Australian Telecommunications Commission

Telecom Australia

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Research Laboratories

762–772 Blackburn Road
Clayton North
Victoria 3168

20 March 1984

Mr. J.H. Curtis
35 Boyd Street
Blackburn South
VICTORIA 3130

Dear Jack,

HISTORY OF TECHNOLOGY

Recently, Roger Banks advised me that you were writing a chapter on the "History of the Development of Communications, Radio and Computers" for inclusion in a history of technology in Australia which is being compiled by the Academy of Technological Science. Roger asked me to provide you with some background material on the role of Telecom's Research Laboratories.

The attachment to this letter has consequently been prepared as a brief history of the Laboratories since they were established in 1923. It draws its material mainly from the more comprehensive history of the Laboratories which was documented in the 1972/73 edition of our Review of Activities, a copy of which is also enclosed.

I hope that this material assists you in your assignment for the Academy. Should you wish to discuss the material further, please do not hesitate to call me.

Yours sincerely,

(Signed) E. SANDBACH

E. SANDBACH

Encl:

Mr A Quan

23/3

Dr A. Gibbs

Copy for info – apropos to your related task for R. Smith. Pls see p 6, expanded bottom item.

Sanders 19/3

AN OUTLINE HISTORY OF THE RESEARCH LABORATORIES

TELECOM AUSTRALIA

19/3/1923 : The Research Laboratories (PMG's Department) were established as a one-man Section at HQ. The founding father was Mr. S.H. WITT. Since then, Heads of the Laboratories have been :

Mr. S.H. Witt	1923 to 1945
Mr. E.P. Wright, B.Sc	1945 to 1953
Mr. N.J. McCay, B.Sc	1953 to 1960
Mr. L.M. Harris, OBE, B.Sc	1960 to 1964
Mr. P.R. Brett, OBE, B.Sc	1964 to 1975
Mr. E.F. Sandbach, AM, B.A. B.Sc, F.I.E. (Aust), FTS	1975 to present (1984)

(Refer Review of Activities, 1972/73, for biographies of Witt to Brett and to Review of Activities, 1975/76, for Brett and Sandbach)

The original charter of the Laboratories was to study "the latest discoveries, inventions and developments in electrical communications" and to advise the Chief Engineer on those "which are promising and likely to benefit the Department's telephone and telegraph services". This charter remains relevant today, except that there is greater diversity of services and greater complexity in telecommunications techniques and technologies.

The initial work of the Laboratories concerned the application of vacuum tube repeaters in the infant Australian trunk network, which was then based on the use of open wire lines. The first 2-wire VF repeaters were introduced into the Sydney-Melbourne trunk route on an experimental basis in 1922 following a visit by Mr. R.N. Partington, acting Chief Engineer, and Mr. S.H. Witt to the USA, England and Europe. (This visit led to the establishment of the Laboratories in 1923).

1923 : The Laboratories established the PMG Department's first reference standards for telephone transmission performance and telephone quality assurance. This work has since extended to subjective and objective measurement of transmission performance and to contributions to

international efforts to standardise measurement techniques and to define key performance parameters. Key figures in this work have included G.N. Smith, J.C. Wilson, D.A. Gray, E. Koop and R.W. Kett. The work has continued to keep up with developments in telephone instruments and transmission systems and it now engages specialist attention in both the Research Laboratories and the Engineering and Commercial Services Departments at HQ.

23/4/1925 : The Laboratories were more firmly established as a Section of five staff (3 engineers, a mechanic and a clerk). The principal field of activity centred on voice frequency trunk transmission and the application of repeaters, which were one of the early applications of the vacuum tube amplifier. This work extended shortly into 3-channel carrier systems and later 12-channel carrier systems.

The staff were :

Mr. S.H. Witt	Supervising Engineer
Mr. E.P. Wright	Engineer
Mr. A.A. Lorimer	Engineer
Mr. G.G. Robb	Mechanic
Miss F. Terrell	Clerk/Typist

1925 : Mr. S.H. Witt installed the first 3-channel open-wire carrier system in Australia on the Sydney-Melbourne trunk route; transmission measuring equipment and transmission standards were developed. This work continued in the line transmission field, with 12-channel open-wire carrier systems introduced into the Australian network by Laboratories and Engineering Department staff in the late 1930s.

1925 : Research activities extended to transmission of radio broadcast programmes over the trunk network. The first simultaneous interstate broadcast was engineered by the Laboratories in 1925 between Melbourne, Sydney, Brisbane and Adelaide via a network hook-up of six stations (2FC, 2BL, 3LO, 3AR, 4QG, 5CL).

1925-27 : The Laboratories begin to establish expertise in radio field strength measurement techniques - applied to MF broadcast transmitters.

1927 : Laboratories staff engineered the national broadcast relay network for the Opening of Parliament House, Canberra, by the Duke of York.

1927 : The Laboratories' measurement facilities and reference standards for the precise measurement of electrical quantities (voltage, current, resistance, capacitance, inductance, etc) were established by Mr. A.A. Lorimer. These facilities have been progressively extended over a widening frequency spectrum to keep pace with the demands of advancing telecommunications technology for increasingly precise measurement accuracies and calibration of test equipment. A key engineer engaged in this field over the last 30 years is Mr. J.M. Warner. The Laboratories expertise and facilities were recognised through NATA accreditation in 1960.

1927-1939 : Mr. S.H. Witt was seconded to plan the Australian National (Radio) Broadcasting System. Laboratories' support was provided to design broadcast transmitters and antennas, and to evaluate studio equipment.

1928 : Laboratories' staff set up the first Australian HF transmitter station on an experimental basis at Lyndhurst, Victoria. The station went into regular service in 1934 to provide broadcast services to those beyond the reach of the MF services. The Laboratories upgraded the station's equipment in 1938.

1928 : The Laboratories' measurement facilities and reference standards for time interval and frequency were first established by Mr. D. O'Donnell - with accuracy traceable to national and international standards. These facilities have been since extended to keep pace with new techniques and technologies. Key engineers in this field were/are Mr. A.H. Cannon, Mr. E. Sandbach and Mr. R. Trainor.

1928-1944 : Laboratories' studies of multichannel telegraph systems and the multiplexing of telephony and voice frequency telegraphy services over carrier systems assisted the establishment of national telegraph services, particularly during World War II when emergency telegraph services were required to be provided. A key figure in this work was Mr. E.H. Palfreyman.

1931 : Physical Sciences activities commenced in the Laboratories under Mr. D. O'Donnell followed by Mr. P.R. Brett. These activities now provide specialist skills and facilities in the fields of analytical chemistry, electro-chemistry, polymer chemistry, metallurgy and applied physics to

underpin Telecom's reliability assessment and quality control activities, with traceability of measurement accuracy in some instances to national standards. NATA registration of the Laboratories facilities and expertise in the environmental testing sphere under controlled temperatures and humidity was obtained in 1979.

1932 : The Laboratories now employ 35 staff, accommodated at 59 Lt. Collins Street, Melbourne, a building they were to occupy until 1983. In 1975, building work started to progressively consolidate the Laboratories in new laboratory buildings at Clayton. Consolidation was achieved in 1983.

1935-1954 : In 1935, the Laboratories assisted in the laying of the coaxial submarine cable between mainland Australia and Tasmania via King Island, which was then the longest submarine cable in the world. A key Laboratories' engineer on this project (representing the Department to the cable laying company) was Mr. G.N. Smith.

In 1954, the Laboratories designed and built a special 9-channel carrier system to extend the capacity of the submarine cable. Prominent engineers on this project were L.M. Harris, E.P. Wright, D.A. Gray and R. Buring.

1937-1938 : The first 12-channel VHF radio telephone system in Australia was engineered by the Laboratories between Mount Tanybryn, Victoria, to Stanley, Tasmania (168 miles) to provide relief while the submarine cable to Tasmania was repaired. Subsequently, in 1942, VHF single channel systems were also installed to link Tasmania and Flinders Island.

1939-1945 : During World War 2, the Laboratories assisted in the development of radar systems and special radio communications systems for the armed services. Radio transmitters and receivers for air, ground and armoured vehicle use were evaluated. A special radio receiving station for overseas transmissions was designed and commissioned at Werribee, Victoria. The station used remote-controlled aerial switching and aerial amplifiers, which were novel features at the time.

1941 : The Australian Government agreed to establish a high power short wave transmitting station in Australia to broadcast to the South Pacific Islands and South-East Asia. The station was to be Radio Australia, Shepparton, and Mr. S.H. Witt was asked to plan the station. Laboratories' and PMG Workshops' staff designed and set up the station, which began operating in May 1944. Other key engineers were A. Kline and R.B. Mair.

1944-1946 : The Laboratories, drawing on radar experience from the wartime activities, developed a 3-channel 2 GHz microwave system for propagation experiments and use between the Laboratories and a field site at Mont Park. The work led to experiments with microwave systems between Melbourne and Sydney and over Port Phillip Bay. Key engineers were J. Campbell, J. Mc Leod, F. Orr, H. Hyamson and O.Moriarty.

1945 to present : Radio telephony investigations extended to VHF and UHF systems, including related work on the technology for the realisation of such systems and on antenna design. Most recently, work has changed emphasis from broadband analogue microwave systems to digital systems for both voice and data transmission.

1946 : The first experimental investigations of VHF (160 MHz) mobile services were conducted.

1947-1960 : The Laboratories engaged in investigations relating to the ultimate introduction of the National TV Broadcasting Service in 1956 - recommending the adoption of a 625-line system standard. The work also examined measurement systems involving advanced high-speed waveform and time domain techniques in anticipation of TV broadcast programme transmission services being provided over the telecommunications network. A video transmission test set was developed in the early 1950s by Dr. A.J. Seyler and Mr. J.B. Potter. Subsequent work examined techniques for bandwidth compression of TV signals and this led to work on Teleconferencing services.

1949-1950 : Microwave propagation studies at 3 and 9 GHz were concentrated on possible applications on the Sydney-Goulburn and Melbourne-Sydney routes. Mr. J. Reen was closely associated with this work.

1953 : The Laboratories designed and commissioned a 900 MHz 120-channel system between Korrumburra and Mt. Oberon to allow the Marconi system across Bass Strait to take additional channels whilst the alternative submarine cable link was being repaired after a serious failure.

1954 : Laboratories' propagation studies resulted in choice of Wilsons Promontory - Flinders Island - Tasmania path for 80-80/160 MHz Marconi System. The Laboratories designed antennas and developed two 160 MHz power amplifiers for the project.

1956 : Laboratories' studies of coaxial cable systems and associated transmission measurement techniques assisted planning and commissioning of the Sydney-Melbourne and subsequent major trunk co-axial cable system implementations in the 1960s.

1959 : The Laboratories designed and built a transistorised single channel carrier system for the Normanton-Burketown route. This was one of the first applications of transistorised equipment in the Australian network.

1960 : Laboratories-designed and constructed transistorised 12-channel repeaters, suitable for pole mounting in open wire carrier systems, were used on the Alice Springs-Darwin route. These repeaters used state-of-the-art solid state transistor technology and circuit packaging techniques in a harsh environment. Key engineers were Dr. E. Rumpelt, D.A. Gray and A.W. Thies.

1960 to present : Preliminary studies of digital coding and transmission techniques utilising the advantages of solid state electronics commenced - later assisting the specification and introduction of PCM systems into the Australian network in the late 1960s. Key engineers were D.A. Gray, H.S. Wragge, R. Smith.

Work on PCM transmission techniques and systems continued through the 1970s, to characterise the analogue network for conversion to digital working, to establish design rules for the expanding use of PCM systems in the junction networks, and to develop digital transmission performance measuring techniques and equipment. This work culminated in the adoption by the CCITT in 1982 of a technique embodied in an invention by Dr. A.J. Gibbs for the characterisation of the crosstalk performance of digital line systems. The novel technique was based on the measurement of a parameter called the Crosstalk Noise Figure to quantify the immunity of a particular PCM repeater to crosstalk interference. Key Laboratories engineers working in the digital transmission field in the 1970s were Mr. R. Smith, Dr. A.J. Gibbs, Dr. B. Smith, Mr. A.Y.C. Quan and Mr. G.J. Semple.

This work expanded in the late 1970s to cover a wide variety of studies of techniques and systems for the digital transmission of voice, data, image and text over dedicated digital networks - ultimately leading to an Integrated Services Digital Network (ISDN).

1960 to present :

The Research Laboratories conducted a preliminary study of the possible uses of satellites in telecommunications shortly after the first 2-way conversation took place using the passive ECHO 1 balloon. In 1961, Mr. E. R. Craig was seconded to the BPO and until 1964, he was responsible for the technical direction of the transmitter installation and operation at the Goonhilly earth station during the historic first exchanges of television and telephony signals between the UK and USA via Telstar 1. Laboratories engineers, notably B.R. Perkins, participated in subsequent international projects involving the Applications Technology Satellite (ATS) of NASA, playing the role of systems engineer at the ATS earth station near Toowoomba and later being seconded to NASA's Goddard Space Flight Centre.

In 1969/70, Laboratories staff commenced studies related to the use of satellites to provide telecommunications services, particularly to outback Australia and for mobile services. In depth propagation studies were conducted to study rain attenuation implications on service standards, and system design, and associated work concerned advanced microwave technology and antennas for satellite ground stations.

Mr. E. Craig played prominent roles both within PMG Dept/Telecom and in CCIR Study Group 4, following his earlier secondment with the BPO from 1961 to 1964 when he was responsible for the technical direction and management of the transmitter installation for the Goonhilly earth station. Mr. P.R. Brett was later Telecom's representative on an inter-Departmental Committee established to examine the potential uses of satellite communications in Australia. More recently, in 1980, the Laboratories have provided OTC(A), the ABC and the Department of Communications with technical assistance to evaluate Home and Community Broadcasting Satellite Services (HACBBS) directly broadcast via satellite transponders to small earth-station receivers, by laboratory simulation of the satellite transponder. In particular, the laboratory tests sought to measure inter-modulation effects when sound service was combined with TV service. Spectrum management issues were also studied and Messrs. E. Sandbach and E. Craig played key roles in WARC meetings.

functions. The exchange was installed in the Melbourne network and carried live traffic successfully into the late 1970s in the course of further studies of digital switching techniques, processor loading, maintenance techniques, traffic flows, etc., in SPC digital exchanges. Key engineers in the project were H.S. Wragge, F.W. Wion, G.L. Crew, M.K. Ward and Dr. F.J.W. Symons.

1971 : Laboratories, staff, in collaboration with CSIRO, commenced studies of a liquid-filled optical fibre invented by the CSIRO Division of Tribophysics. This work has since expanded in scale to consider multi-mode and single-mode optical fibre systems, which are on the point of introduction into regular service in the network. Field trials are now in progress. Considerable liaison has occurred over the last decade between Telecom, the Department of Defence, industry and academia to develop Australian capabilities in this important new field of telecommunications technology. Early work concentrated on characterising the transmission performance of fibres as media and this involved the development of specialised test instrumentation. Recent work extends from optical devices and media to transmission techniques and systems for immediate and longer term application. Telecom, through the Radio Research Board, has played an important role in bringing together Australian researchers in the field in regular Optical Communications Workshops. Key workers have included Dr. R. Morgan, Mr. G. Kidd, Dr. A. Gibbs, Mr. R. Ayre, Mr. G. Rosman.

1972 : The Laboratories developed a prototype Videoconferencing System which underwent successful trials via satellite link between Australia and Britain in 1973 and was later commissioned on a trial basis between Melbourne and Sydney. Subsequent work has concerned alternative forms of teleconferencing services and has involved human factors research and user studies in addition to the development of systems for experimental trials. Dr. A.J. Seyler was a key engineer leading this work.

1979 : Laboratories engineers, notably Dr. J. Steel, Dr. R. Coutts and Mr. G. Champion, conceived a specification for a Digital Radio Concentrator System (DRCS) which could be applied to provide automatic telephony services to remoter parts of rural Australia, where subscribers can be over 100

Km from their terminal exchange. These subscribers have only part-time manually operated services over low-quality transmission paths (wire or HF radio). The DRCS utilises PCM encoded speech, time division multiple access techniques, digital burst transmission techniques, cellular frequency assignments and digital regenerative repeaters to provide a novel and cost-efficient means of improving services to these remote subscribers. The DRCS was accepted by the Engineering Department and further development/supply was contracted to NEC Japan. Field trials of the DRCS are to take place in 1983/84, prior to more extensive use in a programme to provide automatic services throughout Australia by 1990.