# Military Satellite Communications In A Net-Centric Communications World

Satellite communications dominate current and planned military and government communications systems and make Net-Centric Warfare possible. This course provides a review of current and future military satellite communications. Internet protocol (IP) and IP over Satellite (IPoS) are addressed showing this protocol's strengths and weaknesses as a facilitator of Net-Centric warfare.

All of the current and future military and commercial satellite systems are described including MILSATCOM's evolution. The topics provide a perspective of satellite communications for military applications.

## OBJECTIVE
This course describes the fundamental aspects of satellite communication systems engineering with emphasis on the description of current and projected satellite networks in a net-centric and transitional communications environment.

## WHO SHOULD ATTEND
The course is designed for military communications systems planners, engineers, managers, operators, system analysts, and decision makers who need a review of military satellite communications concepts and implementations. A general background in communications is recommended.

**COURSE OUTLINE:** Military Satellite Communications in a Net-Centric Communications World.

## Introduction and System Review
• Basic Principles of Satellite Communications, frequencies, orbits, design rationale
• Overview of Military Satellite Communications Systems, including UHF, SHF and EHF architectures

## Satellite Links
• Model of a satellite communications system
• Link calculation components

## SATCOM Terminals
• Terminal View of Link Equations
• UHF, SHF and EHF Terminals
• Future Terminals Planned

## UHF Military Satellite Systems
• Fleet Satellite Communications System
• UHF Follow-On System
• Mobile User Objective System

**CDMA/AJ/IP over Satellite (IPoS)**
• Code division multiple access and anti jam formulas
• IP, Transmission Control Protocol (TCP) & Universal Datagram Protocol (UDP)
• Performance Enhancement Protocols

**Net-Centric Warfare Workshop**
• OSD Philosophy and Directions
• Impact of Technologies on Net-Centric Warfare
• Latency and Remote Access Exercises

**CONOPS and Budgeting**
• Concepts of Operations
• Budgets of Military Systems
• Budget Exercise

**Course Coordinator and Lecturer**
Mr. James A. Mazzei

Mr. James A. Mazzei provides consulting services to DoD and Intelligence Community customers under a contract with a Federally Funded Research & Development Center. His principal areas of expertise are DoD satellite systems, commercial satellite systems, satellite earth stations and distributed networks. He has over 30 years satellite communications experience in the Air Force and industry, in technical and management roles. He has held technical positions ranging from test engineer to Chief Technical Officer, and management positions ranging from Earth Station Manager to Senior Director & CIO. Mr. Mazzei's experience in industry includes employment with Harris Corporation, COMSAT Corporation and Booz-Allen & Hamilton, Inc., and encompasses testing and production of major systems as well as systems engineering and technical assistance. In addition to his consulting services, Mr. Mazzei has served as an Adjunct Professor for the University of Maryland, George Mason University and Johns Hopkins University graduate programs in the areas of satellite communications, data communications, computer networks, network management and executive programs.

<u>First Day</u>

        8:30 - 10:00                      Unit 1.1 – Intro & Systems Review I

        10:00 - 10:15                   Break

        10:15 - 11:45                   Unit 1.2 – Intro & Systems Review II

The Introduction and Systems Review covers the basics of orbits and satellite frequencies.  It then covers, with approximately 100 slides, the essential characteristics of the UHF, SHF and EHF satellite constellations. It examines the basic characteristics and features of the legacy Defense Satellite Communications System (DSCS) and the new Wideband Global SATCOM System (WGS) satellites. It examines the basic capabilities of the DSCS to shape antenna pattern coverage to reduce the effects of jamming. It explains their unique payloads and special capabilities of the Milstar and Advanced EHF systems. Also, it explains the need for and characteristics of the UHF Follow-on and Mobile User Objective System (MUOS).

        11:45 - 1:00                    Lunch

        1:00 - 2:30                      Unit 1.3 – SATCOM Link Equations Model

The SATCOM Link Equations Model explains the general model of a communications satellite link from the source, through the terrestrial subsystem, the satellite terminal and the transmitted waveform to the satellite and the return connectivity.  It does so giving the attendee a math equivalent to help him/her understand the characteristics and limitations of communications satellite channels and links.

        2:30 - 2:45                      Break

        2:45 - 4:15                      Unit 1.4 – Earth Station Technology

The Earth Station Technology module describes the different types of earth stations used in UHF, SHF and EHF communications.  It then breaks down an earth station and addresses the individual segments, e.g., feeds, antenna pointing and tracking, high & low power amplifiers and frequency converters. Finally, it covers the reason for precise SATCOM control.

<u>Second Day</u>

        8:30 - 10:00                      Unit 2.1 – Code Division Multiple Access, Anti Jam
                                                   and IP over Satellite

This module examines the fundamental aspects of using spread spectrum techniques, first as incorporated into code division multiple access (CDMA) systems and then to provide protection against jammers. It provides a reinforcing view of the fundamentals of the classical satellite communication system and also provides a brief derivation of the fundamental anti-jam equation that relates signal to noise ratio to user and jammer signal power and achievable user data rate based on the available satellite bandwidth. Finally, it addresses the issues and constraints relating to the use of the Internet Protocol over satellite systems.

| 10:00 - 10:15 | Break |

| 10:15 - 11:45 | Unit 2.2 – Network Centric Workshop |

The Network Centric Workshop module looks at the components of what we call the net-centric world. It addresses standards and protocol stacks from a conceptual standpoint with a view of what they mean to the warfighter. It then covers their implementation in LANs and wide area networks and transitions into the dangers of military communications in an IP driven world. Finally, the module has some math exercises so that the attendees can get a feel for issues such as timeliness and capacity in military satellite communications.

| 11:45 - 1:00 | Lunch |

| 1:00 - 2:30 | Unit 2.3 – Commercial Fixed Satellite Systems |

The Fixed Satellite Systems module covers commercial communications from its initiation with the U.S. Communications Satellite Act to the current time. It includes discussions of INTELSAT, Eutelsat, MDA, SES and other major commercial constellations. It highlights the differences between military and commercial systems, which operate on very different baselines. It also covers VSat systems and other domestic initiatives such as DirecTV.

| 2:30 - 2:45 | Break |

| 2:45 - 4:15 | Unit 2.4 – Commercial Mobile Satellite Systems and Ka-band |

The Mobile Satellite Systems module covers the mobile equivalent of fixed satellite services. It addresses the successful mobile companies such as INMARSAT, Iridium and ORBCOM. The module also addresses the emerging Ka-band systems which are opening the door to substantially greater capacities for commercial and military communications.

Third Day

| 8:30 - 10:00 | Unit 3.1 – Acquisitions and Budgets |

The Acquisitions and Budgets module explores the history and trends of satellite and satellite terminal control costs and management trends and lessons learned from complex ventures. It then addresses launch and system control costs, followed by a discussion of requirements and concepts of operation. Finally, the module includes a discussion and exercise in costing a system.

| 10:00 - 10:15 | Break |

| 10:15 – 11:45 | Unit 3.2 – General Review |