions and Dr. Van Trees worked with the NORAD J-6 for the next several months to implement the new version. There were no subsequent false alarm problems.

During this time, he instituted a mission-oriented management structure in the C3I staff, provided guidance to a number of important C3I programs, and provided direction to the Military Satellite Office, the WWMCCS (Worldwide Military Command and Control System) System Engineer, and the Defense Communication Agency. He was in charge of all U.S. C3I activities in the NATO area and was responsible for major accomplishments in the area of satellite communications, secure voice, and IFF in NATO.

There were several serious false alarms in the Missile Warning System at NORAD. Dr. Van Trees led the effort to find the failure mechanism and redesign the system.

Jan. 1981-Aug. 1981: Acting Assistant Secretary of Defense; Command, Control, Communications, and Intelligence C3I.

Dr. Van Trees assumed the Assistant Secretary's responsibilities. During this period he made a significant contribution to national security by initiating the Milstar satellite system in April 1981.

In 1981, President Reagan announced a strategic modernization program and directed that strategic C3 be given top priority. A key issue was to provide a satellite system that could provide guaranteed communication during a nuclear war which might last over several days. During 1979 to 1981, there had been continuing debate among the Air Force, the Defense Science Board and the intelligence community about the best solution. None of these candidates were accepted. Instead, a multi-mission architecture mission offered the best solution. Using an architecture developed by colleagues at M.I.T. Lincoln Labs. Dr. Van Trees managed to get the agreement of all of the interested communities and issued the implementation order in April 1981. The Cold War was over by the time the first Milstar satellite was launched in 1994. However most historians agree that having the Milstar program to give the U.S. the C3 necessary to effectively wage a nuclear war was an important bargaining chip in discussion with the Soviets.

Dr. Van Trees was responsible for the research, development, and acquisition of C3I systems for the Department of Defense. The program consisted of nearly 400 program elements with annual expenditures of approximately $30 billion. He was responsible for providing leadership and direction to the DoD C3I efforts, coordinating service programs, and ensuring a proper balance of C3I capabilities. He played a major role in the development of the military satellite architecture and he initiated the MILSTAR program in April 1981.

Industrial

March 1975-Nov. 1978: Assistant Vice-President, Advanced Systems, Communication Satellite Corporation

He was head of the Advanced Systems Division, whose responsibilities included planning the future INTELSAT system, including the INTELSAT VI satellite.

During this period, he edited an IEEE Press book on "Satellite Communications". It gave him an international reputation and excellent technical background for the subsequent government positions.

Aug. 1981-April 1985: Executive Vice-President, M/A-COM Linkabit and General Manager, Eastern Operations

Dr. Van Trees started the M/A-COM Government Systems operation in Washington and Boston. In three years, it grew to an organization of 200 (with 80 engineers, 40 with advanced degrees) and sales of $35M. Dr. Van Trees personally led the development and production of a portable SHF satellite communications terminal for the White House Communications Agency and other national users.

The portable SHF terminal was an outstanding accomplishment. It was carried in a set of suitcases and could be deployed quickly. It was the only SHF connectivity General Schwarzkopf had when he first arrived in theater for the first Gulf War.

April 1985-Sept. 1988: President, M/A-COM Government Systems Division.

M/A-COM Government Systems was a high technology division in the defense electronics area. It was a world leader in the development and production of modems, decoders, and communications terminals for military satellite systems. Annual sales approached $90M. MGS had over 1600 employees (including 350 engineers) in San Diego, Boston, and Washington. The division had a reputation for innovative design, state-of-the-art solutions to complex communication systems problems, and excellent system engineering. Dr. Van Trees was responsible for running the division and reported to the CEO of M/A-COM. During this period, the division produced the Army MILSTAR Terminal (SCOTT) modem, the UHF satellite terminal for MAC, an advanced DAMA/CDMA model, a high performance UHF radio, an SHF-receive terminal for the nuclear forces, and a portable SHF terminal used for Presidential communications.

ENTREPENURIAL ACTIVITIES

April 1982-June 1998: **AFCEA Professional Development Center**

In collaboration with Dr. Jon Boyes, the President of the Armed Forces Communication and Electronics Association (AFCEA), Dr. Van Trees founded the Professional Development Center. The mission was to teach short courses (classified at the secret level) to professionals in government and industry. Dr. Van Trees organized and was the principal lecturer in the first two courses; "Military Satellite Communications" and

"Principles of Command, Control, and Communications". These courses were taught two or three times per year and typical audiences were 50-75 students from the government and defense contractor area. Often they included senior (0-4 to 0-6) officers who had just been assigned to run a program and wanted to understand it. Dr. Van Trees taught these courses in addition to his full time job. These two courses are still being offered and have been taken by several thousand military and civilian professionals over the years. Many of these students played a major role in the development and production of C3 systems.

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February 1991-August 1999: **CommQuest Technologies Inc.**

In 1991, in collaboration with Dr. Hussein El-Ghoroury and Dale McNeill, former colleagues at M/A-COM, Dr. Van Trees co-founded CommQuest Technologies Inc. and was the first Chairman of the Board of Directors.

The company developed efficient satellite modems. However, its outstanding accomplishment was a low-cost, low-power consumption GSM chip-set for cellular telephones. The company was very successful and was acquired by IBM in 1999.

PROFESSIONAL AWARDS

National Science Foundation Fellow (1960, 1961)
Fellow, Institute of Electrical and Electronic Engineers (1974)
Meritorious Civilian Service Award (1975)
Presidential Award for Meritorious Executive (1980)

AFCEA Gold Medal for Engineering (1988)
Virginia Cultural Laureate (1992)
AFCEA Education Medal (1993)

PUBLIC SERVICE

The following is a list of previous memberships. I am not currently active on any committees.

Member, U.S. Air Force Scientific Advisory Board
Member, U.S. Air Force Studies Board, National Academy of Sciences
Member, Space Division Advisory Group, U.S. Air Force
Member, Army Science Board

Member, Rome (Air Force Base) Labs Advisory Group
Member, Defense Information Systems Agency Scientific Advisory Group
Member, Board of Directors, AFCEA Educational Foundation

MAJOR PUBLICATIONS:

Detection, Estimation, and Modulation Theory, Part I. New York: John Wiley and Sons, 1968.

Detection, Estimation, and Modulation Theory, Part II. New York: John Wiley and Sons, 1971.

Detection, Estimation, and Modulation Theory, Part III. New York: John Wiley and Sons, 1971.

Synthesis of Optimum Nonlinear Control Systems. Cambridge, Massachusetts: Massachusetts Institute of Technology Press, 1962.

Probability, Volumes I-IV, Massachusetts Institute of Technology, 1970, 1506 pages. This is a detailed study guide to accompany the *Probabilities* video-taped course.

Random Processes, Volumes I-V, Massachusetts Institute of Technology, 1971, 1100 pages. This is a detailed study guide to accompany the *Random Processes* video-taped course.

Probability (fifty video-taped lectures, 22 hours). This was a graduate-level video course produced by the Center for Advanced Engineering Study at M.I.T.

Random Processes (fifty video-taped lectures, 22 hours). This was a graduate-level video course produced by the Center for Advanced Engineering Study at M.I.T.

Satellite Communications (Ed.), IEEE Press, 1979.

Proceedings of the IEEE, Special Issue on Packet Communication Networks, Volume 66, No. 11, pp. 1303-1576, November 1978. Kahn, R. (Guest Editor), Uncapher, K. and H. Van Trees (Associate Guest Editors).

Detection, Estimation, and Modulation Theory, Part IV,: Wiley Interscience, New York, NY, 2002

Bayesian Bounds for Nonlinear Filtering and Tracking,(with Dr. Kristine Bell): Wiley Interscience, New York, NY, 2007

Personal
Married to Diane Enright. Seven children and nineteen grandchildren.

Runner since 1969. Completed five Boston marathons.(personal best 3:17)

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