broadcast communications

Zetrox Broadcast Communications
Archer Lodge, Chequers Road, Basingstoke,
Hampshire, RG21 7PU, United Kingdom
training@zetrox.com; www.zetrox.com
Tel. / Fax.: +44 (0)1256 328484

Training Course Description

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

Course code: **BTC174**

Duration: **2 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 BitRate 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
- Describe networking and internetworking processes and protocols
- 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 the issues of transporting HBRMT signals over networks
- 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-67
- SMPTE ST2022
- SMPTE ST2110 (expected December 2017, after standard is published)
- SMPTE 2059 timing
- IEEE 1588 PTP (Precision Time Protocol) standard
- NMOS)Networked Media Open Specifications) (not published at time of writing)

IP and Network Layer in HBRMT

- L2 frames and Jumbo frames
- Use of UDP vs. TCP
- Network MTU
- Network Fragmentation
- Network Frame size limitations
- The need for RTP
- Use of L3 multicast vs. unicast
- Need for, and use of, UDP/multicast in a broadcast environment
- L3 Multicast address ranges
- IGMPv2 vs. IGMPv3
- Source specific multicast
- IGMP join requests , leave requests and group membership requests
- Multicast at L2
- Multicast MAC addressing and issues
- Multicast L2 flooding
- Use of, and need for IGMP snooping switches
- Spine and leaf network topology
- L2 and L3 issues when transporting High Bitrate Media
- Wide and narrow media senders
- HBRMT issues for non-blocking switches, switch derating

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 followup messages
- Phase Lock
- Delay Request, Delay Response and Delay Response followup 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
- The RTP header
- 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
- 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-2110-40

- Standard unreleased at time of writing