Hands-On
Real Time HD and 3D IPTV
Encoding and Distribution over RF and Optical Fiber

Course Description

This course provides systems engineers and integrators with a technical understanding of current state of the art technology for capture, encoding and distribution of High Definition (HD) and 3D television. The course includes technical discussion of the technologies used with practical demonstrations where possible and appropriate. It will try to identify where commercial off the shelf technology exists and compare practical standards that exist for TV distribution.

Several distribution technologies exist each with its own advantages and disadvantages. Two groups of distribution technologies will be studied and compared in detail. Firstly delivery of services over radio frequency (RF) systems. This will include point to point microwave, terrestrial broadcast, RF over coaxial cable and over Hybrid Fiber Coaxial cable (HFC) networks. Distribution over optical fiber will also be examined considering the problems of selecting fiber types, transmitter wavelengths and system construction. Point to point single wavelength and multiple wavelength systems will be compared and both active and passive optical network systems (PON) compared.

A key part of any services is the compatibility of system component subsystems with each other and with national and International public services. The course will examine the currently available IPTV standards, standards for RF and for fiber optical systems.

Where feasible, practical demonstrations within the classroom will be used. These will be used to illustrate elements of the technology difficult to describe. Video presentation of field installations and field deployments will also be used.

Students Will Learn

- Describe how High Definition and 3D TV can be delivered over IP
- Appreciate how Digital TV streams are carried over RF and Optical Transports
- Analyze Internet protocols needed to deliver IPTV unicast and multicast
- Design RF systems for point to point delivery
- Design Fiber Optic systems for point to point delivery
- Appreciate how HDTV can be efficiently encoded
- Size HDTV and 3DTV delivery services
- Understand the advantages and challenges to delivering 3DTV
- And more...

Target Audience

Systems engineers, integrators and anyone involved in the design, engineering, deploying and/or working with Real Time
HD and 3D IPTV.

**Course Outline**

**Day 1:**

**Chapter 1 What is IPTV?**

Types of IPTV
Live TV streams
Live Web TV
On Demand Video
Methods of distribution
Distribution over Datagram Services

Demonstration of TV delivered live from a camera over IP point to point

Impact of errors
Typical RF error rates
Typical optical error rates
Error correction with TCP

Demonstration of delivery over links with errors

Demonstration of delivery services of error prone links with error recovery

**Chapter 2 Internet Protocol Delivery Technology**
Internet Protocol Model

Addressing Issues

Link Layer Protocols: Ethernet

IEEE 803.3

Gigabit and 10 Gigabit Ethernet

Ethernet Aggregation

Multicast distribution

Multicast over Ethernet at Layer 2

Multicast over routed networks at layer 3

Addressing issues

Demonstration of Multicast Live TV delivery over Ethernet

Demonstration of Multicast delivery through Layer 3

Delivery of TV services on demand

Delivery via Web technology

Demonstration of Live TV delivered via Web technology

Delivery via single streams

Delivery via multiplex streams

Day 2
Chapter 3 Encoding

Picture resolution
North American and International Standard Formats
Standard Definition Formats
High Definition Television
Comparison of picture sizes and formats

Demonstration of comparison between picture sizes and formats

Measures of quality and resolution
Color depth
Principles of encoding
MPEG-1 and MPEG-2 encoding evolution

Demonstration of MPEG encoding of video

Groups of pictures (GOPs)
Picture types: Intra-Pictures, Predictive Pictures and Bidirectional Pictures
Impact of picture rates on stream speed

Techniques for Picture Compression
Fourier Discrete Cosine Transforms
Wavelet functions
Block sizes and shapes
Inter and Intra Encoding
Motion compensation
Scaling
Evolution of MPEG-4 Part 10: H.264
MPEG Program Streams

Program Stream Encapsulation

Demonstration of H.264 encoding

Demonstration of Video Stream Bit rate over time

Chapter 4 TV and Video Transport

Efficiency of transport
Synchronous and Asynchronous Transmission
Carrying multiple streams together
Multiplexing
Error recovery considerations
Reed-Solomon Forward Error Correction (FEC) Coding
MPEG-2 transport streams
MPEG-4 Encapsulation and Transport

Demonstration Analyzing MPEG Transport Streams

Service Information
Program Service Information
Electronic Program Guide
Conditional Access
Digital Rights Management Control
Day 3:

RF Distribution
RF fundamentals
RF over air transmission
RF over cable
Modulation, noise and error recovery
Cable TV distribution
DOCSIS standards, carriage of IPTV over DOCSIS

3. Demonstrations
Spreadsheet design of RF systems

Chapter 5 Radio Frequency Distribution Principles

Frequency Issues
Radio Transmission Principles
Propagation over cables
Propagation through space
Propagation through air and atmosphere
Frequency, Wave Length, Phase and polarization
Signal Power and Free Space Loss
Effective Radiated Power (ERP)
Polarization
Absorption
Diffraction
Reflection
Signal to Noise Ratio
Interference effects and Fading
MiMo and SiSo
Channel Allocation
Modulation
Amplitude, Frequency and Phase Modulation
QAM
Multi-Access Systems
FDM, TDM, TDMA, FHSS, DSSS, OFDM, CDMA
Frequency use
Overlapping channels
Noise and signal strength
Sensitivity, Feedback and Drift
Noise: sources and temperature
Microwave Point to Point Delivery
Area Coverage Terrestrial Delivery
Antenna Systems

Chapter 6 IPTV Delivery over RF on Cable Systems

Evolution of Community Antenna Systems
Evolution from Analog to Digital Cable
How CATV/over the air industry is migrating their system to the digital age
Typical Hybrid Fiber Coax (HFC) Networks
Digital Cable DOCSIS standards for delivering IP
DOCSIS 3.0
Architecture of modern Cable TV system
Upstream and Downstream Frequency Division
Carrying IP over MPEG Transports
Multi-Protocol Encapsulation
Upstream and Downstream Channel bonding
Cable Modem Termination Systems
Cable Modems
Multicast TV over DOCSIS Cable systems
Network and Higher Layer Protocols
CM and CMP Provisioning and Management
Relationship to Physical HCF Plant and topology
Cable Modem Service Group (CM-SG)
CMTS Downstream Service Model
MAC Specifications
MAC Formats
Time Sync
Upstream features
Dynamic Service Features
Dynamic Bonding
MAC Protocol Operation
Quality of Service
Channel Bonding
Data Forwarding
Dynamic Bonding and Load Balancing

Day 4:

Chapter 7 Fiber Optic Systems
Principles of Fiber Optic Transmission

Operational System Parameters

Capacity Considerations

Fiber Optics Design Principles

Optical Sources: LED, Vertical Surface Emitting Lasers (VCSELs), Lasers

Optical Modulation

Fiber Types: Multimode, Restricted Mode Launch Bandwidth, Laser Optimized Multimode, Single-mode

Cable Types: Breakout Cables, Ribbon Cables, Armoured Cables

Cable Installation Methods: Ducting, Pulling, Blown Fiber, Ploughed Cables

Video Demonstration of Fiber Cable Installation

Deploying Wavelength Division multiplexing and Switching options

Hardware Selection Factors

Connectors and Splicing Options

Core Network Solutions

Access Solutions: PON, FTTB, FTTC, FTTH

Chapter 8 Calculating Key Fiber Optical Link Design Parameters

Theory And Principles of Fiber Optics Link Budgets

Cable Construction

Recommended Cable Types

Cable Selection

Termination Methods

Fusion Splicing Methods

Mechanical Splicing
Video Demonstration of Fiber installation and Splicing

Loss Analysis Link Loss Calculation
Cost Comparison Model
System Redundancy and Availability

Demonstration Exercise Calculating the Budgets for a Link

Availability and reliability
Physical and Logical Network Topologies
Point to Point, Ring, Star, Mesh
Physical Plant Layout: Fiber Counts/Types
Structured Cabling
Inter-building, Intra-building and Horizontal Cabling
Cable Support System Design
Fiber Testing Procedures for Installation and Design Validation
Optical Testing and Measurements
TIA/EIA Standards

Day 5:

Chapter 9 Stereoscopic Vision and Human 3D Perception for Video

Visual perception
Stereoscopic 3D viewing
Motion perception
Video and TV
Colour perception and encoding
Analogue and digital broadcast TV
Digital Video Broadcasting
2D Camera Systems

Chapter 10 3D TV Transport and Display

Multiview Video Encoding
H.264 Annex H
Syntax and Semantics
MVC Decoding Process
Reference Pictures
Base View Bit Stream
Multiview High Profile
3D TV Profiles and Levels
Anaglyphic 3D using passive red-cyan glasses
Polarization 3D using passive polarized glasses
Alternate-frame sequencing using active shutter glasses/headgear
Autostereoscopic displays without special viewing glasses
Example 3D TV systems
3D Broadcasting Channels
HD 3D TV, Stereoscopic principles
Display systems
Issues of convergence and focus
3DTV transport.

Demonstration of 3D Video using anaglyptic services on standard TV Monitors
Demonstration of 3D Video using shuttered glasses

Demonstration of Shooting and editing 3D content

Chapter 11 Futures and Other Interests

KVM over IP technology
Evaluation and Review

Delivery Method

Instructor-Led with numerous 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