Hands-On

DVB-T2 and MPEG Essentials

for Digital Terrestrial Broadcasting

Course Description

Governments everywhere are moving towards Analogue Switch Off in TV broadcasting. Digital Video Broadcasting standards for use terrestrially as well as over satellite and cable have been available for many years, but viewers and users often see limited benefits in migration. With recent changes in television formats, demands for high definition TV services have increased. These already exist for delivery over DVB-S and over cable but are not easy to achieve over DVB-T. Delivering new HDTV services and migrating from analogue to digital together can offer attractive possibilities to governments and the industry alike.

DVB-T2 provides new opportunities to increase performance of DVB-T services and with changes in channel coding and encoding compression, deliver HDTV services without increases in radio bandwidth. Already exist in the UK and extensive interest is seen around the world in HDTV. To succeed new services will need to migrate encoding of video streams, change multiplexing techniques and implement new mechanisms in the radio layer to deliver better forward error recovery and more digital bandwidth.

This course covers how DVB-T is deployed HDTV services are encoded and delivered currently. It will then provide a detailed understanding of the frame structure, channel coding and modulation for a second generation digital terrestrial television broadcasting system that will be used by DVB-T2.

Students Will Learn

- **Describe the evolution and architecture of modern second generation Digital TV services**
- **Compare over-air terrestrial with cable, satellite and Internet delivery systems**
- **Discuss appropriate broadcasting/multicasting strategies for TV delivery**
- **Compare encoding of SDTV and HDTV services**
- **Identify how second generation DVB-T2 radio transmission can be implemented**
- **Identify how to multiplex channels, video pictures and sound within a stream**
- **Identify the key aspects of MPEG transport streams for second generation DVB**
- **Size video delivery options**
- **Identify how to multiplex channels, video pictures and sound within a stream**
- **Deploy the scrambling used for Conditional Access systems**
- **Compare the effectiveness of the different compression approaches**
- **Measure and test services to TR 101 290 (formerly ETR 290)**
- **Compare SFN and MFN designs**
- **Appreciate the trend in the technologies and the evolution to second generation of TV broadcasting**
- **And More...**

Course Outline

Module I: Television Architecture and Evolution

Colour Television

NTSC, PAL, SECAM

Analogue vs. Digital Systems

Interlaced vs. Progressive

Introduction to Digital Video Broadcasting

Formats:

4:2:2, 4:2:0, CIF, QSIF

The Signals

Satellite vs Cable delivery

Components of a modern Digital TV Service Network

Video Head End

Streamers

Encoders and Transcoders

Multiplexers

Set-top Boxes

Service Types and Issues

Channel Zapping

Encoder Classification: MPEG-2, MPEG-4, H.264

ETSI Digital Video Broadcast Standards

DVB-C, DVB-S/S2, DVB-T, DVB-H, DVB-IPI

Module II: **MPEG Encoding DVB Services**

Encoding in MPEG-2

Source Encoding

MPEG Compression Concepts

Discrete Cosine Transforms

Prediction and Interpolation

Reordering

Motion: Prediction, estimation and compensation

I, P and B Pictures

MPEG Levels and Profiles

Framing Formats

Multiplexing of Signals

Packetized Element Stream(PES)

Decode Time Stamp (DTS)

Presentation Time Stamp (PTS)

System Clock Reference (SCR)

Quantization of Program and Transport Streams

Encoding Sound

MPEG-2 layer 3

AAC and AC3

Hands-on Exercise encoding Video in MPEG-2 using different rates, and more...

Module III: **MPEG Transport Streams and Packets**

Transport stream format

MPEG Packets and headers

Service Information (SI), Program Specific Information (PSI)

Data Broadcasting DSM-CC

MHP Signalling

Program Allocation Table (PAT)

Program Map Table (PMT)

Conditional Access Table (CAT)

Network Information Table (NIT)

Service Description Table (SDT)

Event Information Table (EIT)

Effect on STB Behaviour

Channel Coding and Forward Error Recovery

Energy Dispersal

Reed-Solomon Coding

Convolutional Coding

Interleaving

Trellis Decoding

Temporal Spreading

Module IV: **DVB Terrestrial Transmission**

Physical Layer transmission Elements

Modulations using QPSK, 16-QAM and 64-QAM

Reference signals

Locating carriers and Transmission Parameter Signalling

Spectrum characteristics

Performance comparisons for static and moving reception

Single and Multi-Frequency operation

Interference Issues

Reflection and Diffraction

Multi-path issues and their removal

Antennas

Coverage issues and re removal of dead-spots

Typical troubleshooting tool-kit

Hands-on Exercise Analysing MPEG-2 Transport stream from DVB-T Live off air, and more...

Module V: **Using MPEG-4 and H.264 Standards for HDTV**

Video Objects (VO)

Video Object Plane (VOP)

I-VOP, P-VOP, B-VOP

Short Header Mode

Motion Vectors

Video Packet Structure

MPEG4 Part 10 and H.264

H.264 Modes: I, P, B, SP and SI

Reordering

B Slices and Reference Pictures

Weighted Prediction

Context-based Adaptive Binary Arithmetic Coding (CABAC)

Sound Encoding

AC3

New Evolution of sound encoding

Extended Profiles

MPEG-2/MPEG-4/H.264 Comparisons

Hands-on Comparison between MPEG-2, MPEG-4 and H.264 encoding, and more...

Module VI: **IPTV Delivery Protocols**

DVB-IPI

UDP/IP

RTP

RTCP

Quality of Service

Layer 2 and Layer 3 QoS compared

The Quality of Service Alphabet Soup:

802.1P/Q, RSVP, WFQ, DiffServ, DSCP, MPLS

Pro-MPEG Error Recovery

Hands-on Exercise decoding DVB-IPI encodings over IP MPEG-2 transport stream, and more...

Module VII: **Multicasting**

Deploying Multicasting for network delivery of video

Multicast routing approaches

Multicast extensions to Routing protocols

Protocol Independent Multicast (PIM)

Selecting Mode of operation: Dense or Sparse

IGMP

Protocol exchanges to build tree

Protocol exchanges to prune tree

Potential failures and fixes

Hands-on Exercise TV Stream Analysis using protocol analyzer, and more...

Module VIII: **Conditional Access**

Conditional Access Mechanisms

CA Standards

DVB-CSA

Simulcrypt & Interoperability

Common Interface

Encryption

Entitlement Management Messages (EMM)

Entitlement Control Messages (ECM)

Encoding ECM and EMM into the transport stream

Alternatives using DRM

Hands-on Analysis of MPEG Service Information using Transport Stream Reader, and more...

Module IX:

DVB-T2

Reasons for evolution to second generation transmission

Key objectives of changes

DVB-T2 framing structure

Physical Layer Pipes (PLPs)

Input mode B

Frame Building

Null Packet Deletion

Baseband header Insertion

High Efficiency Mode Transport

BB Scrambling

FEC Coding

Outer encoding (BCH)

Inner encoding (LDPC)

Bit Interleaver

16QAM, 64QAM and 256QAM modulation

Cell Interleaver

Time Interleaver

Coding and modulation of Layer 1 signalling

Signalling data

Modulation and error correction coding of the L1 data

FEC Encoding

Framing and Super-framing

Future Extension Frames (FEF)

MISO Processing

IFFT - OFDM Modulation

Carrier Distribution

Spectrum characteristics

Splitting of input MPEG-2 TSs into the data PLPs

T2-frame structure for Time-Frequency Slicing

Indexing of RF channels

Pilot patterns

Module X: **DVB-T2 Network Design and Measurement**

Selecting frequencies and transmitter locations

Estimating coverage

Single Frequency Networks (SFN)

Multi-Frequency Networks (MFN)

Comparative design of SFN and MFN

Measurement guidelines for DVB based on ETR-290

ETSI TR 101 290

General measurement methods

Test Signals

RF accuracy (precision)

BER vs. C/N ratio by variation of transmitter power

BER after RS (outer) decoder

Modulation Error Ratio (MER)

System Target Error (STE)

Carrier Suppression (CS)

Amplitude Imbalance (AI)

Quadrature Error (QE)

Phase Jitter (PJ)

Estimated Noise Margin

RF phase noise measurements using a spectrum analyser

System and Link Availability

Module XI: **Set-Top Boxes for DVB-T2**

STB architecture

Main chipset vendors

Inside a digital STB

STB middleware

Functions of middleware

Middlewares

STB software stack

Customer Interface Issues:

Analogue Video Reception

Digital Video Reception

Migration issues from Analogue to Digital

High-Definition Multimedia Interface (HDMI)

Consumer Electronics Interface

Dolby Audio Surround Sound

Personal Video Recording Interfaces

In-Home Networking

Module XII: **Migration to DVB-T2**

Typical DVB Terrestrial services

Migration from DVB-T to DVB-T2

Migration from Analogue directly to DVB-T2

Beyond DVB-T2

Delivery Method

Instructor-led with Numerous Hands-On labs and exercises.

Equipment Requirements

(This apply's to our hands-on courses only)

BTS always provides equipment to have a very successful Hands-On course. BTS also encourages all attendees to bring their own equipment to the course. This will provide attendees the opportunity to incorporate their own gear into the labs and gain valuable training using their specific equipment.

Course Length

5 Days