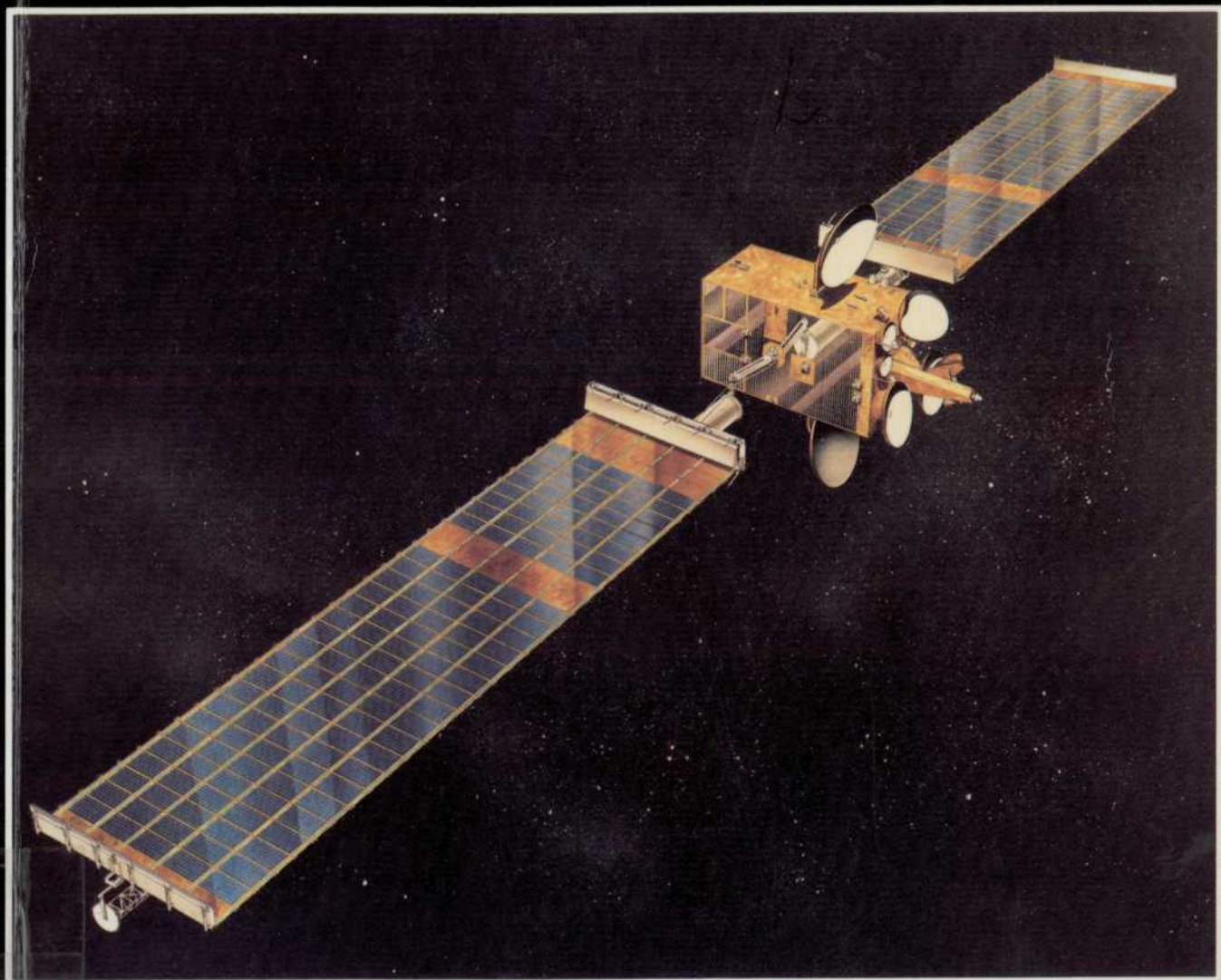


COMMUNICATIONS SATELLITES

THE TECHNOLOGY OF SPACE COMMUNICATIONS



LARRY BLONSTEIN

Contents

Preface vii

List of photographs xi

Acknowledgements xii

Introduction xiii

- 1 Getting a crate into orbit 1**
- 2 The geosynchronous orbit 8**
- 3 From low orbit to geosynchronous altitude 13**
- 4 Disturbances in orbit 20**
- 5 Turning a crate into a satellite 23**
 - Station-keeping 23
 - Pointing 28
 - Electrical power 34
 - Thermal control 41
 - Nearly a working satellite 44
- 6 On-board communications equipment 45**
 - Transponders 45
 - Antennas 48
 - The complete satellite 64
- 7 Logarithms and decibels 66**
- 8 Radio frequencies and wavelengths, and their allocations 72**
- 9 Coverage, gain and EIRP 78**

Communications Satellites

- 10 Earth stations 84**
 - Types, construction and sizes 84
 - Performance 90
 - Up-link transmission 92
 - Pointing an Earth station 95
 - 11 Traffic capacity and quality 97**
 - Quality 97
 - EIRP and G/T 99
 - Space loss 99
 - Boltzmann's constant 100
 - Capacity 100
 - Other losses 102
 - Estimating traffic capacity and quality 102
 - Worked examples 103
 - 12 Selecting a satellite 108**
 - 13 Economic system optimisation 112**
 - Access methods 112
 - Modulation techniques 115
 - Compression techniques 115
 - Encryption 116
 - Echo and delay 116
 - 14 Encryption 118**
 - One-way functions 119
 - Modulo arithmetic 120
 - Example of encryption and decryption 120
 - Scrambling 124
 - 15 Operational systems 125**
 - 16 The economics of satellite communications 140**
 - Satellite prices 141
 - System prices 142
 - System income and profit 144
 - User profit 144
 - 17 Future trends 147**
- Further reading* 151
- Appendix Manufacturers and owners* 152
- Index* 159