broadcast communications

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Training Course Description

Course: **Satellite Head-End Systems**
Course code: **ESS112**
Duration: **4 day**

Format: Classroom explanation and demonstration.

Supporting materials:

Each delegate completing the course will receive the following:

- A full set of course notes
- Certificate of attendance

Overview:

The course provides delegates with a practical understanding of the technologies, vocabulary, techniques digital television systems, focussing on the DVB implementations, explaining broadcast and DVB headend infrastructure, the creation of DVB transport structures, including MPEG audio and video processing, DVB and MPEG SI and PSI tables and DVB-S/S2 transmission systems.

Who should attend:

Technical staff working in a DVB satellite environment who need an understanding of the specific technologies and issues associated with implementing and working with DVB based systems.

Prerequisites:

No specific television or broadcast knowledge is required, but a general familiarity with technical concepts is assumed. A PC video projector should be available for presentation and to show demonstration sequences.

Key benefits:

At the end of the course delegates will be able to:

- Understand television systems and architectures
- Describe DVB architectures and processes
- Describe the MPEG-2 and MPEG-4 audio and video compression processes
- Describe the MPEG Elementary and Transport streams PSI (Program Specific Information) tables
- Describe the function and structure of DVB SI (Service Information) and its interaction with MPEG PSI
- Understand how to analyse MPEG streams and DVB tables and structures through the use of a Transport Stream Analyser
- Understand the issues involved in manipulating and transmitting DVB signals
- Understand the requirements and issues of different DVB satellite modulation systems in differing transmission environments.

Course Content:

Broadcast Television and Audio systems

- Video sampling structures, 4:4:4, 4:2:2, 4:2:0
- SDTV, HDTV (high definition TV) and aspect ratios
- WideScreen WSS (Wide Screen Signalling) AFD (Active Format Descriptor)
- HDSDI, 3GSDI
- ITU-BT.709 and SMPTE HDTV standards
- Progressive scan and interlace, Segmented Format
- frame rates

MPEG Video Compression

- MPEG-2 part 2, MPEG-4 part 10 AVC and H264 video coding
- Use of MPEG levels and profiles
- Intra and Inter frame/slice coding, I, P and B frames/slices
- MPEG structure, GOPs (Groups of Pictures) Slices, Macroblocks and Blocks
- Intra frame estimation
- Motion estimation
- Sub pixel motion estimation
- Integer transform coding
- Prediction Slices
- Use of arbitrary reference frames
- Hierarchical GOP
- Switch slices
- Exp Golomb coding
- Discrete Cosine Transform
- Entropy coding
- Zig Zag Scan
- Lossy and Lossless compression
- MPEG-4 decoding, use of de-blocking filters
- Performance comparison with MPEG-2

MPEG Audio Compression

- MPEG audio coding, layers and modes
- Sample frequencies and bit rates
- comparison of MPEG and Dolby audio compression methods
- Working with Dolby E and Dolby Digital

MPEG-2 System Layer and DVB SI tables

- The PES, Packetised Elementary Stream
- The Transport Stream and Program Stream
- MPEG PSI, PIDs, PATs and PMTs
- Timing through PCR, PTS and DTS
- MPEG testing and measurement
- Control and interaction with CA systems through CAT tables, EMMs and ECMs
- DVB SI and tables structure, NIT, TDT, TOT, EIT, BAT etc.
- Table rebroadcast and turnaround transmission
- Analysis of MPEG PSI and DVB SI tables through Transport Stream analyser

Conditional Access

- Symmetric key systems
- DVB Simulcrypt and Multicrypt systems
- Key periods, odd and even keys
- ECM repetition rates
- Use of EMMs and ECMs in content control and protection
- Authorisation deauthorisation and blackouts
- ECM bandwidth requirements and calculation
- EMM bandwidth and latency calculation
- STB pairing
- Fingerprinting
- Watermarking systems

DVB Interfaces

- DVB ASI
- ASI burst and byte modes
- DVB SSI / SMTPTE 310
- DVB Parallel / LVDS
- ASI vs SSI and parallel lock time
- DVB RS-422
- DVB IP encapsulation of Services and Transport Streams
- Error correction for video and audio FEC, ProMPEG and COP3

DVB in Practice

- DVB headend architecture
- System Multiplexing
- Inserting components into the multiplex
- Rebroadcast and Turnaround
- Transrating and Transcoding
- Channel change (zap time) assessment and optimisation
- Lip sync issues
- Picture assessment quantisation and compression artefacts
- Statistical Multiplexing
- MPEG test and measurement
- ETR101-290 monitoring

DVB-S SYSTEM

- Spectral scambling
- 188/204 byte streams
- Reed-Soloman FEC
- Reed-Soloman error correction method
- Interleaving
- Convolutional FEC coding
- Code rates 1/2 - 7/8 FEC
- Hard and soft decoding
- Viterbi error correction
- Effect of FEC on link performance and cliff edge effect
- QPSK modulation
- Symbol rate vs. bit rate
- Calculation of Symbol rate and bandwidth from bit rate, FEC rate and modulation ratio
- Spectral inversion
- IF frequencies

DVB-S2 SYSTEM
- PLPs (Physical Layer Pipes) and Data Structure
- FEC (Forward Error Correction)
- QPSK (Quadrature Phase Shift Keying), 8PSK (Eight Phase Shift Keying)
- 16APSK (Amplitude Phase Shift Keying) and 32 APSK modulation
- Pilot Tone Insertion
- Interactive modes and control through return channel
- Backwards compatibility mode

DVB-S2 STRUCTURING - DATA INPUTS TO FRAMES
- PLPs (Physical Layer Pipes)
- Input Stream Types
  TS (Transport Stream)
  Generic Streams
- BBFrame (BaseBand Frame) Creation
- Single PLP BBFrame
- Multiple PLP BBFrame
  Input Sync
  Delay
  NULL Deletion
  Scrambling
- FECFrame (Forward Error Correction Frame) Creation
- Bitstream to PSK Constellation formation
- FECFrames
- FEC Blocks

DVB-S2 ERROR CORRECTION SCHEME
- Outer BCH code
- Inner LDPC
- BCH and LDPC options
- Multipass error correction

DVB-S2 MODULATION
- QPSK (Quadrature Phase Shift Keying), 8PSK (Eight Phase Shift Keying)
- 16APSK (Amplitude Phase Shift Keying) and 32 APSK modulation
- Pilot Tones
- Roll-off filters and system performance

DVB-S/S2 PERFORMANCE COMPARISON
- Comparison of DVB-S and DVB-S2
- Phase noise issues
- Performance gain
- FEC and modulation advantage

Hands-on with recordings
this section may be run as demonstration or, where the delegates have analysers available, as hands-on exercises
- Use of various Transport Stream analysers in different tasks
- Use of WireShark as an MPEG analysis tool
- Analysis of good and bad streams
- Real time and offline analysis
- Zap time (channel acquisition) analysis
- ETR 101 290 alarms
- Reading and drilling into PSI tables

- Reading and drilling DVB SI tables
- Following information paths/flow between tables
- Monitoring CA key change
- Stream recording and playback
- RTP (Real Time Protocol) header analysis
- PES header analysis
- ES Buffer analysis and Zap time measurement