Stojče Dimov Ilčev

Global Mobile Satellite Communications Theory

For Maritime, Land and Aeronautical Applications

Second Edition

Springer

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By
Stojče Dimov Ilčev
(Стойчо Димов Илчев)
Durban University of Technology (DUT)
Durban, South Africa

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Stojče Dimov Ilčev
Durban University of Technology (DUT)
Durban
South Africa

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To the memory of my late father

Prof. Dimo Stoev Ilčev
(Димо Стоев Илчев)

Preface

Global Mobile Satellite Communications (GMSC) structures are specific to mobile satellite communication discipline and technique for maritime, land, and aeronautical applications that enable connections between Mobile Earth Stations (MES). These include ships, land vehicles and aircraft on the one hand and ground telecommunications subscribers on the other, through the medium of space segment (satellite constellation), Land Earth Stations (LES), and Terrestrial Telecommunications Network (TTN) or other landline providers.

This book is very important for modern shipping, land (road and rail) and aeronautical concerns, because GMSC are providing more effective business, trade, and prosperity in the new millennium, in the first place for transport safety and security matters and second, for commercial communications. The most considerable marketing and technical point of this book is great deficiency of suitable manuals on the international book market, which completely describe GMSC fundamentals, space segments, ground segments (MES and LES), and Global Mobile Personal Satellite Communications (GMPSC).

The book discusses hot topics in GMSC techniques and technology, which will be useful for technical staff onboard vessels, land vehicles and aircraft, on offshore constructions, and for those possessing satellite handset phones. This includes sea, land, and air transport sets with many other requirements for more effective trade, which need development, design, utility, implementation, and knowledge of Communication, Navigation and Surveillance (CNS) for safety and commercial applications. Otherwise, GMSC solutions are very important to all modern transportation companies, dispatchers, agencies, brokers, and the successful management, commerce, carriage tracking, and logistics of their fleet.

In general, this book may become the manual for a broad range of readers with different levels of technical education and knowledge, for professional staff involved in GMSC and their technical managers, engineers, professors, students, instructors, and participants in GMDSS courses, consultants and supervisors of MES and for military officers and cadets. This book could find an important place in libraries, universities, and institutions as well.

Mobile satellite systems today have become very important topics for students in many maritime, transportation and aviation universities, faculties in telecommunication and electrical engineering, for all modern transportation companies, GMSC manufacturers, providers, operators, and their management staff. Everyone involved in GMSC systems has to know something about these technology and transmission systems. Thus, in writing this book the author has used the expertise, prospects, literature, and manuals of numerous experts, specialists, institutions, and references mentioned at the end of this handbook as well as information from the Internet.

The author has been a professional expert in maritime radiocommunications since 1969, as a radio officer on board ocean-going cargo ships using Morse MF/HF radiotelegraphy and MF/HF/VHF radiotelephony and later as master mariner and Electronics/GMDSS Operator with Inmarsat Ship Earth Stations (SES). In addition, for over 15 years he has managed the Former-IS Marine Radio Company and newly established CNS Systems for research, service, installation, and engineering of GMSC and Global Navigation Satellite Systems (GNSS) systems and equipment onboard ships and integration with modern IT systems. The author has also used his doctoral dissertation, master's theses, technical manuscripts, papers, and practical experience with radiocommunications, navigation, and GMSC systems.

For basic and principal technical information he has drawn heavily mostly on the following sources:

- "Global Mobile Satellite Communications, For Maritime, Land and Aeronautical Applications", 1st Edition published by Springer in 2005 and "Global Aeronautical CNS", published by AIAA in 2013, both written by S.D. Ilcev.
- "Mobile Satellite Communication Networks", written by R. Sheriff and Y.F. Hu; and "Satellite Communications Systems", written by G. Maral and M. Bousquet. Both books were published by Wiley in 2001 and 1994, respectively.
- "Mobile Satellite Communications—Principles & Trends", written by Madhavendra Richharia and published by Addison-Wesley in 2001.
- "Mobile Antenna Systems Handbook", written by K. Fujimoto and J.R. James; "Mobile Satellite Communications", written by S. Ohmori, H. Wakana and S. Kawase; and "Low Earth Orbital Satellites for Personal Communication Networks", written by A. Jamalipour. All three books were published by Artech House, in 1994, 1998 and 1998, respectively.
- "Satellite Communications: Principles and Applications" and "Electronic Aids to Navigation: Position Fixing". Both books written by L. Tetley and D. Calcutt were published by Edward Arnold, in 1994 and 1991, respectively.
- "An Introduction to Satellite Communications", written by D.I. Dalgleish; and "Satellite Communication Systems" edited by B. Evans. Both books were published by IEE, in 1991 and 1993, respectively.
- "Never Beyond Reach", edited by B. Gallagher and published by Inmarsat, in 1989.

- “Спутниковая связь на море”, written by L. Novik, I. Morozov and V. Solovev; and “Международная спутниковая система морской связи—Инмарсат”, written by V. Zhilin. Both books were published by Sudostroenie, Leningrad, in 1987 and 1988, respectively.
- “Telekomunikacije satelitima”, written by R. Galić, Školska Knjiga, Zagreb, 1983.
- “Radio wave Propagation Information for Predictions for Earth-to-Space Path Communications”, edited by C. Wilson and D. Rogers, ITU, Geneva.

Readers will find that this book has been written using up-to-date systems, techniques, and technology in satellite communications. The material has been systematized in such a way to cover satellite development, systematization, definition of all nomenclature, synonyms of mobile satellite communications systems and services, new kinds of launcher systems and the presentation of all types of satellite orbit constellations and spacecrafts. The newest concepts of transmission models and accesses including IP networking, a complete introduction to mobile antenna systems and propagation, Inmarsat, Cospas-Sarsat, Big LEO, Little LEO, navigation and tracking systems, including the forthcoming augmentation satellite system for Communications, Navigation and Surveillance (CNS) mobile solutions, stratospheric platforms as communications systems, including mobile DVB-RCS.

Furthermore, new concepts and innovations in GMSC, such as Inmarsat BGAN, Fleet and Swift Broadband solutions, Global Xpress for maritime and aeronautical applications, new Iridium LEO mobile applications, innovative maritime O3B MEO solutions, and mobile DVB-RCS GEO users segment are covered. Also, modern VSAT broadcasting applications and integration of GMSC systems with new Personal Videophone Technology and Mobile Videophone over IP (VPoIP) will be discussed. Finally, the historic moment is approaching when we can use MES terminals and say: *“Hallo, can you see me, over”?*

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Above all, the author of this book would like to express his very special appreciation and gratitude to Prof. Ahmed Cassim Bawa, former Vice Chancellor (VC) and principal of Durban University of Technology (DUT), who gave him huge support in Space Science Research and postgraduate studies. He also expresses his special gratitude to Prof. Sibusiso Moyo, the Director of Research and Postgraduate Studies at DUT, and DUT staff for support and encouragement to establish Research and Postgraduate Studies in Space Science and for moral assistance in completing this book.

The author is Research Professor in Space Science and Supervisor at DUT for research and postgraduate studies. He works on very important multinational project African Satellite Augmentation System (ASAS) for all of Africa and the Middle East including many other proposals in Radio and Satellite Communication, Navigation and Surveillance (CNS), Digital Video Broadcasting-Return Channel via Satellite (DVB-RCS), Global Radio and Satellite Tracking of mobile and living beings, Satellite SCADA (M2M), Stratospheric Platform Systems (SPS,) and Space Solar Power (SSP). He also would like to express his special appreciation to DUT for generous contribution as a sponsor of this book.

The Durban University of Technology takes pride on its commitment to academic excellence.

The over 24,000 students who pass through the doors everyday are testament to a growing ethos of learning, research, and community engagement. DUT is a multi-campus university of technology at the cutting edge of higher education, renowned for technological training and academic prowess. The university is characterized as being research-driven with a focus on strategic and applied research that can be translated into professional practice. Furthermore, research output may be commercialized thus providing a source of income for the institution. In striving to create a new and dynamic ethos, the university builds upon current strengths and celebrates the expertise of its staff. DUT provides Web pages for its research and postgraduate studies in Space Science at: www.dut.ac.za/space_science—Showing full study programs and projects whilst including all research and supervisor staff.

The author is also very grateful to the group of authors for various manuals, brochures, and pamphlets issued by IMO, ICAO, ITU, IATA, ARINC, WMO, ESA, SITA, ETSI, ETRI, Intelsat, Intersputnik, Eutelsat, Roscosmos, Eurocontrol, Inmarsat, Cospas-Sarsat, Iridium, Globalstar, Orbcomm, Sea Launch, and other regulatory bodies and operators.

This book is dedicated to all his friends and students working in shipping companies and industry, and to his present postgraduate students of Space Science at DUT. He also wishes specially to acknowledge the valuable support and understanding from publisher of this book Springer, especially to Ms. Mary E. James, Senior Editor in Applied Sciences and her assistants Ms. Zoe Kennedy and Ms. Rebecca R. Hytowitz.

Finally, he would like to express his heartfelt appreciation and gratitude to his lovely wife, Svetlana Mihailovna Ilčeva, and his family for their help and understanding, while the manuscript was written, especially to his dear children and grandchildren living in Montenegro: son Marijan with his wife Vanja and their children Daria and Martin, daughter Tatjana, with her husband Boško and their children Anja and Stefan, to his stepdaughter Olga from Ukraine, her husband Boris and his stepgranddaughter Bažena, to his sister Prof. Tatjana Ilčeva and niece Ivana in Belgrade, Serbia and to his cousin Valentin Boyadžiev and his family in Sofia, Bulgaria.

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About the Author

Prof. Stojče Dimov Ilčev is Chair of Research and Postgraduate Studies in Space Science and CNS at Durban University of Technology (DUT), Durban, South Africa. He studies both maritime radio engineering and nautical science at Montenegro University in Kotor, maritime electronics and communications at Rijeka University in Croatia, postgraduate satellite engineering at Skopie University in Macedonia and Belgrade University in Serbia. Professor Ilčev holds Bachelor (B.Sc.), Master in Electrical Engineering (M.Sc.) and Doctor of Science (Ph.D.) degrees. He also holds the certificates for Radio operator 1st class (Morse), for GMDSS 1st class Radio Electronic Operator and Maintainer and for Master Mariner without limitations. Since 1969, Ilčev has worked onboard merchant ships, in Satellite Earth Station, at Coast Radio Station, shipping company, Nautical School and at Maritime Faculty. Since 2000, he has worked at IS Marine Radio and CNS Systems companies on research and projects related to modern Communication, Navigation and Surveillance (CNS) for maritime, land, and aeronautical applications. He has written three books on CNS engineering and systems for maritime, land, and aeronautical applications and he has many projects and inventions in this field including DVB-RCS and Stratospheric Platforms.

Acronyms

a	Large semi-major axis of elliptical orbit
A	Apogee
A	Azimuth angle
A/D	Analog-to-Digital signal conversion
AAC	Aeronautical Administrative Communications (Advanced Audio Encoding)
AAC-AOC	Airline Administrative and Airline Operational Control
AAIC	Accounting Authority for Satellite Traffic Invoicing
ABR	Available Bit Rate
ABS	Automatic Beam Switching
AC	Alternating Current
ACARS	Aircraft Communications (Addressing) and Reporting System
ACB	Antenna Control Board
ACC	Aeronautical Control Center
ACE	Antenna Control Equipment
ACK	Acknowledgement
ACM	Adaptive Coding and Modulation
ACO	Aeronautical Communications Organization
ACR	Allowed Cell Rate
ACS	Attitude Control System (Assembly and Command Ship)
ACSE	Antenna Control and Signaling Equipment of LES
ACSSB	Amplitude Companded SSB
ACTS	Advanced Communications Technology Satellite
ACU	Above Cockpit Unit (Antenna Equipment of AES)
ACV	Assembly and Command Vessel
ADE	Above Deck Equipment (Antenna Equipment of SES)
ADM	Adaptive Delta Modulation
ADPCM	Adaptive Differential PCM
ADPS	Aeronautical Data Processing System
ADREP	Accident/Incident Data Reporting

ADS	Automatic Dependent Surveillance
ADSL	Asymmetrical Digital Subscriber Line
ADSS	Automatic Dependent Surveillance System
AEEC	Airline Electronic Engineering Committee
AEIS	Aeronautical Enroute Information Service
AES	Aircraft (Aeronautical) Earth Station
AFC	Automatic Frequency Control
AFIS	Airborne Flight Information Service
AFTAX	Aeronautical Fixed Telecommunication Automatic Exchange
AFTN	Aeronautical Fixed Telecommunication Network
AGC	Automatic Gain Control
AHD	Above Haul Device (Antenna Equipment of VES)
AHNIS	Aeronautical Highlights and Navigation Information Services
AHRS	Attitude and Heading Reference System
AIDC	ATS Interfacility Data Communications
AIES	Aeronautical Information Enroute Service
AIRCOM	Aeronautical Communications
AIS	Aeronautical Information Services
AKM	Apogee Kick Motor
AL	Accuracy Lateral
ALC	Automatic Level Control
ALOHA	A random multiple accesses devised at the University of Hawaii
AM	Amplitude Modulation (Air Ministry)
AMBE	Advanced MultiBand Excitation
AMES	Aeronautical and Maritime Engineering Satellite (Japanese program)
AMSC	Aeronautical MSC
AMSS	Aeronautical Mobile Satellite Service (System)
AMVER	Automated Mutual Assistance Vessel Rescue System
ANS	Aeronautical Navigation System
ANSS	Aeronautical Navigation Satellite System
AOC	Aeronautical (Airline) Operational Control (Attitude and Orbit Control)
AOC	Advanced Operational Capability
AOR	Atlantic Ocean Region (Old system)
AOR-E	Atlantic Ocean Region East (New system)
AOR-W	Atlantic Ocean Region West (New system)
APC	Adaptive Predictive Coding (Aeronautical Passenger Communications)
APL	Airport Pseudolites
Apogee	More distant point of satellite from the Earth
APS	Air Passenger Services

APT	Automatic Picture Transmission
AR	Axial Ratio
ARC	Aeronautical Radio Communications (Aircraft Radio Corporation)
ARINC	Aeronautical Radio Inc.
ARMMD	Automatic Remote Monitoring and Messaging Data (M2M)
ARNSS	Aeronautical Radionavigation Satellite Service
ARQ	Automatic Repeat Request
ARTS	Automated Radar Terminal System
ASAS	African Satellite Augmentation System
ASCII	American Standard Code for Information Exchange
ASI	Aeronautical Safety Information
ASIC	Application Specific Integrated Circuit
ASIU	ATM Satellite Interworking Unit
ASK	Amplitude Shift Keying
ASQF	Application Specific Qualification Facility
ASR	Airport Surveillance Radar
ASTP	Aviation Security Training Packages
Astra	Applications of Space Technology to the Requirements of Aviation
ATAS	Aeronautical Transportation Augmentation System
ATB	Antenna Tracking Block
ATC	Air Traffic Control
ATCAS	ATC Automation System
ATCDPS	ATC Data Processing System
ATFM	Air Traffic Flow Management
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management (Asynchronous Transfer Mode)
ATS	Air Traffic Service
AUSREP	Australian Report (as an AMVER)
AV	Accuracy Vertical
AVCS	Aerial Vehicle Communications System
AVICOM	Avicom Japan Co. Ltd.
AvSat	Aviation Satellite Program
AVHRR	Advanced Very High Resolution Radiometer
AVSEC	Aviation Security
AWGN	Additive White Gaussian Noise
AWRS	Aeronautical Weather Report Services
AWS	Automatic Weather Station
AWT	Applied Weather Technology
b	Small Semi-major Axis of Elliptical Orbit
b/s	Bits per second (Baud)
BA	British Airways
BACS	Broadband Aeronautical Communications Service

Baud	1 b/s
BBFRAME	Baseband Frame
BBMSS	Broadband MSS
BC	Before Christ
BCD	Broadcasting and Content Distribution
BCH	Bose Chadhuri Hocquenghem Code
BCM	Block Coded Modulation
BCMSS	Broadcast MSS
BCU	Below Cockpit Unit (AES Transceiver Unit)
BDC	Block Down Converters
BDE	Below Deck Equipment (SES Transceiver Equipment)
Beacon	All types of emergency satellite beacons used in COSPAS-SARSAT System
BeiDou	Chinese GNSS System (Compass)
BER	Bit Error Rate
BES	Base Earth Station (Gateway)
BEST	Bandwidth Efficient Satellite Transport
BGAN	Broadband Global Area Network
BHD	Below Haul Device (VES Transceiver Equipment)
BISDN	Broadband Integrated Service Digital Network
BITE	Built-In Test Equipment
BMCS	Broadband Maritime Communication Service
BNC	Bayonet Neill–Concelman
BOB	Blackberry On Board
BOL	Beginning Of Life
BPS	Baseband Processing Signals
BPSK	Binary PSK
BSS	Broadcasting Satellite Service
BSU	Beam Steering Unit
BT	British Telecom
BUC	Block UpConverter
BVS	Bonvoyage System (WX)
c	Axis between center of the Earth and center of ellipse
C/M	Carrier-to-Multipath Ratio
C/N	Carrier-to-Noise Ratio
C/No	Carrier to Noise Power Density Ratio
CA	Channel Amplifier (Conditional Access)
CAASD	Corporation's Center for Advanced Aviation System Development
CAB	Civil Aviation Bureau
CAC	Civil Aviation Community
CADIN	Common Aeronautical Data Interchange Network
CATV	Community Antenna Television
c-band	Centimeter band

C-band	Frequency band on 6/4 GHz (Tx/Rx) for Feeder Link (from 4 to 8 GHz)
CBR	Constant Bit Rate
CCF	Central Control Facility
CCIR	International Radio Consultative Committee
CCIT	International Telecommunications Consultative Committee
CCITT	International Telegraph and Telephone Consultative Committee
CCU	Central Control Unit
CD	Compact Disk
CDDA	Crossed-Drooping Dipole Antenna
CDMA	Code Division Multiple Access
CDR	Critical Design Review
CELP	Code Excited Linear Prediction
CES	Coast Earth Station (Maritime and Land Mobile)
CF	Control Facilities
CIMS	Customer Information Management System
CIR	Committed Information Rate
CIS	Commonwealth of Independent States (Former USSR)
CIS	Communication and Information System
CIU	Cabin Interface Unit
cm	Centimeter waves (SHF)
CM	Coded Modulation (Configuration Module)
CMU	Communications Management Unit
CN	Correspondent Nodes
CNES	Centre National d'Etudes Spatiales (France)
CNS	Communications, Navigation and Surveillance
CNSO	Civil Navigation Satellite Overlay (Inmarsat)
CoA	Care-of Address
COE	Committee on ECDIS
Compass	Chinese GNSS System (BeiDou)
COMSAT	Communications Satellite Corporation
Cospas	Space System for Search of Distress Vessels and Airplanes (In Russian КОСПАС: Космическая Система Поиска Аварийных Судов и Самолетов)
CP	Circular Polarization
CPDF	Central Personnel Data File
CPDLC	Control Pilot Data Link Communications
CPF	Central Processing Facility
CPFSK	Continuous Phase Frequency Shift Keying
CPU	Central Processor Unit
CQD	Come Quick Distress (A UK Precursor to SOS)
CRL	Communications Research Laboratory of Japan
CRS	Coast Radio Station (Maritime)
CRT	Cathode Ray Tube

CSC	Common Signaling Channel
CSCF	Called State Control Function
CSS	Circuit Switched Service
CTU	Cabin Telecommunications Unit (Cabin Telephone Unit)
CWnd	Congestion Window
d	Distance Between Satellite and the Earth's Surface
D&E	Demonstration and Evaluation
D/A	Digital-to-Analog signal conversion
DA	Demand Assignment
DAB	Direct Audio Broadcasting
DACE	Dual Antenna Control Equipment
Dam	Decameter waves (HF)
DAMA	Demand Assigned Multiple Access
DASA	Daimler Chrysler Aerospace AG
dB	Decibel
DBMC	Data Base Main Computer
DBPSK	Differential Binary PSK
DBS	Direct Broadcasting Satellite
DC	Direct Current
DCCP	Distribution and Concentration Communication Processor
DCM	Digital Circuit Multiplication
DCPR	Data Collection Platform Repeaters
DCS	Data Collection System
DCT	Discrete Cosine Transform
DCTE	Data-Circuit Terminating Equipment
DDR	Data Distribution Region
deci mm	Deci millimeter waves (VEHF)
DECT	Digital European Cordless Communication
DeMUX	Demultiplexer
DFSK	Differential Frequency Shift Keying
DGPS	Differential GPS
DHBS	Direct-to-Home Broadcast System
DIP/LNA	Diplexer/Low-Noise Amplifier
DIT	Digital Image Transfer
DLNA/BITE	Diplexer/Low-Noise Amplifier/Built-In Test Equipment
DLP	Data Link Processing
DM	Delta Modulation
dm	Decimeter waves (UHF)
DME	Distance Measuring Equipment
DMG	Distress Message Generator
DND	Department of National Defense (Canada)
DOD	Tepartment of Defense
DOE	Department of Energy
DOP	Dilution of Precision
DPCM	Differential PCM

DPSK	Differential PSK
DRS	Direct Readout Service
DS	Direct Sequence
DSB-AM	Double-Side Band-Amplitude Modulation
DSB-SC	Double-Side Band Suppressed Carrier
DSC	Digital Selective Call
DSCS	Defense Satellite Communications System
DSI	Digital Speech Interpolation
DSNG	Digital Satellite News Gathering
DTAX	Domestic Telecommunication Automatic Exchange
DTE	Data Terminal Equipment
DTH	Direct-to-Home
DTVC	Digital TV Contribution
DVB	Direct Video Broadcasting
DVB-SM	Digital Video Broadcast-Satellite Mobile
DVB-SP	Digital Video Broadcast-Satellite Personal
DVB-S	DVB-Satellite
DVB-T	DVB-Terrestrial
DVB-RCS	Digital Video Broadcasting-Return Channel over Satellite
DVP	Development Verification Platform
DVSI	Digital Voice Systems Incorporated
E	Eccentric Anomaly
EC	European Commission
ECAC	European Civil Aviation Conference
ECDIS	Electronic Chart Display and Information Systems
ECS	European Communications Satellite
EDCT	Estimated Departure Clearance Time (Aviation)
EFB	Electronic Flight Bag
EGC	Enhanced Group Call
EGNOS	European Geostationary Navigation Overlay Service
EHF	Extremely High Frequency from 30 to 300 GHz (mm-band)
EIRP	Effective Isotropic Radiated Power
ELMSS	European Land Mobile Satellite System
ELT	Emergency Locator Transmitter (Aeronautical application)
EM	Electromagnetic
EMCA	European Maritime Core Area
EME	Externally Mounted Equipment
EMS	European Mobile System
EMSS	Experimental Mobile Satellite System (Japanese program)
EOL	End of Life
EP	Electric Power
EPC	Electronic Power Conditioner
EPG	Electronic Program Guide

EPIRB	Emergency Position Indicating Radio Beacon (Maritime application)
ERAST	Environmental Research Aircraft and Sensor Technology
ESA	European Space Agency
ESA/PAA	Electronically Steered Array/Phased Array Antenna
ESC	Engineering Service Channel
ESNP	European Satellite Navigation Programme
ESOC	European Space Operation Centre
ESS	ETC Short Burst Data Subsystem
ESTB	EGNOS System Test Bed
ETA	Estimated Time of Arrival (Shipping and Airways)
ETC	Earth Terminal Controller
ETD	Estimated Time of Departure (Shipping)
FTP	File Transport Protocol
ETS	Engineering Test Satellite of Japan (ETC Transmission Subsystem)
ETSI	European Telecommunications Standard Institute
EU	Electronics Unit
EUMETSAT	Exploration of Meteorological Satellites
Eurocontrol	European Organization for the Safety of Air Navigation
Eutelsat	European Telecommunications Satellite Organization
EVGC	Enhanced Voice Group Call
F1	Fleet One
FAA	Federal Aviation Administration of USA
FANS	Future Air Navigation Systems
Fax	Facsimile
FB	FleetBroadband
FCC	Federal Communications Commission (US)
FDM	Frequency Division Multiplexing
FDMA	Frequency Division Multiple Access
FDP	Flight Data Processing
FEC	Forward Error Correction
FES	Fixed Earth Station
FET	Field Effect Transistor
FFPP	Flexible Flight Profile Planning
FH	Frequency Hopping
FIR	Flight Information Region
FIT	Fixed Interactive Terminals
FleetNET	Inmarsat EGC broadcast of ship-owner data to part of all fleet
FLS	Forward Link Subsystem (System)
FM	Frequency Modulation
FMS	Flight Management System
FNBDT	Future Narrowband Digital Terminal
FoIP	Fax over IP

FQR	Factory Qualification Review
FRec	Fast Recovery
FRet	Fast Retransmit
FRU	Field Replaceable Units
FSC	Fixed Satellite Communications
FSK	Frequency Shift Keying
FSS	Fixed Satellite Service/System (Flight Standards Service)
FSSE	Flight Safety Satellite Equipment
FTP	File Transfer Protocol
G	Universal Gravitational Constant
G/T	Ratio of system gain to system noise Temperature (Figure of Merit)
GaAs	Gallium Arsenide
GaAsFET	Gallium Arsenide FET
GABS	Globalstar Accounting & Billing System
GACCS	Global Aeronautical Corporate and Commercial System
GADSS	Global Aeronautical Distress and Safety System
GAGAN	GPS/GLONASS and GEOS Augmented Navigation
GAN	Global Area Network
GASP	Global Aviation Safety Plan (ICAO)
GASSC	Global Aeronautical Safety Satellite Communications
Gateway	GES (BES)
GBAS	Ground Based Augmentation System
GBO	Globalstar Business Office
Gb/s	Gigabit per second
GCC	Gateway Control Center
DCP	GEO Data Collection Platform
GCS	Ground Control Station
GD	General Dynamics
GDE	Group Delay Equalizers
GDL	Gas Dynamic Laboratory
GDN	Globalstar Data Network
GDSS	Global Determination Satellite System
GEO	Geostationary Earth Orbit
GEOLUT	GEO Local User Terminal
GEOSAR	GEO Search and Rescue
GES	Ground Earth Station/Aeronautical Mobile (Gateway Earth Stations)
GET	Ground Earth Terminals
GFC	Ground Forecasting Center
GFR	Guaranteed Frame Rate
GGS	Gateway Ground Station
GHz	Gigahertz is a radio frequency unit of 1000 MHz
GIC	Ground Integrity Channel
GIO	Geosynchronous Inclined Orbit

GIRD	Group for Investigation of Reactive Movement
GLONASS	Global Navigation Satellite System (In Russian: ГЛОНАСС—Глобальная Навигационнаяа Спутниковая Система)
GLS	GNSS Landing System
GMBSS	Global Maritime Broadcasting Satellite System
GMDSS	Global Maritime Distress and Safety System
GMPSC	Global Mobile Personal Satellite Communications
GMR	Geostationary Mobile Radio (of Himawary Japanese Series)
GMS	Ground Monitoring Stations (Gateway Management System)
GMS	Geosynchronous Meteorological Satellite
GMSC	Global Mobile Satellite Communications
GMSS	Global Mobile Satellite Systems
GMT	Global Meteorological Technologies
GNC	Ground Notification Center
GNSS	Global Navigation Satellite System (ICAO Definition)
GNSS-P	GNSS Panel
GOES	Geostationary (Global) Operational Environmental Satellite
GOMS	Geostationary Operational Meteorological Satellite
GPRS	General Packet Radio Service
GPS	Global Positioning System
GR	Guaranteed Rate
GRS	Geostationary Ranging Station
GRS	Ground Radio Station (Aeronautical)
GSAS	Global Satellite Augmentation System
GSSII	Global Sea State Information via Internet
GSM	Global Service for Mobile communications or Group Special Mobile
GSPS	Global Stratospheric Platform Systems
GTE	Ground Telecommunication Equipment
GTO	Geostationary Transfer Orbit
GTS	Global Telemaque Service
GUS	Ground Uplink System
GW	Gateway
GX	Global Xpress
h	Altitude of Satellite Above the Earth's Surface
HAP	High-Altitude Platform
HAIPE	High Assurance Internet Protocol Encryptor
HDTV	High-Definition TV
HEC	Hybrid Error Correction (Header Error Check}
HEMT	High-Electron Mobility Transistor
HEO	Highly (Highinclined) Elliptical Orbit

HF	High Frequency from 3 to 30 MHz (Dam-band)
HGA	High-Gain Antenna
HLP	Horizontal Linear Polarization
Hm	Hectometrer waves (MF)
HoA	Home Address
HPA	High-Power Amplifier
HPA/DLNA	High-Power Amplifier and Diplexer–Low-Noise Amplifier
HPBW	Half Power Beamwidth
HSD	High Speed Data over 9600 b/s, max 56/64 Kb/s
HSO	Hybrid Satellite Orbits
HTTP	Hyper-Text Transfer Protocol
HVAC	Heating, Ventilation and AirConditioning
Hz	Hertz is basic radio frequency unit (1 Cycle/sec)
i	Inclination Angle
IA	Initial Approach
IAMSAR	International Aeronautical and Maritime SAR Manual
IATA	International Air Transport Association
IAWVG	Instrumental Approach with Vertical Guidance
IBF	Input Bandpass Filter
ICAO	International Civil Aviation Organization
ICF	Integrated Communications Facility
ICM	Integral Core Module (Integrated CommBox Modem)
ICO	Intermediate Circular Orbits
IDEC	Integrated Development and Evaluation Center
IDP	Input Data Processing
IDU	InDoor Unit
IEC	International Electrotechnical Commission
IESS	Intelsat Earth Station Standards
IETF	Internet Engineering Task Force
IF	Intermediate Frequency
IFE	In-Flight Entertainment
IFR	Instrument Flight Rule
IFRB	International Frequency Registration Board
IGA	Intermediate-Gain Antenna
IGN	Inmarsat Ground Network
IGP	Ionospheric Grid Points
IH	Inmarsat Hemisphere
IHO	International Hydrographic Organization
IKE	Internet Key Exchange
ILS	Instrument Landing System
IM	Intermodulation
IMAP	Internet Message Access Protocol
IMBE	Improved MultiBand Excitation
IMCO	Intergovernmental Maritime Consultative Organization (Former IMO)