broadcast communications

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Training Course Description

Course: **ST2110 and High Bitrate Media Transport over IP Networks**

Course code: **BTC174**

Duration: **3 day**

Format:

Classroom explanation, demonstration and practical work.

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 an understanding of the technologies, vocabulary and techniques and used in HBRMT (High Bit Rate Media Transport) in a broadcast environment, covering the key standards, implementation of both the media and network.

Who should attend:

Technical staff working with high bitrate broadcast technologies who need to become familiar with the specific methods, concepts and terminology used in this field.

Prerequisites:

A knowledge of UHD/HD/SDI broadcast video and IP and Ethernet networking is assumed for this course. Where required, supporting IP and video courses are available, or appropriate modules can be prepended to this course for maximum benefit.

Key benefits:

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

- Describe the key functionality of an HBRMT networked system
- Understand the issues for network systems caused by HBRMT stream
- Understand the multicast Ethernet and IP processes
- Understand the requirement for, and use of, RTP (Real-time Transport Protocol)
- Understand the relationship of the AES-67, TR-03/04, ST2022 and ST2110 standards
- Understand how to work without time code and video/audio reference signals
- Understand PTP (Precision Time Protocol) and RTP synchronisation

Course Content

HBRMT Introduction

- Overview and relationship of the HBRMT (High Bit Rate Media Transport) standards
- The involved standards bodies, and what they do
  AES, ASPEN, AIMS, IETF, VSF, SMPTE
- IETF RFC 4175
- VSF TR-03, TR-04
- AES-3 and AES-67 audio
- SMPTE ST2022 suite
- SMPTE ST2110 suite
- SMPTE 2059 timing
- IEEE 1588 PTP (Precision Time Protocol) standard
- NMOS (Networked Media Open Specifications)

IP and Network Layer in HBRMT

- L2 frames and Jumbo frames
- Use of UDP vs. TCP
- Network MTU and Fragmentation
- Network Frame size limitations
- The need for RTP
- Non-standard use of RTP by broadcast systems
- Use of L3 multicast vs. unicast
- Need for, and use of, UDP/multicast in a broadcast environment
- IGMPv2 vs. IGMPv3
- Source specific multicast
- IGMP join requests, leave requests and group membership requests
- Use of, and need for IGMP snooping switches
- Multicast at L2
- Multicast MAC addressing and issues
- Multicast L2 flooding
- Issues for broadcasters using Spanning Tree
- Spine and leaf network topology
- L2 issues of aggregation and hashing for broadcasters
- L2 and L3 issues when transporting High Bitrate Media
- Issues at L2 with HBRMT wide and narrow media senders, gapped senders
- HBRMT issues for non-blocking switches, L2 switch derating for broadcast traffic
- Frame accurate switching of L2/L3 carried video
- Make before break, and break before make, and video aware L2 switching

PTP / SMPTE 2059 / IEEE 1588

PTP / SMPTE 2059 System

- How RTP/PTP/STPTE 2059 replaces reference video and timecode
- PTP and SMPTE 2059 Epochs
- Relationship of PTP to RTP timestamp in broadcast systems
- Achievable timing accuracy and jitter
- TAI (Temps Atomique International) and UTC
- PTP Ordinary Clock

- PTP Grand Master
- PTP Boundary Clock
- PTP Transparent Clock

PTP Function

- Frequency Lock
- SYNC and SYNC follow-up messages
- Phase Lock
- Delay Request, Delay Response and Delay Response follow-up messages
- Time Values
- Domains
- Redundancy and Best Grand Master Selection

Non SMPTE Media Carriage Standards

DVB standard A086 MPEG-2 TS Services over IP Networks

- Encapsulation of MPEG-2 TS (Transport Stream) packets in RTP
- TS packet number limitations
- Do not fragment at l3

Pro MPEG Forum CoP3.2

- Use of 2D FEC (Forward Error Correction)
- Error correction strategy
- Error correction power and scope
- Use of L4 port numbering
- Media delay considerations vs. correction power

IETF RFC 4175 RTP based Uncompressed Video

- Relationship of IETF RFC 4175 and VSF TR-03
- RFC4175 RTP container
- RFC 4175 extended RTP header
- Extended sequence number and roll over periods
- Line and pixel numbering
- Field and frame modes
- Pgroups (Pixel groups) and packing
- Subsampling modes 4:2:2, 4:2:0, et al
- Sample word lengths 8. 10, 12 et al

VSF TR-03, Transport of Uncompressed over IP

- Carriage multiple media elementary streams over IP
- Timing synchronisation through PTP and RTP timestamps
- Synchronising of different media RTP clock rates
- Managing framerate/1001 frame rates
- Use of PTP/ST-2059
- IP L3 Fragmentation considerations
- IP multicast and unicast considerations

SDP (Session Description Protocol)

- SAP (Session Announcement Protocol)

- Understanding an SDP message
- Session description
- Connection information
- Lipsynch groups
- Media attributes
- Use of RTP dynamic payload types

VSF TR-04, ST2022-6 in a TR 03 environment

- The modified SDP message
- RTP dynamic payload type

SMPTE Media Carriage Standards

ST 2022-1
- Forward Error Correction for Real-Time Video/Audio Transport Over IP Networks
- FEC blocks and Interleave

ST 2022-2
- Unidirectional Transport of Constant Bit Rate MPEG-2 Transport Streams on IP Networks
- ST2022 relation to DVB086 transport

ST 2022-3
- Unidirectional Transport of Variable Bit Rate MPEG-2 Transport Streams on IP Networks
- Considerations for transport of VBR (Variable Bitrate) content

ST 2022-4
- Unidirectional Transport of Non-Piecewise Constant Variable Bit Rate MPEG-2 Streams on IP Networks
- Extensions to the RTP header
- Timing data and clocks

ST 2022-5
- Forward Error Correction for Transport of High Bit Rate Media Signals over IP Networks (HBRMT)
- Considerations and use of FEC with uncompressed video

ST 2022-6
- Transport of High Bit Rate Media Signals over IP Networks (HBRMT)
- Carriage of active video frame media
- Carriage of U/HD/SDIHANC and VANC timing and meta data
- Clock rates and FEC
- RTP header, use of marker bit and non-standard timestamp rate
- Frame counting
- SDI mode mapping
- Frame types, rates and sampling
- Time stamping
- Active video payload, EAV SAV and TRS

ST 2022-7
- Seamless Protection Switching of SMPTE ST 2022 IP Datagrams
- Stream duplication
- Network delay and jitter
- Receiver buffering

- Network packet loss
- Data recovery
- ST-2022 receiver grades Class A, B and C

ST 2110 2017, ST2110

- Suite of standards unifying the transport of high bitrate media over IP as elementary streams

ST-2110-10 System and Network Timing

- RTP timestamp and PTP clock
- RTP/UDP Packet sizes
- Non-standard use of RTP time stamp
- Non-standard use of RTP start values
- Understanding the SDP (Session Description Protocol) object

ST-2110-20 Uncompressed active video over IP

- Video frame sizes
- Progressive, PsF and interleaved modes
- Video sampling modes, 4:2:0, 4:2:2 etc.
- Alpha/Key channel elementary stream
- RTP header and extended header
- RTP payload format
- Pgroup pixel modes
- Pgroup BPM and GPM packing structures
- SDP parameters

ST-2110-21 Traffic shaping and delivery of uncompressed video

- Narrow, Wide and Narrow Linear senders
- Network switch and receiver buffer modelling
- Cmax and VRXfull models
- HBRMT traffic issues for network switches

ST-2110-30 PCM digital audio over IP

- Relationship to AES67
- A to CX conformance levels

ST-2110-31 AES-3 Transparent Digital Audio

- The RTP container and header
- AMS324 encapsulation
- Ptime / packet time
- Conformance levels and modes

ST-2110-40 Ancillary Data

- ANC data formatting
- Carriage of SDI source and destination data
- RTP parameters

Hands-on Sessions

If hardware is available these will be conducted as hands-on by the course delegates, otherwise as demonstration.

Use of bespoke broadcast network analysis tools, where available

Use of Wireshark as an analysis tool

- Configuring Wireshark for broadcast stream analysis
- Installing lua extensions/dissectors for broadcast stream analysis
- Configuring WireShark to analyse different RTP dynamic payload types
- Issues of recording HBRMT stream, understanding stream errors
- Display and capture filter rules
- Extracting and saving live media content to disc
- Extracting and saving control signalling in the presence of high bit rate media
- Viewing the key network stream configurations and parameters
- Viewing and understanding the key media stream configurations and parameters
- Extracting media stream information from packet analysis
- Dissection of Transport Stream, PTP, ST2022-6, ST-2110 media streams