Spread spectrum communication experiment with satellite Apstar 1

Guanyi Ma[1], Yuepeng Yan[2], Huli Shi[1]

1. National Astronomical Observatories, Chinese Academy of Sciences, 20A Datun Road, Chaoyang District, Beijing 100012, China, guanyima@bao.ac.cn, shl@bao.ac.cn

2. Institute of Microelectronics, Chinese Academy of Sciences, 3#, Beitucheng West,Chaoyang District, Beijing 100029, China, yanyuepeng@ime.ac.cn

Abstract

Satellite communication systems have become an essential part of the world's telecommunications infrastructure. The service it provided to ships and aircrafts has been valuable, although at a high price. In China there are areas where conventional communication systems are unavailable. And satellite system is the only reliable communication means when the conventional systems are destroyed by natural disaster.

The satellite Apstar 1 carries 24 C-band transponders for general telecommunications services across China and Southeast Asia. It was launched on a Long March rocket in July 1994 and retired in 2004. Located at ~140°E, Apstar 1 operates in the C-band (6/4 GHz) and extended C-band (3.6 GHz) frequency range, and is powered by 15-watt traveling-wave tube amplifiers. Four of the transponders aboard Apstar 1 offer 72 MHz of bandwidth, while each of the remaining twenty transponders has a bandwidth of 36 MHz. Its radiated power over China averages 35 dBW.

Spread spectrum is also known as code division multiple access (CDMA). Direct sequence spread spectrum is the type we used to make satellite communication experiment. CDMA has become popular in cellular telephone systems where it is used to enhance cell capacity. However, it has not been widely adopted by satellite communication systems. Moreover, Apstar 1 had been mainly designed and utilized for TV broadcasts. The main purpose of the experiment with Apstar 1 is to examine whether the inclined geosynchronous satellite orbit (IGSO) or geostationary (GEO) satellite can be used efficiently for spread spectrum communication, and find the adequate space link design parameters and the error control mode for such system. With the following specification, the primary phase of the experiment was successful.

Transmitting power	10-watt
Dipole antenna	5 dBi
Earth station	with a dish in 13 m diameter
Used code	2047-bit PN sequences
Code rate	2.047 Mbps
Data rate	50 bps
Error control	convolution code (2,1,7)
Rolloff factor	0.4
Modulation	BPSK