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