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SATELLITE COMMUNICATION NETWORKS AND APPLICATIONS:
CREATING NEXT-GENERATION SYSTEMS IN COMMERCIAL AND GOVERNMENT ENVIRONMENTS
4-7 MARCH, 2014
LEVEL 4, 210 KINGS WAY, SOUTH MELBOURNE VIC 3205
About this course

This course provides an intensive state-of-the-art review of satellite communications networks and applications from system and service perspectives. Intended for technical, operations and business professionals as well as newcomers to satellite technology, the course details the fundamentals, architecture, and development of modern satellite networks with emphasis on cutting-edge broadcast, interactive and mobile applications.

Topics include:

» Satellite and ground station principles, digital image and full-motion video for broadcast distribution using the MPEG 2 and 4, DVB-S and S2 standards and IP Video
» Internet Protocol (IP)-based data performance optimisation over satellite
» Ku- and Ka-band Very Small Aperture Terminals (VSATs) applied to fixed networks as well as those having location flexibility
» L- and S-band; mobile satellite services and propagation (GEO and non-GEO)
» Mobile broadcasting using Digital Audio Radio Service (DARS) systems

» Advanced broadband capabilities of Ka-band satellite systems currently in use and under development.

Emphasis is placed on the proper selection of requirements, technologies and their providers (space and ground) and on the most effective ways to architect and operate the associated satellite networks.

Organised and led by satellite industry expert and consultant Bruce Elbert, president of Application Technology Strategy, Inc., the course provides fundamentals as well as a detailed review of current applications and implementations and a unique approach to the selection and development of advanced satellite networks for use in commercial and government environments.

The course is appropriate for engineers and managers new to the field as well as experienced professionals wishing to update and round out their understanding of current systems and solutions.

Details

In partnership with

UCLA Extension

DATE: 4-7 March, 2014
8am-4pm
VENUE: Level 4, 210 Kings Way, South Melbourne VIC 3205
COST: $4,800 per person + GST
REGISTRATION CLOSES: 4 February, 2014
STUDENTS RECEIVE: Course materials, morning tea, light lunch, afternoon tea, course photograph and certificate.
REGISTRATION Register online at www.QTTraining.com.au

QinetiQ TECHNOLOGY TRAINING
Course outline

DAY ONE

Principles of Communications Satellites and Networks
- Architecture of the space segment: GEO and non-GEO satellites and constellations, impact on coverage and quality of service
- Developing requirements for applications and services using systems engineering principles; commercial requirements for business use; government and military requirements for mission success
- Network architecture: broadcast, interactive star and mesh topologies and their application
- Information formats: speech, video, and image; the many forms of data and the associated protocols
- Introduction to satellite system design: the communications payload (antenna and repeater) and the spacecraft bus; satellite program planning (spacecraft and ground).

Engineering of Satellite Links
- Frequency spectrum and bandwidth: L and S band mobile links; C band, telecommunications services; X band, government applications; Ku and Ka band, telecommunications and broadcasting; millimeter-wave and optical applications
- Introduction to line-of-sight propagation at microwave frequencies (1 to 30 GHz) on the space-earth path; atmospheric and ionospheric impairments; rain attenuation principles and prediction models
- Design of the satellite link: introduction to assessing microwave link performance using link budgets using available software tools
- Comparison of digital modulation and encoding techniques: QPSK, OQPSK, MSK, and GMSK; bandwidth-efficient modulation: 16QAM and 32APSK; forward error correction (FEC) using block, convolutional, concatenated, and turbo codes.

Principles of Multiple Access Systems
- Frequency Division Multiple Access (FDMA) and Single Channel per Carrier (SCPC)
- Time Division Multiple Access (TDMA) and ALOHA
- Code Division Multiple Access (CDMA) using spread spectrum; hybrid modulation & multiple access techniques
- Comparison and application of multiple access systems.

DAY TWO

IP over Satellite
- Principles of TCP/IP design: windowing; packet loss and retransmissions; slow start and congestion, TCP extensions
- Operation and issues of TCP/IP over satellite: bandwidth-delay product, acknowledgement and retransmissions, congestions control
- TCP/IP acceleration and optimisation techniques for satellite networks: TCP acceleration, HTTP acceleration, CIFS acceleration, compression and caching, QoS
- Survey of available standards-based and proprietary optimisation solutions: SCPS, XTP, commercial WAN optimisation products, satellite-specific optimisation products, application-specific optimisation products, solution section criteria
- IP multicast versus broadcast of video and multimedia traffic: IP multicast fundamentals, multicast deployment issues, solutions for reliable multicast.

Satellite Direct-to-Home Systems
- Overview of digital DTH developments: comparison of systems (DIRECTV, DISH, etc.); evolving features and services (local channels, DVRs, interactivity); reference DTH system architecture
- DTH architecture, high- and medium-power satellites to serve small receivers and digital set-top boxes, microelectronics evolution
- Digital Video Broadcasting (DVB) standards: DVB-S concatenated Reed-Solomon and Viterbi convolutional coding, DVB-S2 BCH and LDPC concatenated block codes
- Compression and multiplexing technologies: Motion Picture Experts Group (MPEG) standards
- Requirements for video transmission networks (broadcast and cable)
- Security, conditional access and service management systems; options for achieving interactivity.

DAY THREE

Ground Station Basics
- Introduction to primary ground stations and remote user terminals
- Fixed, transportable, and mobile (on-the-move) terminals
- Integration with space segment
- Interfacing the ground segment with terrestrial networks.

Interactive VSAT Data Networks
- Network topology and implications: the star network versus full mesh architectures, "Forward" and "Return" traffic patterns, and degrees of asymmetry
- Star networks: ALOHA, TDMA, SCPC, and CDMA variants
- Interactive two-way satellite service using the DVB Return Channel via Satellite (DVB-RCS) standard
- Pairs Carrier Multiple Access (PCMA): carrier in carrier communications
- Central ground station (hub) implementations: baseband equipment and interfaces to terrestrial networks
- Capacity planning and sizing: collecting requirements for the VSAT network; protocol support; estimating delay and response time
- Discussion and comparison of suppliers and technologies for VSATs: ViaSat, Hughes, Gilat, iDirect, COMTECH EF Data.

Broadband and Multimedia Systems
- Broadband and multimedia for consumer, business-to-business services, and government use: characteristics, requirements for interactivity
- Ka-band spectrum suitability and availability; propagation considerations, rain attenuation, system noise temperature increase and de-polarisation; typical link budgets
- On-board processing multibeam satellite design: hopping spot beams, dynamic microwave switching, on-board regeneration, on-board demux/remux, on-board circuit and packet switching, on-board and ground-based adaptive beam forming, inter-satellite links (millimeter-wave and optical/laser).
Day Four
Satellite Mobile Communications at L and S Bands
- Historical progression of mobile radio, cellular, and satellite mobile systems
- “Big LEO” mobile satellite systems: Iridium and GlobalStar
- GEO systems for satellite phone and data services: Thruaya, Inmarsat 4
- Ancillary Terrestrial Component: ATC, ICO GEO, TerreStar, and SkyTerra
- Review of digital voice compression technology and performance at data rates below 4 kbps
- Modeling the L and S band propagation environment; multipath, noise, and interference; foliage and building penetration
- Digital Audio Radio and Mobile TV Services.

Addressing Military and Emergency Management Requirements
- U.S. Navy requirements and installations on ship
- Army and Marines’ use for short-term and tactical requirements: global, regional, and theatre; comms on the move (COTM)
- Aeronautical broadband installations: manned and unmanned
- Providers in the marketplace: TCS, Arrowhead, Datapath, Artel, et al
- Integration of SATCOM with other networks, particularly the Global Information Grid (GIG)
- Satellite services in civil government: disaster recovery and business continuity; emergency communications: national, regional, state and local; e-com architecture and the role of satellite terminals and vehicles.

Application and Business Planning Considerations
- Economic modeling of satellite communication systems
- Selecting the most appropriate satellite and transponder capacity; risk mitigation and avoidance as related to the space segment; source selection tactics and strategies
- Case study of a complete satellite network, based on requirements to be developed in class.

About the instructors
Coordinator and Lecturer
Bruce R. Elbert, MSEE, MBA, President, Application Technology Strategy, Inc., Thousand Oaks, California; and Adjunct Professor, College of Engineering, University of Wisconsin, Madison. Mr Elbert is a recognised satellite communications expert and has been involved in the satellite and telecommunications industries for over 30 years. He founded ATSI to assist major private and public sector organisations that develop and operate cutting-edge networks using satellite and other wireless technologies and services.

During 25 years with Hughes Space and Communications (now Boeing Satellite Systems), he directed communications engineering of several major satellite projects, including Palapa A (Indonesia’s original satellite system), the Galaxy follow-on system and the development of the first GEO mobile satellite system capable of serving handheld user terminals.

Mr Elbert also worked as a communications engineer for the INTELSAT system and developed link analysis tools while a radio officer in the U.S. Army. He has written seven books on telecommunications and IT, including The Satellite Communication Applications Handbook, Second Edition (Artech House, 2004), The Satellite Communication Ground Segment and Earth Station Handbook (Artech House, 2001) and Introduction to Satellite Communication, Second Edition (Artech House, 1999).

UCLA Faculty Representative
Kung Yao, PhD, Professor, Department of Electrical Engineering, Henry Samueli School of Engineering and Applied Science.