Satellite telecommunications in the civil environment

W. T. T. Prince

Summary Satellite communication is expanding and developing rapidly. This article reviews the current situation, describes systems and applications at present in use or in the course of development, and looks ahead to the progress which is likely to be made in the 1980s.

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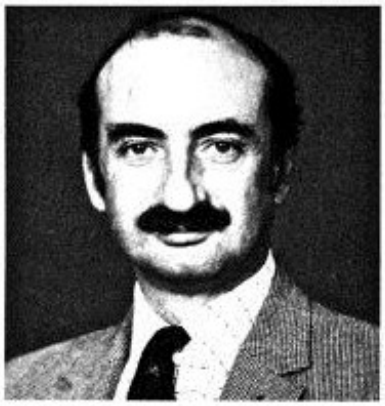

Introduction

The ever-increasing demand for international circuits has made satellite telecommunications a major electronics growth area over the past decade. Not only are more and more countries, particularly those in the Third World, joining the INTELSAT (International Satellite) network, but the traffic capacity of existing earth stations is constantly being increased due to steady expansion of the network at a rate of more than 20% per year. Furthermore, the range of services potentially available to users is widening dramatically as both satellite telecommunications technology, and the terrestrial links that serve it, become more sophisticated.

Foremost in commercially-orientated satellite telecommunications at present is the communications network in the 6/4GHz band. This is operated by telephone authorities (PTTs) for telephony (including telex) and television links between continents, or for domestic communication networks in large areas where existing terrestrial networks are inadequate.

As well as the INTELSAT system, plans are being implemented for the provision of major regional satellite systems such as the European Communication Satellite (ECS)[1], by EUTELSAT (an organization of European PTTs) and ARABSAT, by the Arab Satellite Communications Organization. Both of these systems are scheduled to become operational during 1983/4. Domestic systems using dedicated satellites exist in North America and in Indonesia, and are planned for Australia and France. Many other countries, including Saudi Arabia, Sudan, Algeria and Oman, have domestic satellite systems operating by use of satellite capacity leased from INTELSAT. Earth stations are generally owned and operated by, or on behalf of, the relevant PTT.

Earth stations

Three major types of earth station are involved in the INTELSAT network. Standard A terminals, with antennas of between 30m and 32m diameter, operate in the 6/4GHz band and form the backbone of the INTELSAT system. There are some 150 Standard A stations around the world with capacities ranging from about 60 to more than 1000 channels.

Not quite so common are the Standard B terminals. These have 11m to 13m antennas and also operate in the 6/4GHz band, usually working to Standard A stations. Standard B terminals, which are much cheaper than Standard A terminals (approximately 20% to 25%), are of low capacity – 12 to 48 channels – and are intended for use by smaller administrations. Because the antenna is relatively small, more satellite power is required and this is reflected in higher tariffs for circuit utilization. This tends to make the use of Standard B stations uneconomical for more than 60 circuits. There are between 40 and 50 Standard B stations throughout the world.

With the 6/4GHz band forecast as reaching saturation by the mid 1980s, a new frequency band, 14/11GHz, is coming into use internationally through INTELSAT. Initially, service is planned between stations in Western Europe and North America via the INTELSAT V satellite. The terminals operating in the 14/11GHz band are now known as Standard C stations, and the antenna size varies from 17·5m to 19m, according to variations in angle of elevation to the satellite. Another factor determining the size of a Standard C antenna is the nature of the local rainfall, which may influence path attenuation at these higher frequencies.

Implementation of large earth stations embraces many engineering disciplines, from soil engineering, through civil, structural and mechanical engineering, electrical high-power supply, lightning protection and earthing, to microwave communications and broadcasting, cryogenics, digital electronics, software and thermionics.

The scope of a project also depends upon the extent to which an administration requires a contractor to undertake ancillary services such as site development, buildings, access roads, prime power supplies and back-haul microwave links to extend the circuits from the earth station to an international switching centre under a turnkey project.

Fig. 1. The standard C satellite earth station at Goonhilly, prior to conversion to become Goonhilly IV

Maritime systems

A major new field of satellite operations is the provision of maritime satellite communications to ships at sea. Since satellite communications are at all times line-of-sight and are virtually unaffected by the ionsphere, they provide a consistently reliable link between ship and shore. Commercial operations at sea rely for their safety and financial viability on effective communications, and so when the first MARISAT (Maritime satellite) was launched in 1976 to provide the US Navy with a satellite link, a number of circuits were made available for commercial use. A new international institution known as INMARSAT was established to operate a global maritime satellite system from February 1982, with satellites covering the Atlantic, Pacific and Indian Ocean areas[2].

The technology involved in maritime communications requires complex control systems. The ship-borne terminals have to be small enough, and cheap enough, for operational viability. They must be designed to be virtually maintenance-free at sea but with an antenna system stabilized to track a satellite no matter what the ship's course or the weather conditions.

Ashore, INMARSAT coast earth stations are under construction around the world, including the Gulf states.

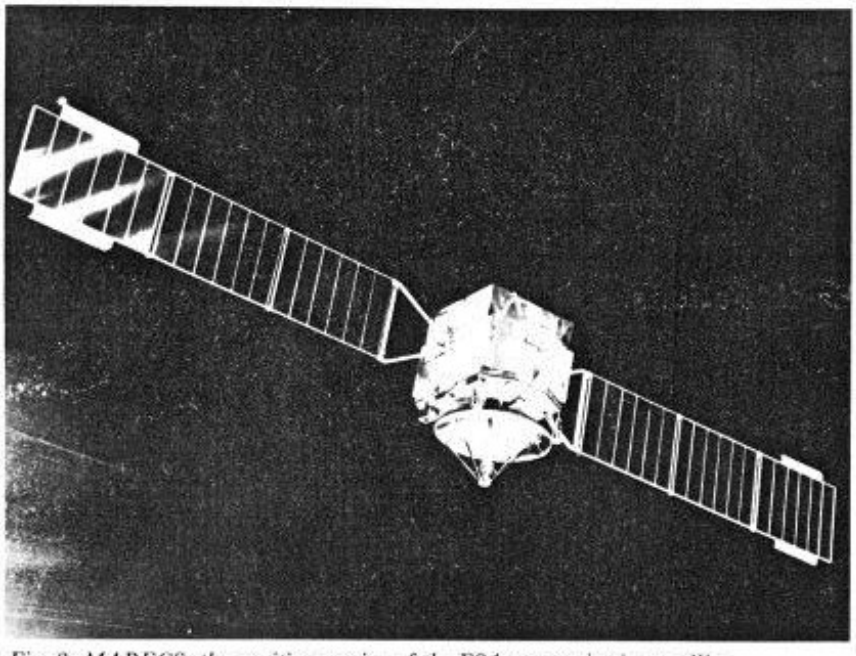

Fig. 2. MARECS, the maritime version of the ESA communication satellite

Future developments

The 1980s, however, promise to be a decade in which even greater advances in satellite communications are likely to take place. The consolidation of international telephony services has already been mentioned, and there are two further fields in which technology now offers new facilities to the operator. These fields are satellite broadcasting – which includes television to the home – and business communications.

The major problem associated with satellite broadcasting is that one television channel uses up a very considerable number of telephony channels due to the width of the spectrum. As the frequency bands available to satellite operation are already approaching saturation point, measures have been taken by the International Telecommunications Union (ITU) to allocate special frequency bands for satellite broadcasting.

Satellites are already widely used to provide links for television broadcasting from remote locations and for television and radio programme distribution. In the USA, for example, satellite links distribute nationally networked programmes to network stations which then interleave them into their own regional material and redistribute. Redistribution may include retransmission by standard television broadcast techniques from local transmitters, or by cable direct to the individual subscriber in his home or office.

Direct broadcasting

'Direct broadcasting' is a new field where high-power satellites beam high-density signals directly to small 0·8m antenna stations in the user's home. With mass production, these terminals are likely to cost as little as £200. However, being relatively insensitive, they will require a considerably greater power output from the satellite, which can now be provided by the use of high-power 200W to 300W tubes and large solar panel structures on the satellite.

The advent of direct broadcasting raises interesting political and financial issues. Satellite television could be a particularly effective and potent propaganda weapon, offering viewers a message that may not be acceptable to the local administration.

In financial terms the problems of licensing, or preventing 'piracy' of programmes, and of the control of advertising – and in particular of advertising standards – are all matters that are causing concern in a number of quarters, particularly in densely populated Europe where national programmes could quite easily overlap broadcasting regions. Where a vast area, such as the United States, is a geographic entity and does not have the overall population density that is to be found in Western Europe, direct broadcasting and also the 'community antenna' concept – one terminal serving a number of homes – have much to commend them. It is doubtful whether the direct system to individual homes will be so viable in such countries as the United Kindom, where the geographical area is small and the existing terrestrial distribution system of several programmes is very comprehensive.

Business systems

A major breakthrough in satellite communications during the 1980s is likely to be in the field of business systems in developed countries. These, comprising a dish antenna around 3m in diameter and a terminal rack about the size of a filing cabinet, are now available commercially. Numbers of such links are already operating throughout the world, particularly in the United States where competitive carrier services are encouraged. In Europe the administration of telecommunications is not vested in one PTT Authority.

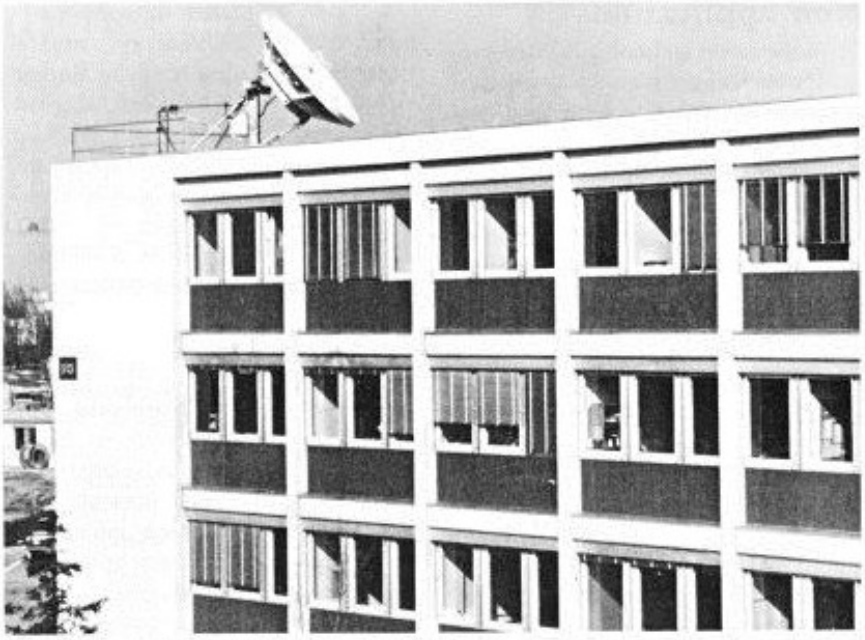

Fig. 3. The 3m business data antenna at CERN, Geneva

Fig. 4. The business data terminal in an office at the Rutherford Laboratories, Oxford

New applications

With the latest technological developments, such as the high-bit-rate digital transmission possible with new systems, numbers of new applications are becoming possible. Besides telephony, television and telex, it is now feasible to offer teleconferencing and high-quality facsimile – which leads to the possibility of remote printing and electronic mail distribution – and to provide considerably wider ranges of information service than are presently available on services such as teletext and PRESTEL.

The ability to transfer data accurately and quickly – satellite communications are about 100 times faster than land-line/microwave relay – opens up exciting possibilities for research, such as is already happening in the STELLA and SPINE programmes being carried out by ESA.

In the STELLA programme a number of high-energy nuclear research centres, such as the Rutherford laboratories at Oxford, are connected by satellite with CERN in Geneva for the purpose of experimenting in the bulk transfer of data, a process normally carried out by courier. This enables the conduct of real-time experiments at an international level.

Conclusion

In purely commercial terms the value of satellite links for business use is likely to cause the greatest interest in the near future. The present trend towards computer-based informatics as the key to most business operations, together with the development of non-regional business groupings, must result in an increased need for business managers to be kept fully and constantly aware of all that is going on within their far-flung empires. Commercially secure, rapid, in-house communications at a very reasonable cost are a major attraction.

Satellite communication is a field in which the pace of development is quickening, and it is likely to be one of the most significant growth areas in business in the 1980s.

Acknowledgement

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References

1. C. B. Wooster: 'ECS – the European Communication Satellite system', *Communication & Broadcasting*, Vol.7, No.1 (September 1981), pp.39–47.
2. C. B. Wooster: 'The INMARSAT system', *Communication & Broadcasting* (this issue).

RÉSUMÉ

La communication par satellite se propage et se développe vite. Cet article examine la situation actuelle, décrit les systèmes et les applications actuellement utilisés et en cours de développement, et prévoit les progrès qui se feront probablement au cours des années 80.

ZUSAMMENFASSUNG

Die Verbreitung und Entwicklung des Satellitenfunks erfolgt auf rapide Weise. Dieser Artikel befasst sich mit der augenblicklichen Situation, beschreibt die sich zur Zeit in Betrieb befindlichen Systeme und Anwendungen sowie die im Entwicklungsstadium und bringt einen Überblick über die während der 80er Jahre zu erwartenden Fortschritte.

RESUMEN

La comunicación por satélite se está ampliando y desarrollando rápidamente. Este artículo examina la situación presente, describe los sistemas y aplicaciones actualmente en uso y en el curso de desarrollo; y mira el futuro hacia el progreso que muy probablemente se conseguirá en los años 1980.