

AUSTRALIAN POST OFFICE

Research Laboratories Field Site
Mount Cottrell, February 19, 1970

INFORMATION KIT

SATELLITE COMMUNICATION MAY HELP SOLVE ISOLATION PROBLEMS

The Research Laboratories of the Australian Post Office are engaged in a series of experiments to investigate some of the technical problems that would require solution before satellites could be used to provide telephone services to remote areas in Australia.

Such services, if introduced, would require the use of very small earth stations and the experiments, scheduled to continue until June this year, include the operation of an experimental model of such a station, which has been installed by the Laboratories at Mt. Cottrell near Melbourne.

The space segment for the current experimental programme is being provided by the microwave transponder in satellite ATS-1, by arrangement with N.A.S.A.. (A transponder is equipment which receives radio signals on one frequency and re-transmits them on another.)

To determine the technical parameters of an integrated system design to provide service to remote telephone subscribers by means of a satellite the Research Laboratories will use the Mt. Cottrell installation to represent the remote subscriber. This will be connected through ATS-1 over the Pacific to the N.A.S.A. earth station at Cooby Creek in Queensland which, for the experiments, will represent the interface between the satellite communication system and the terrestrial national network.

During the demonstrations at Mt. Cottrell, inspections will be made of the installations and Research Laboratories officers will outline and explain the purpose and extent of the experiments and will relate the findings to proposals under consideration to achieve the objective mentioned.

Telephone calls will be made between the Cooby Creek and Mt. Cottrell installations through ATS-1. Visitors to the demonstration will have the opportunity of speaking by specially installed telephones through the satellite link, over a distance of about 53,000 miles.

BACKGROUND INFORMATION NOTES RELATING TO THE MT. COTTRELL DEMONSTRATION

Satellite may bring Communication to Remote Australia

The Australian Post Office Research Laboratories are currently conducting experiments in co-operation with N.A.S.A. to determine the technical factors controlling the feasibility of using a satellite to provide telephone services with normal access to the main network for subscribers living in remote localities in Australia.

For some years the Post Office has been working towards achieving a completely automatic telephone system in Australia, and it is now policy that all new subscribers services must be suitable for automatic working.

In general practice subscribers are connected by physical line pairs to automatic exchanges, but as an alternative to physical lines radio telephone links have been in limited use for some time where it is more economical to connect subscribers this way. Experiments are now being made on the technical aspects of using satellites to provide a service to subscribers who are too far from an exchange to be served by either a physical line or a radio system.

In contrast to conventional exchange subscriber radio telephone links, subscribers to a satellite system would be linked directly through the satellite repeater without intervention by an exchange. However, supervision and control of such a network and its connection to the national telephone network would need to be carried out by means of a control station.

The major advantage of a satellite system would be that it can be used by earth stations anywhere in the area covered by the satellite's antenna. If a satellite was positioned so as to cover the whole of Australia, communications could be established to any point of the country by using suitable earth stations.

Last year the Post Office Research Laboratories carried out a systems study covering the provision of subscriber telecommunication services to remote areas by means of satellites. The conclusions contained in the report on this systems study were that a satellite service to telephone sub-

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scribers might be technically feasible when based on a multi-access method which would depend on a frequency division multiplex for channel separation and digital modulation of individual carriers carrying the voice signals. It was suggested that Delta modulation was the preferred digital modulation method.

The purpose of the current round of experiments is to evaluate some technical factors thrown up in this preliminary systems study and to obtain engineering data needed for a future systems implementation.

As would a future system, the experiments and related studies involve the use of small earth stations such as the prototype model which has been installed at Mt Cottrell in Melbourne. This small station will experimentally operate through the A.T.S.-1 satellite of the National Aeronautics and Space Administration (N.A.S.A), which is located over the Pacific, to the A.T.S. earth station at Cooby Creek, Queensland.

The current experimental programme, which will continue until June this year is based on the use of the microwave transponder in A.T.S.-1 to supply the space segment. (A "transponder" is a receiver-transmitter combination which receives on one frequency and transmits on another without operating on the information carrying signals). The facilities of the Cooby Creek Station are being used to simulate a multi-channel earth station required to connect the satellite subscribers into the national telephone network and to act as a network control and interface station.

The Need for Overcoming Isolation Problems.

The Australian National Telecommunications Network reflects the concentration of population in the South-East corner of the continent, and to some extent in the South-West corner, and the scattered nature of settlement throughout the remainder of Australia.

Recent developments particularly in mineral exploration, have resulted in increasing pressure for the supply of telecommunication services to those sparsely settled areas.

A major problem for the Australian Post Office is the supply of telecommunication services to a number of very remote homesteads for which it is not practicable to provide connection to the network by terrestrial means. Illustrating this situation is the fact that the Royal Flying Doctor

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Service is providing rudimentary communications to and between approximately 3,500 outstations. The service operates on common use high-frequency channels and outstations are not given voice connection to the national telephone network. In addition, more than 36,000 remote subscribers are connected to exchanges by means of part-privately erected lines which in many cases operate as a party line service. Nine hundred of these lines are over 30 miles long and may extend to up to 300 miles. The majority of these telephone services are not technically suitable for connection into an automatic network.

The HF services and many of the part-privately erected line services would form the bulk of subscribers which could be served by means of satellite subscriber services if such were technically and economically feasible.

However, a number of problems are associated with integrating a domestic satellite system into the national telephone network. Most of these problems arise from the time delay inherent in transmission through a geo-stationary satellite. The reason for using a geo-stationary satellite for this purpose is primarily to avoid the need for the earth stations to continuously track a moving satellite in a lower orbit. Any tracking operation would increase the cost of the earth station considerably and would price it out of the field of consideration for this type of service.

The transmission delay through a geo-stationary satellite is in the order of a $\frac{1}{4}$ sec., consequently the round trip delay including extension from the earth station may be more than half a second.

This creates human factor problems in adapting to a conversation containing such delays and at this stage of experience it is doubtful whether a satisfactory service can be obtained when two such satellite links are cascaded. However, this is as yet an undecided human factor limitation.

Technical problems which are more readily definable arise in the area of systems control that is commonly known as signalling in automatic telephone networks. It is already obvious that the conventional existing signalling systems would not satisfy the conditions obtaining in such a satellite system. Consequently a major portion of future investigations will be devoted to experimentation with novel and special signalling techniques. Any interconnection with the conventional automatic telephone net-

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work would then involve interface translation equipment to make the signalling system used in the satellite system compatible with that used in the national and international terrestrial systems.

To reduce the maximum time delay as far as possible to that encountered in a single satellite link the systems design for the current investigations aims at providing all services within Australia with not more than one satellite link. This is particularly important if one envisages that any such national subscriber may be connected into an international network containing at least one more satellite link and consequently may create time delays between subscribers in the order of 1 second.

Such delays may be acceptable in international links where the subscribers would be psychologically conditioned to special circumstances. However, within a national network they may not be acceptable when the average user is accustomed to alternative, high quality terrestrial circuits which do not contain such transmission delays.

The system aspects of such a subscriber satellite communication system are substantially different from those obtaining in trunk satellite communication systems such as those used in the international communication services of this country by the Overseas Telecommunications Commission.

Satellite trunk systems within Australia, however, have recently been introduced between Sydney and Perth making use of the O.T.C. earth stations at Moree and Carnarvon and of capacity in the Intelsat III satellite over the Pacific. This is the first case of regular commercial trunk telephone operations within a country's continental border, in contrast to the domestic circuits operated by the United States over a geo-stationary satellite which provide connections between the islands of Hawaii and mainland U.S.A..

From this domestic operation, the Australian Post Office is gaining valuable experience in the development of its proposals for a national system. In addition, the results of surveys of customer reaction may create considerable interest from a point of view of the acceptability of long transmission delays within a domestic telephone network.

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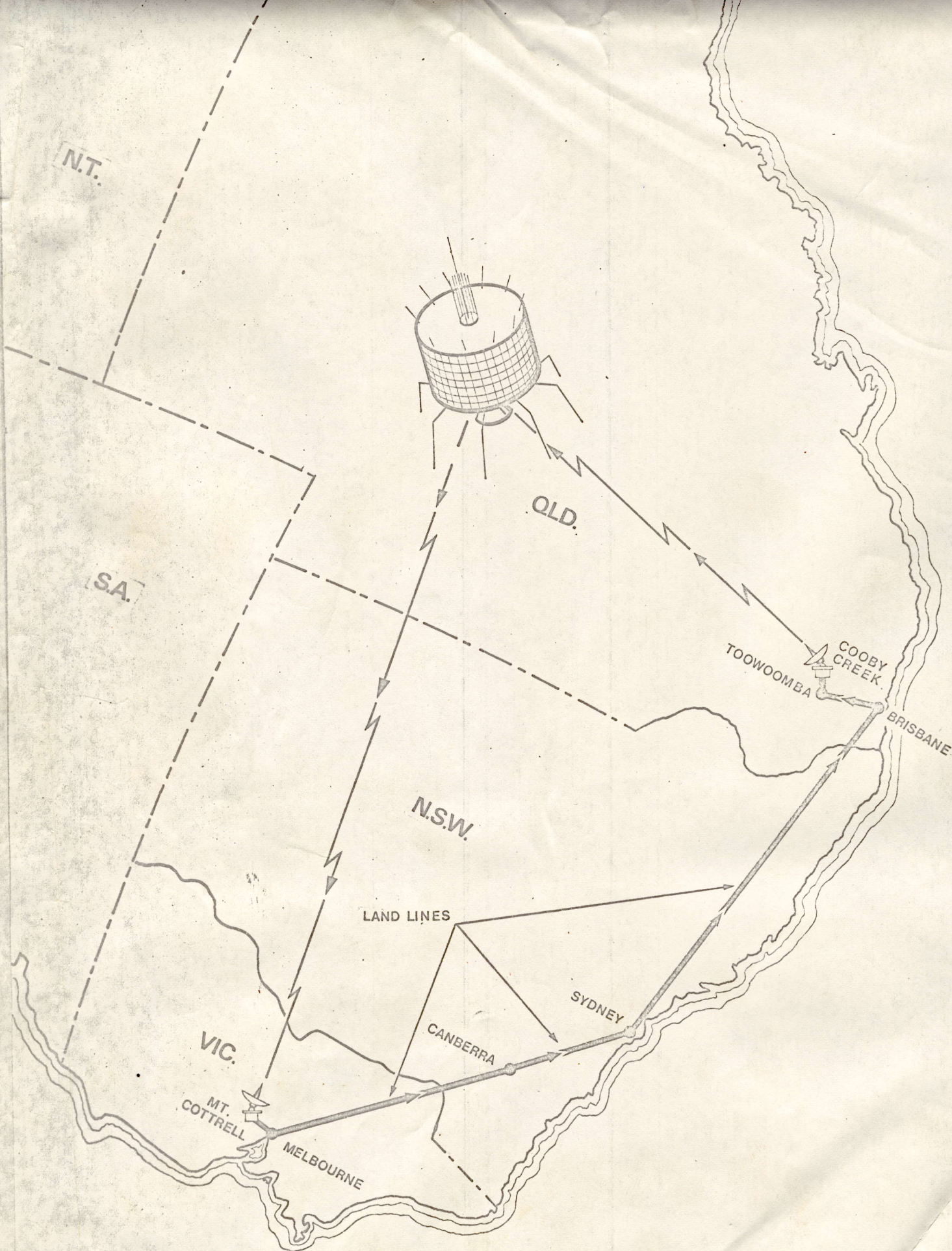
Overseas countries which propose to establish satellite systems for domestic communication operations include Canada, United States and Japan. There are also two regional proposals in Europe. A domestic satellite system is operating in the Soviet Union comprising a number of non-stationary satellites in elliptical orbits which have a period of approximately twelve hours.

This system is used in the distribution of television programmes from a central earth station to regional earth stations being equipped with 40 ft. parabolic antennae which must follow the path of the satellites. As one satellite disappears over the horizon the receiving station must switch to a succeeding one.

Earlier studies on the economic factors of satellite communications carried out by the Australian Post Office found that on the cost structure and technology at the time, a satellite system would not be as economical as a terrestrial system for the provision of trunk and television facilities.

There are indications, however, that the economic factors are improving, especially as it is now possible to envisage a system which would incorporate not only services normally covered by terrestrial broadband systems but would also include direct subscriber telephone services and a nationwide television distribution system, again to comparatively small earth stations in remote locations which couldn't possibly be provided with television facilities by conventional methods.

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CIRCUIT ARRANGEMENT FOR DEMONSTRATION

