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1. Introduction

In 1979, Domestic Satellite Communications in Thailand was inaugurated by leasing a transponder of the Indonesian satellite, PALAPA, to distribute a television programme from Bangkok to the provincial areas. Since then, the satellite communications systems have been extensively applied to support a variety of telecommunication services that encompass the transmission of voice, sound, video and data. These systems supplement the existing terrestrial means and make possible the nationwide communications coverage both urban and rural areas.

At present, for the purposes of domestic communications applications, Thailand leases both INTELSAT and PALAPA space segments which consist of 1 transponder of INTELSAT (72 MHz transponder bandwidth) and $2\frac{3}{8}$ transponders of PALAPA (36 MHz transponder bandwidth).

This paper summarizes the various aspects of the development of the Thai domestic satellite communications systems, in a particular case of the utilization of transponders at present and in the future.

2. The use of INTELSAT transponder

The domestic satellite communications system of the Communications Authority of Thailand (CAT), a state-owned enterprise, presently leases 1 transponder of a spare INTELSAT Satellite for the simultaneous transmissions of 2 color TV programmes and 480 preassigned FM SCPC.

For this application, each TV programme with Frequency Modulation occupies 20 MHz RF bandwidth and a channel spacing of FM SCPC is 30 kHz. CAT provides 2 TV distribution services (from the studios in Bangkok to

22 TV rebroadcasting stations located throughout the country) for the Mass Communication Organization of Thailand (MCOT), TV Channel 9, a state-owned enterprise, and for the Bangkok Entertainment Company Limited, TV Channel 3, a company operating the TV broadcasting under the franchise of the MCOT.

In addition, the use of FM SCPC transmissions are to handle a variety of communications services (such as voice, teletype, facimile and data) for the CAT internal uses and providing the leased channels to meet various requirements of its customers.

The CAT domestic satellite communications system presently consists of 31 earth stations with antenna sizes ranging from 6 m. - 11 m. : 1 master earth station for transmitting 2 TV programmes and SCPC transmissions, 6 for SCPC transmissions, 16 for both receiving TV programme and SCPC transmissions, 6 for TVRO earth stations, 1 transportable earth station, and finally, 1 offshore terminal on a natural gas platform in the Gulf of Thailand for SCPC transmissions.

3. The use of PALAPA transponders

At present, Thailand leases $2\frac{3}{8}$ transponders of PALAPA : $1\frac{1}{8}$ for distribution of 2 color TV programmes, $\frac{1}{8}$ for public telephone services, $\frac{3}{4}$ for the government administrations, and $\frac{3}{8}$ for domestic data communications services of 2 private companies.

3.1 The distribution of TV programmes

In December 1979, as it was well-known that the first domestic communications via satellite was inaugurated by the Bangkok Broadcasting Television and Radio Company Limited (BBTV), a company operating TV Channel 7 under the franchise of the Royal Thai Army. In order to make possible

the nationwide TV coverage, BBTV decided to lease a transponder of PALAPA to distribute its color TV programme from Bangkok to the TV rebroadcasting stations in selected remote areas throughout the country.

The leased transponder was initially dedicated to carry 1 TV programme (video signal plus audio signal on a subcarrier) together with 2 orderwire channels and several vacant audio channels for the future applications. The transmission of TV programme employed Frequency Modulation with 30 MHz RF bandwidth, while FM SCPC with 30 kHz spacing has been used for the orderwire channels up to now.

According to the Assignment of The Royal Thai Army, BBTV is responsible for providing the satellite communications facilities for the TV programme distribution of the Army Television Broadcasting Station, TV Channel 5, from Bangkok to the TV rebroadcasting station in selected remote areas.

To achieve more effective costing and operation, several major factors are considered. The TV programme is separated into its 2 components, the video and the audio signals. These signals are transmitted on separate carriers. For the video transmissions, by reducing the RF bandwidth of each FM video carrier to 17.5 MHz, two video carriers per transponder could be transmitted. It has been found that output video S/N (at the receiving station with G/T of 27.3 dB/K) is approximate 48 dB, which can be obtained acceptable picture quality for rebroadcasting. Furthermore, FM SCPC with 200 kHz spacing is used to transmit each audio signal in another transponder.

In summary, these applications requiring $1\frac{1}{8}$ leased PALAPA transponders, 1 transponder has been dedicated to simultaneous transmissions of 2 FM video carriers, and the rest of $\frac{1}{8}$ transponder has been provided

for FM SCPC transmissions of 2 orderwire channels, 2 audio signals and the remaining space for the future applications. This, of course, BBTV leases $1\frac{1}{4}$ transponders, but $\frac{1}{8}$ transponder is shared by the Telephone Organization of Thailand (TOT).

As of 1990, BBTV operates 21 earth stations with antenna diameters ranging from 7.5 m. - 11 m. (except 4.5 m. mobile station) which comprise 1 master station for transmission of 2 TV programmes (one is dedicated to BBTV and another is to the Army Television Broadcasting Station), 19 TVRO earth stations, and 1 mobile station. The orderwire is also provided for network control of all stations.

In addition, the Army Television Broadcasting Station uses 8 earth stations of BBTV and also operates its own 8 TVRO earth stations with 7.5 m. antenna diameters, for the distribution of its TV programme.

3.2 Public Telecommunication Services

The Telephone Organization of Thailand (TOT), another state-owned enterprise, is responsible for providing the telephone services in Thailand. TOT has established a variety of terrestrial telecommunication transmission networks that encompass radio and optical fibre communications. Meanwhile, in case of emergency, there are 2 mobile earth stations with 4.5 m. antenna sizes, using FM SCPC, to be served as a back-up to the terrestrial means. This satellite communications system, presently in its initial stage uses $\frac{1}{8}$ PALAPA transponder by a sharing of the leased transponder of BBTV.

A new satellite communications project of TOT is under implementation to supplement to the terrestrial transmissions. This project aims to lease 1 additional PALAPA transponder for Time Division Multiple Access System.

3.3 Government telecommunication networks

In 1980, The Supreme Command Headquarters (SCHQ) had established a satellite communications system with 3 earth stations by leasing 13 units (SCPC) of PALAPA space segment in order to set up the links for telecommunications between the headquarters in Bangkok and its two offices in the southern part of Thailand. Meanwhile, the terrestrial microwave circuits which would be leased from TOT were not available for the increasing demands.

The Government of Thailand perceives that the satellite communications could supplement to the existing terrestrial means and, be used as an essential instrument for the development of her telecommunication networks in a short period, because of the relative low cost, the operational flexibility and the distance independence. Therefore, the Government has approved many projects which aim to expand the telecommunication networks by using satellite communications.

At present, Thailand leases $\frac{3}{4}$ PALAPA transponder for the government administrations, $\frac{1}{2}$ for military and $\frac{1}{4}$ for civilian administrations.

The Post and Telegraph Department (PTD) is the representative of the Government as a central organization of domestic satellite communications activities. Although the space segment is leased by PTD, but the administrations must set a certain amount of budget according to their own utilization. They will own and operate the earth stations by themself.

The systems utilize the preassigned multiple access and various transmission techniques which include FM SCPC with 22.5 kHz - 45 kHz channel spacing and BPSK SCPC with 30 kHz channel spacing (FM SCPC are mostly used), to provide the telephone services or the combination of

voices, teletype, facsimile and data. Furthermore, the networks have approximately 46 earth stations with antenna sizes ranging from 4.0 m. - 11 m.

Meanwhile, is an ongoing project under implementation to distribute a national radio programme of the Radio Broadcasting of Thailand for the 42 rebroadcasting stations in the provincial areas. And it is expected to be completed within 1990.

Another ongoing project is the TV programme distribution of the Television Broadcasting of Thailand (of the Public Relations Department), TV Channel 11, which aims to lease 1 additional PALAPA transponder in 1991.

3.4 Domestic data communications services

The Thai Government has granted the 15 - year franchise to operate and to provide a nationwide data communications services via satellite in Thailand to each of private companies, namely, Compunet Corporation Limited, and Samart Telcoms Company Limited. This event opens to the private sectors to participate in the data communications services in a competing manner.

These services will strengthen the telecommunications infrastructure of Thailand to meet the rapidly expanding economy. Because they will make the benefit of banking, hotel, tourism and insurance business, and industries etc., to access the data bases, remotely process information and distribute information to enhance the production.

Compunet has leased $\frac{1}{4}$ PALAPA transponder since August 1989, and has commissioned the Teleport since November 1989. At present, Compunet is offering two data communications services, the first one

is the SATLINK (data speeds up to 64 Kbps), and the second is the DATASAT (up to 56 Kbps). The SATLINK services use the conventional SCPC techniques, BPSK (9.6-64 Kbps) and QPSK (112-2048 Kbps), whilst the DATASAT is based on the VSAT principle. The network consists of a VSAT earth station hub with 9.2 m. antenna diameters, designated as the Teleport, and the remote VSAT terminal with 1.8/2.4 m. (3.6/4.5 m. optional) antenna sizes. The transmitted signals from VSAT terminals are AA/TDMA, on the other hand, the received signals are TDM.

Samart Telcoms also has leased $\frac{1}{8}$ PALAPA transponder since November 1989, and has commissioned the services since the early 1990. Samart Telcoms will provide a variety of data communications services, namely, SAMARTLINK, SAMARTNET (Teleport Service and VSAT Network service) and SAMART BROADCAST services. At present, Samart Telcoms is providing only SAMARTLINK service which uses the conventional SCPC techniques, BPSK (data speeds 19.2-64 Kbps) and QPSK (64 Kbps up). It is expected that the SAMARTNET will be put into operation within August 1990. The SAMARTNET which is based on the VSAT principle, and it consists of a temporary hab station with 6 m. antenna diameters and the VSAT terminals with 1.8 m. antenna diameters. And the transmitted signals from VSAT terminals are Slotted-ALOHA TDMA, on the other hand, the received signals are TDM.

Besides Compunet and Samart Telcoms actually provide the previously mentioned services via PALAPA, CAT has another project to provide the data communications services via PALAPA satellite which will supplement to the existing services carried by the terrestrial and domestic satellite means (via INTELSAT). This project aims to lease 5 MHz bandwidth of PALAPA space segment for using RA/TDMA for VSAT applications.

4. Conclusions

The Thai domestic satellite communications systems, leasing 1 INTELSAT (72 MHz transponder bandwidth) and $2\frac{3}{8}$ PALAPA (36 MHz) transponders are designed to support a variety of telecommunications services that encompass the distribution of 4 TV programmes and the transmission of voice, telex, facimile and data. The networks have approximatly 130 earth stations, with antenna sizes ranging from 1.8 m. - 11 m. (excluding the private-owned TVRO terminals which are up to 200.).

It is recently confirmed that within the year of 1991 the PALAPA space segment will be additionally leased 2 transponders and 5 MHz bandwidth: 1 of the Public Relations Department, 1 of TOT, and 5 MHz of CAT.

As previously mentioned, the satellite communications in Thailand has been grown and evolved to be an integral part of the national telecommunications infrastructure and ongoing social and economical development. Therefore, the cooperation between the government and the private sectors are essential, to ensure the satellite communications development of modern technology and investment.

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