Chapter 1. The Road to DTV

1.1 Introduction
1.1.1 The Pioneers
1.1.2 Transmission Standards
1.1.3 Conventional TV Systems

1.2 Early Development of HDTV
1.2.1 1125/60 Equipment Development
1.2.2 The 1125/60 System
1.2.3 European HDTV Systems
1.2.4 A Perspective on HDTV Standardization
1.2.5 Digital Systems Emerge
1.2.6 Digital Video Broadcasting
1.2.7 Involvement of the Film Industry
1.2.8 Political Considerations
1.2.9 Terminology
1.2.10 Proposed Routes to HDTV
1.2.11 System Testing: Round 2
1.2.12 Formation of the Grand Alliance
1.2.13 Testing the Grand Alliance System
1.2.14 The Home Stretch for the Grand Alliance
1.2.15 Digital Broadcasting Begins
1.2.16 Continuing Work on the ATSC Standard

1.3 Compatibility in HDTV Systems
1.3.1 Compromises in Compatible Systems
1.3.2 Adapters for Compatible Service
1.3.3 Transcoding Functions
1.3.4 Standardization Issues
1.3.5 Harmonized Standards

1.4 References
1.5 Bibliography

Chapter 2. Applications for HDTV

2.1 Introduction
2.1.1 Resolution
2.1.2 Production Systems vs. Transmission Systems
2.1.3 Defining Terms
Chapter 6. High-Definition Production Systems

6.1 Introduction
6.2 The 1125/60 System
6.2.1 Fundamental Principles of 1125/60
6.2.2 The Standardization of 1125/60 HDTV
6.2.3 HDTV Production Standard
6.2.4 Technical Aspects of SMPTE 240M
6.2.5 Bandwidth and Resolution Considerations
6.2.6 Interlace and Progressive Scanning
6.2.7 Digital Representation of SMPTE 240M

6.3 SMPTE 260M
6.3.1 Sampling and Encoding
6.3.2 Principal Operating Parameters
6.3.3 Production Aperture
6.3.4 SMPTE 240M-1995

6.4 DTV-Related Raster-Scanning Standards
6.4.1 1920 1080 Scanning Standard
6.4.2 1280 720 Scanning Standard
6.4.3 720 483 Scanning Standard
6.4.4 MPEG-2 4:2:2: Profile at High Level

6.5 High-Definition Serial Digital Interface
6.5.1 A Practical Implementation
6.5.2 Audio Interface Provisions
Chapter 7. DTV Audio Encoding and Decoding

7.1 Introduction 245
    7.1.1 AES Audio 245
    7.1.2 Audio Compression 247
    7.1.3 Encoding 247
    7.1.4 Decoding 249

7.2 Implementation of the AC-3 System 250
    7.2.1 Audio-Encoder Interface 251
    7.2.2 Output Signal Specification 252

7.3 Operational Details of the AC-3 Standard 253
    7.3.1 Transform Filterbank 254
    7.3.2 Coded Audio Representation 254
    7.3.3 Bit Allocation 256
    7.3.4 Rematrixing 256
    7.3.5 Coupling 256
    7.3.6 Bit-Stream Elements and Syntax 257
    7.3.7 Loudness and Dynamic Range 258
    7.3.8 Encoding the AC-3 Bit Stream 259
    7.3.9 AC3/MPEG Bit Stream 261
    7.3.10 Decoding the AC-3 Bit Stream 261
    7.3.11 Algorithmic Details 265
    7.3.12 Bit Allocation 265

7.4 Audio System Level Control 266
    7.4.1 Dialogue Normalization 266
    7.4.2 Dynamic Range Compression 267
    7.4.3 Heavy Compression; COMPR, COMPR2 269

7.5 Audio System Features 270
    7.5.1 Complete Main Audio Service (CM) 270
    7.5.2 Main Audio Service, Music and Effects (ME) 271
    7.5.3 Visually Impaired (VI) 271
    7.5.4 Hearing Impaired (HI) 271
    7.5.5 Dialogue (D) 271
    7.5.6 Commentary (C) 272
    7.5.7 Emergency (E) 272
    7.5.8 Voice-over (VO) 273
    7.5.9 Multilingual Services 273

7.6 References 275
Chapter 8. The ATSC DTV System

8.1 Introduction
8.1.1 System Overview
8.1.2 Video Systems Characteristics
8.1.3 Transport System Characteristics

8.2 Overview of Video Compression and Decompression
8.2.1 MPEG-2 Levels and Profiles
8.2.2 Overview of the DTV Video System
8.2.3 Color Component Separation and Processing
8.2.4 Number of Lines Encoded
8.2.5 Film Mode
8.2.6 Pixels
8.2.7 Transport Encoder Interfaces and Bit Rates
8.2.8 Concatenated Sequences
8.2.9 Guidelines for Refreshing

8.3 Transmission Characteristics for Terrestrial Broadcast
8.3.1 Channel Error Protection and Synchronization
8.3.2 Modulation
8.3.3 Service Multiplex and Transport Systems
8.3.4 Overview of the Transport Subsystem
8.3.5 Higher-Level Multiplexing Functionality
8.3.6 The PES Packet Format
8.3.7 High-Data-Rate Mode
8.3.7 Compatibility With Other Transport Systems

8.4 Program and System Information Protocol
8.4.1 Elements of PSIP
8.4.2 Transport Stream Identification

8.5 References

Chapter 9. DTV Transmission Issues

9.1 Introduction
9.1.1 Real World Conditions
9.1.2 Bit-Rate Considerations

9.2 Performance Characteristics of the Terrestrial Broadcast Mode
9.2.1 Transmitter Signal Processing
9.2.2 Upconverter and RF Carrier Frequency Offsets
9.2.3 Performance Characteristics of High-data-rate Mode

9.3 Spectrum Issues
9.3.1 UHF Taboos
9.3.2 Co-Channel Interference
9.3.3 Adjacent-Channel Interference
9.3.4 Power Ratings of NTSC and DTV
9.3.5 Sixth Report and Order
9.3.6 ATSC Standards for Satellite

9.4 Transmitter Considerations
9.4.1 Operating Power
Chapter 10. Receiver Systems and Display Devices

10.1 Introduction
10.1.1 Noise Figure

10.2 Receiver System Overview
10.2.1 Tuner
10.2.2 Channel Filtering and VSB Carrier Recovery
10.2.3 Segment Sync and Symbol Clock Recovery
10.2.4 Noncoherent and Coherent AGC
10.2.5 Data Field Synchronization
10.2.6 Interference-Rejection Filter
10.2.7 Channel Equalizer
10.2.8 Phase-Tracking Loop
10.2.9 Trellis Decoder
10.2.10 Data De-Interleaver
10.2.11 Other Receiver Functional Blocks
10.2.12 Receiver Equalization Issues

10.3 HDTV Display Considerations
10.3.1 Color Space Issues in Digital Video
10.3.2 Display Technology Trends
10.3.3 Color CRT Display Devices
10.3.4 Projection Systems
10.3.5 Light-Valve Systems
10.3.6 LCD Projection Systems
10.3.7 Projection Requirements for Cinema Applications

10.4 Consumer Networking Issues

10.5 References

10.6 Bibliography

Chapter 11. The DVB Standard

11.1 Introduction

11.2 European System
11.2.1 D-MAC/D2-MAC Systems
11.2.2 Enhanced Television Objectives and Constraints
11.2.3 Eureka Program
11.2.4 The End of Eureka

11.3 Digital Video Broadcasting (DVB)
11.3.1 Technical Background of the DVB System
11.3.2 DVB Services
11.3.3 The DVB Conditional-Access Package
11.3.4 Multimedia Home Platform
11.3.5 DVB and the ATSC DTV System
Chapter 12. Video Measurement Techniques

12.1 Introduction

12.2 The Video Spectrum
   12.2.1 Minimum Video Frequency
   12.2.2 Maximum Video Frequency
   12.2.3 Horizontal Resolution
   12.2.4 Video Frequencies Arising from Scanning

12.3 Measurement of Color Displays
   12.3.1 Assessment of Color Reproduction
   12.3.2 Chromatic Adaptation and White Balance
   12.3.3 Overall Gamma Requirements
   12.3.4 Perception of Color Differences
   12.3.5 Display Resolution and Pixel Format
   12.3.6 Contrast Ratio
   12.3.7 Color Bar Test Patterns
   12.3.8 Conventional Video Measurements
   12.3.9 Automated Video Signal Measurement
   12.3.10 Applications of the Zone Plate Signal
   12.3.11 Display Measurement Techniques
   12.3.12 Subjective CRT Measurements
   12.3.13 Objective CRT Measurements
   12.3.14 Viewing Environment Considerations

12.4 Picture-Quality Measurements for Digital Television
   12.4.1 Signal/Picture Quality
   12.4.2 Automated Picture-Quality Measurement

12.5 Serial Digital Bit Stream Analysis
   12.5.1 SMPTE RP 259M
   12.5.2 Jitter
   12.5.3 The Serial Digital Cliff
   12.5.4 Pathological Testing
   12.5.5 Eye Diagram

12.6 Transmission Issues
   12.6.1 Transmission System Measurements
   12.6.2 In-band Signal Characterization
   12.6.3 Power specification and Measurement

12.7 References
12.8 Bibliography

Chapter 13. DTV Implementation Issues

13.1 Introduction

13.2 MPEG Bit-Stream Splicing
   13.2.1 Splice Flags
   13.2.2 SMPTE 312M

13.3 Planning the DTV Infrastructure
13.3.1 Considerations Regarding Interlaced and Progressive Scanning 541
13.3.2 Network Contribution Options 541
13.3.3 DTV Implementation Scenarios 543
13.3.4 Top Down System Analysis 547
13.4 References 548

Chapter 14. Glossary 549
14.1 Terms Employed 549
14.2 Acronyms and Abbreviations 554
14.3 References 556

Chapter 15. Reference Documents 559
15.1 General 559
15.1.1 Video 559
15.1.2 Audio 559
15.2 ATSC DTV Standard 560
15.2.1 Service Multiplex and Transport Systems 560
15.2.2 System Information Standard 560
15.2.3 Receiver Systems 561
15.2.4 Program Guide 561
15.2.5 Program/Episode/Version Identification 561
15.3 DVB 561
15.3.1 General 561
15.3.2 Multipoint Distribution Systems 562
15.3.3 Interactive Television 562
15.3.4 Conditional Access 562
15.3.5 Interfaces 562
15.4 SMPTE Documents Relating to Digital Television 562
15.4.1 General Topics 562
15.4.2 Digital Control Interface 563
15.4.3 Edit Decision Lists 564
15.4.4 Image Areas 564
15.4.5 Interfaces and Signals 564
15.4.6 Monitors 565
15.4.7 Test Patterns 565
15.4.8 Television Recording and Reproduction 566
15.5 SCTE Standards 567
15.6 References Cited in this Book 568

Index of Tables and Figures 585
Tables 585
Figures 587
Index 601

Afterword by Dr. Robert Hopkins 613

About the Author 619