

Short courses/training on Satellite Communications

available with Tim Tozer

Outline syllabus / content

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This is an outline menu as a basis for short training courses on satcoms of 1- 2- or 3- days, which may be developed and adapted to suit customers' requirements. Focus can be on civil systems, and/or on military systems, as required. The training aims to provide both an overview and a sound technical / academic basis. Modules are flexible, and can be lengthened or adapted to suit clients: not all Modules would necessarily be delivered.

Precise content and the rate of delivery will depend upon the client group, and can be adapted in real time to suit. Interactive dialogue is seen as more important than 'death by powerpoint'. This suggests that things work best with a small group of students having similar background and expectations.

A/B Satcoms Introduction and Overview

- Setting the scene; services; strengths, opportunities and weaknesses of satellite comms for both civil and military services. Terminology. History and application areas. Users, service providers, services overview, ownership, operation and regulatory issues. Orbit basics and characteristics. Key elements; frequency bands (Ku, C, X, Ka, L); basic transponder types. VSAT systems; system architectures; key technology elements; performance limitations and critical features.

C Link Fundamentals

- Power, dB, basic link equations & trade-offs, elements of link budgets, PFD, EIRP. Noise basics, noise temperature, C/N , C/N_0 , G/T . Footprints, coverage. Cascaded links. Performance examples and trade-offs.

D Antennas for Satcoms

- Basic designs & fundamental theory. Antenna characteristics, polar plots, gain & gain-aperture relationship, efficiency, beamwidth, sidelobes. Dish antennas, helical antennas. Polarisation, XPD. Practical considerations.

E Satcom Access Techniques

- Network architectures (Star, Mesh) SCPC, MCPC. Multiplexing. FDMA principles & practice, Transponder limitations, IPs and back-off. TDMA principles and practice, system requirements & illustrations. Fixed-assigned and DAMA principles. Contention schemes, ALOHA + variants [as reqd.], ARQ [depth as reqd.]. Spread Spectrum concepts, SS system issues. CDMA. Advanced access schemes.

F Modulation & Coding

- Satellite modulation techniques, performance and characteristics. Noise; Data detection in AWGN, BER vs E_b/N_0 . Bandwidth issues + Nyquist roll-off. High order schemes (QPSK + variants, m -PSK). Modem design issues. Coding principles [briefly] & performance. FEC, Convolutional coding. Coding gain. Turbo Coding, LDPC [briefly]. DVB and OFDM.

G Satellite Engineering

- Types of satellite; Payload configurations and issues (including High Thruput Satellites – HTS, and Digital Transparent Transponders); Power and bus features; station keeping; space environment; reliability and lifetimes.

H Military Satcoms

- Milsatcoms features, deployments, operation, bands. Current & emerging systems and features. Design issues. Threats & countermeasures. Trends & upcoming systems. [Can expand if reqd., including discussion of UK satcoms in particular].

I Installation and Operation

- Terminal installation principles. Site location. Terminal practicalities. Setting-up issues.

J Link & Terminal Design

- Principal components; receiver architectures (incl. intro to superheterodyne principle if needed). Key parameters. Noise sources, noise temperature, noise figure, cascaded stages, design considerations.

K Higher Frequency Bands

- Trade-offs of moving to higher freq bands (e.g. Ka vs Ku or EHF vs X-band). Propagation and link considerations. Technology aspects. LPE and interference.

Q Propagation Effects

- Propagation Overview; mechanisms & requirements; gaseous absorption; rain and hydrometeors and effects; Availability and margins; Low angle effects; XPD.

N Data Services over VSATs

- Data principles; traffic and services; layered models e.g. ISO 7-layer; ARQ recap; TCP/IP; flow control. Overview of limitations & mitigation techniques (acceleration options, PEPs).

R Markets and Evolution

- Brief historical overview of commercial VSAT markets, trends and issues.

S DVB and DVB-RCS

- DVB. DVB-S2, DVB-S2x. DVB-RCS overview. DVB-H. [Briefly only].

W Q&A Session

Lecturer's background: 35 years experience including military satcom system design, and in academia researching and teaching satcoms and related wireless communications topics.

Lecturer's baseline expectation here: Small class ideally (e.g. no more than 12 engineers) with some satcom experience; professional/technical (but not necessarily graduate) background.

Mode of presentation: Lectures on informal interactive basis, supported by Notes based on powerpoint slides. Material and level adaptable to suit the class.

Style: Emphasis on principles, and including some mathematics as appropriate. Interactive approach with free discussion.