

Table of Contents

Acronyms and Abbreviations.....	9
Introduction: Satellites, key assets of global communication.....	13
Acknowledgments.....	15
Disclaimer.....	15
1 The geostationary spacecraft and its subsystems.....	16
1.1 The geostationary orbit.....	16
1.2 The satellite and its subsystems.....	18
2 Satcom systems and the organization of Satcom business.....	24
2.1 Satellite networks.....	24
2.2 The Satcom business.....	26
3 Connectivity and coverages	29
3.1 Link geometry.....	29
3.2 Frequency plans.....	33
3.3 Channelization.....	35
3.4 Polarization.....	36
3.5 Frequency plans and downconversion frequencies.....	39
3.6 Connecting coverages.....	43
3.7 Noise analysis.....	52
3.8 Figures of merit.....	55
3.9 Coverage specifications.....	61
4 Waveforms and access schemes.....	63
4.1 Waveforms.....	63
4.2 Modulation.....	65
4.3 Pulse shaping and Nyquist's theorem.....	67
4.3.1 Filtering impulses.....	68
4.3.2 Filtering rectangular pulses.....	72
4.3.3 Filtering PSK modulated signals.....	75
4.4 PSK modulation.....	79
4.5 Mixed amplitude and phase modulation.....	84
4.6 Noise and the receiver threshold.....	86
4.7 Forward Error Correction encoding.....	91
4.7.1 Shannon's limit.....	91
4.7.2 Convolutional coding.....	94
4.7.3 Puncturing of convolutional codes and the code rate.....	100
4.7.4 Block codes.....	102
4.7.5 Concatenated codes.....	105
4.7.6 Scrambling.....	109
4.7.7 Trellis-coded modulation.....	111
4.8 Carrier bandwidth.....	112
4.9 Access schemes.....	114
5 The digital Satcom link.....	116
5.1 Satcom link parameters.....	116
5.2 Atmospheric and rain loss.....	117
5.3 Backoff and the impact of power amplifier nonlinearity.....	124
5.4 Link budgets.....	131
5.5 Ground terminal sizing.....	145

5.6 Transponder sizing.....	149
6 The communication payload.....	152
6.1 Payload architecture.....	152
6.2 Transponder frequency response.....	154
6.2.1 Channel properties.....	154
6.2.2 Channel analysis.....	156
6.3 Payload equipment.....	162
6.3.1 Antennas.....	162
6.3.2 The input section.....	163
6.3.3 Redundancy and switches.....	164
6.3.4 Waveguides.....	165
6.3.5 Coaxial cables.....	168
6.3.6 Input demultiplexers.....	172
6.3.7 Redundancy rings.....	173
6.3.8 High power amplifiers.....	174
6.3.9 Output multiplexers.....	175
6.4 Multi-coverage switching.....	177
6.5 Repeater level and noise budget.....	178
6.6 Intermodulation.....	181
6.7 Transponder loading.....	189
6.7.1 Multi-carrier intermodulation.....	189
6.7.2 Power robbing.....	192
6.8 Payload mass and DC power budget.....	194
6.9 Electromagnetic compatibility.....	196
7 Satcom antennas.....	198
7.1 Classification.....	198
7.2 A simple antenna model.....	199
7.3 Horn antennas.....	201
7.3.1 Smooth horns.....	201
7.3.2 Corrugated horns.....	205
7.4 Reflector antennas.....	209
7.4.1 Single reflector central feed antennas.....	210
7.4.2 Single reflector offset antennas with reflector shaping.....	214
7.4.3 Double reflector antennas.....	220
References.....	225