

## **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

### **Mega Satellite Systems**

- Concepts of Operations
- Starlink, OneWeb Telesat & Other Systems
- Advantage & Disadvantages of Each Constellation

### **Course Coordinator and Lecturer**

Mr. James A. Mazzei

Mr. James A. Mazzei has spent the last 20 years providing 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.

## First Day

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.

## Second Day

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

A number of new international satellite initiatives by corporations such as SpaceX, OneWeb, Telesat, Kuiper and others are planning to remake satellite communications and international internet access. They are high stakes and high risk endeavors with unique capabilities and issues related to each proposed constellation. The module addresses the basic design, advantages, disadvantages, and projected success potential of each system.

10:00 - 10:15 Break

10:15 – 11:45 Unit 3.2 – UHF Communications

The UHF Communications Module covers highly mobile communications systems. It traces the foundations of these satellite capabilities and reviews the different access techniques such as demand

assigned multiple access which are primarily used in systems that support highly mobile forces. The module also covers the Mobile User Objective system (MUOS) which dramatically increases capacities over the 5 KHz and 25 KHz channels that compose the legacy UHF networks.