

SCTE Digital Video Engineering Professional (DVEP)

Scope

The SCTE **Digital Video Engineering Professional (DVEP)** certifies knowledge in the engineering aspects of digital media (which includes video, audio, interactive services, and associated data) systems as deployed in the Cable Telecommunications Industry. The scope of this credential includes the design, analysis, testing, integration, deployment considerations, and troubleshooting of a variety of digital media systems from the headend to the customer premises.

Specific categories include:

- I. Digital Multimedia Theory
- II. Digital Multimedia & Systems Standards
- III. Digital Video Systems Design and Integration
- IV. Digital Video Systems Test Monitoring and Performance Management
- V. Digital Video Systems Deployment

I. Digital Multimedia Theory

| Competency | Knowledge, Skills, and Abilities |
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| A. Baseband Analog Media Theory | 1. Describe the fundamental principles of analog video |
| | 2. Describe the fundamental principles of analog audio |
| | 3. Ancillary Services |
| | a. SAP |
| | b. VBI |
| | c. Closed Captioning |
| B. Baseband Digital Media Theory | 4. VITS |
| | 1. Describe the fundamentals of sampling analog signals (Nyquist) |
| | a. Sampling |
| | b. Quantization (SNR considerations) |
| | c. Encoding |
| | 2. Describe the characteristics of Digital Video |
| | a. Sampling |
| | i. Synchronization of sampling |
| | ii. Sampling bit depth |
| iii. Color Spaces | |



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| | b. Lumina & chrominance |
| | c. Vectors |
| | d. Resolution vs Aspect Ratio |
| | e. Embedded metadata (VANC/HANC) |
| | f. Discuss loss Characteristics of digital video |
| | 3. Discuss the Characteristics of Digital Audio |
| | a. Lower Sampling, Higher Quantization |
| C. Timing | 1. SMPTE Timecode |
| | 2. NTP |
| D. Compressed Media | 1. Introduction to MPEG Compression |
| | 2. MPEG-2 Transport Stream |
| | 3. MPEG-2 Video compression |
| | 4. Audio codecs |
| | a. AC-3 |
| | b. MPEG-1 Layer II |
| | c. AAC/HE AAC |
| | 5. Advanced Video Codecs |
| | a. SMPTE VC-1 |
| | b. AVC (H.264 or MPEG-4 part 10) |
| | c. HEVC (H.265 or MPEG-H) |
| | 6. Describe various physical interfaces used |
| | a. ASI |
| | b. MPEG-2 TS over IP |
| | i. TS over UDP over IP |
| | ii. TS over RTP |
| | iii. Raw PES over RTP |
| | c. MPEG-4 over MPEG-2 TS |
| | 7. Discuss VOD-optimized transport |
| | 8. Explain commonly used Control Plane protocols |
| E. Metadata & Signaling | 1. In-band Metadata |
| | a. PSI/SI (MPEG/DVB/SCTE signaling and announcement) |
| | b. ATSC A/65: PSIP (ATSC/SCTE signaling and announcement) |
| | c. SCTE-35 (Digital Program Insertion Messaging) |
| | d. SCTE-18 (EAS Messaging) |
| | e. Private Metadata |
| | f. SCTE 65 (SCTE and ATSC signaling and announcement) |
| | 2. Out of band Metadata |
| | a. Carousels |



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| F. Digital Video Systems | 1. Digital Video/Audio/Data Infrastructure overview |
| | 2. DAC Systems |
| | a. SRM |
| | 3. DNCS Systems |
| | a. SRM |
| | 4. Set-top Software Stack |
| | 5. Home Networking |
| | a. MOCA |
| | b. HPNA |
| c. DSG | |
| G. Content Security | 1. Conditional Access (CableCard) |
| | 2. Digital Rights Management |
| | 3. Macrovision |
| H. Advanced Technologies | 1. PCMM |
| | 2. On-demand |
| | 3. Switched Digital |
| | 4. PVR |
| | 5. Interactive Video |
| | 6. Mosaics |
| | 7. IPG |
| | 8. OCAP |
| | 9. Thick/Thin Clients |
| | 10. Network PVR / Startover |
| | 11. Home Networking (MOCA, HPNA) |
| | 12. DSG |
| I. Networking Principles | 1. Discuss basic IP networking principles |
| | 2. Verify Communication between Digital Video System Components |
| | 3. Explain Internet Protocol (IP) Principles |
| | 4. ISO Reference Model |



II. Digital Multimedia & Systems Standards

| Competency | Knowledge, Skills, and Abilities |
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| A. Understand the applicable MPEG standards by title and application | 1. MPEG-2 Systems: ISO/IEC 13818-1 (also ITU-T H.222.0) 2. MPEG-2 Video: ISO/IEC 13818-2 (also ITU-T H.262) 3. MPEG-2 Audio/MPEG-1 Audio: ISO/IEC 13818-3 or ISO/IEC 11172-3 4. AVC Video: ISO/IEC 14496-10 (also ITU-T H.264) 5. MPEG-4 Video: ISO/IEC 14496-10 (also ITU-T H.264) |
| B. Understand the applicable SMPTE standards by title and application | 1. SD analog video: SMPTE 170M 2. SD digital video: SMPTE 125M 3. HD 1080i video: SMPTE 274M 4. HD 720P video: SMPTE 296M 5. SD SDI transport: SMPTE 259M 6. HD SDI transport: SMPTE 292M 7. SD ancillary data: SMPTE 272M 8. HD ancillary data: SMPTE 291M 9. VC-1 video compression: SMPTE 421M 10. VC-1 transport: SMPTE RP227 11. Format for AFD and Bar Data: SMPTE 2016 12. Digital video time code SMPTE 12M-1 and 12M-2 |
| C. Understand the applicable SCTE standards by title and application | 1. TS Verification RP: SCTE 142 2. AVC Video/Transport: SCTE 128 3. MPEG-2 Multiplex/Transport: SCTE 54 4. MPEG-2 Video: SCTE 43 5. MPEG-4 stream in MPEG-2 TS: SCTE 128 6. Carriage of Vertical Blanking Interval (VBI) Data in North American Digital Television Bitstreams: SCTE 127 7. DPI - Automation Trigger Protocol: SCTE 104 8. DPI - Cue Message Protocol: SCTE 35 9. DPI - Splicer/Server Protocol: SCTE 30 10. DPI – Advertising Systems Interfaces: SCTE 130 11. DPI – Program Specific Ad Insertion: SCTE 118 12. VC-1 – Video Systems and Transport Constraints for Cable Television: SCTE 157 13. EAS – Emergency Alert Services; SCTE 18 14. SI delivered out of band, SCTE 65 |
| D. Understand the | 1. ATSC Digital Television: A/53 (Parts 1 through 7) |



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| | 2. AC-3 Audio: A/52 |
| | 3. AVC in the ATSC system: A/72 Parts 1 and 2 |
| | 4. Transport Stream Verification: A/78A |
| | 5. Carriage of Legacy TV Data Services: A/99 |
| | 6. Recommended Practice for Conversion of ATSC Signals for Distribution to NTSC Viewers: A/79 |
| | 7. PSIP A/65 |

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| E. Understand the applicable DVB standards by title and application | 1. Video/Audio Coding: ETSI TS 101 154 |
| | 2. Specification for the carriage of Vertical Blanking Information (VBI) data in DVB bitstreams: ETSI EN 301 775 |
| | 3. Specification for conveying ITU-R System B Teletext in DVB bitstreams: ETSI 300 472 |
| | 4. Measurement Guidelines for DVB Systems: ETSI TR 101 290 |
| | 5. DVB-C ETS 300 429 |
| F. Understand the applicable ITU standards by title and application | 1. SD digital video: ITU-R BT.601 |
| | 2. HD digital video: ITU-R BT.709 |
| | 3. Video Quality testing: ITU-R BT.500 |
| | 4. Cable Modulation: ITU-T J.83 |
| | 5. ITU-T J.83 |
| G. Understand the applicable CEA standards by title and application | 1. Analog Line 21 Closed Captions: CEA-608 |
| | 2. Digital TV Closed Captions: CEA-708 |
| | 3. "Active Format Description (AFD) & Bar Data Recommended Practice": CEA-CEB-16 |
| | 4. RF Channels: CEA-542C |
| H. Understand the applicable AES Audio standards by title and application | 1. Digital audio AES3 |
| | 2. AES3 on coax: AES-3id/SMPTE 276M |
| I. Understand the applicable CableLabs standards by title and application | 1. VoD Content Specification 2.0 (ADI metadata spec) MD-SP-VOD-CONTENT 2.0 |
| | 2. Content Specification 3.0 MD-SP-CONTENTv3.0 |
| | 3. VOD Asset Distribution Interface Specification 1.1 MD-SP-ADI1.1 |
| | 4. ADI 2.0 Specification Asset Inventory Messages: MD-SP-ADI2.0-AIM |
| | 5. ADI 2.0 Specification Asset Structure MD-SP-ADI2.0-AS |
| | 6. VoD Content Specification Version 3.0 |
| | 7. |
| | 8. VoD Content Encoding Profile Specification 2.0 MD-SP-VOD- |



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| | CEP2.0 |
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| | 10. CableCARD Interface 2.0 Specification OC-SP-CCIF2.0 |
| | 11. OCAP Specification 1.3.1 OC-SP-OCAP 1.3.1 |
| | 12. OpenCable Content Definition Format CoDF OC-SP-CoDF |
| | 13. Enhanced TV Binary Interchange Format OC-SP-ETV-BIF1.0.1 |

III. Digital Video Systems Design and Integration

| Competency | Knowledge, Skills, and Abilities |
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| A. Linear System Considerations | 1. Encoding/Multiplexing |
| | a. Grooming |
| | b. Digital Program Insertion |
| | c. Stat Muxing |
| | d. VBR/CBR |
| | e. Closed Loop/Open Loop |
| | f. Encoding Parameters |
| | i.GOP Size impacts to service (latency/quality) |
| | ii.Encoder Filters |
| | g. Video Quality (evaluating encoders) |
| | 2. Head-end Controllers |
| | a. DAC |
| | b. DNCS |
| | 3. RF/QAM |
| | a. Node splits |
| | b. Return Path Considerations |
| | i.DOCSIS |
| | ii.DAVIC |
| | iii.Tru2Way |
| | iv.DSG |
| c. Forward Path Considerations | |
| i.DOCSIS | |
| ii.Tru2Way | |
| iii.DSG | |
| 4. Bandwidth Utilization | |
| a. Analog Reclamation | |
| b. ADS (All-Digital Simulcast) | |
| c. SDV bandwidth savings | |
| B. On-Demand System Considerations | 1. Video Quality (evaluating encoders) |
| | 2. Architectures |
| | a. NGOD |
| | b. ISA |
| | c. Network bandwidth |



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| | d. Service Group Sizing |
| | 3. Storage |
| | a. Scalability |
| | b. Caching considerations |
| | 4. Streaming |
| | a. Scalability |
| | b. Latency |
| | c. Trick modes |
| | 5. Propagation |
| | a. Availability |

IV. Digital Video Systems Test Monitoring and Performance Management

| Competency | Knowledge, Skills, and Abilities |
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| A. Effective Test Practices | 1. Video/Audio Quality Testing |
| | a. Highlight differences between subjective and objective testing. |
| | b. Understand how some content is more challenging to the encoder process. (talking heads vs. high action) |
| | 2. Video Distribution and Transport |
| | 3. Encryption |
| | 4. Advanced / Interactive Services testing |
| | a. ITV Test (i.e. caller ID) |
| | b. IPG Test |
| | c. Provisioning and Staging |
| | d. Scalability Testing |
| | 5. EAS Testing |
| | 6. DPI Testing |
| | B. Effective Monitoring Practices |
| a. OSS | |
| b. NMS | |
| c. EMS | |
| 2. Interfaces | |
| a. SNMP | |
| b. XML | |
| c. API | |
| d. Contact/Closure | |
| 3. Methods | |
| a. SCTE-142 | |
| b. ATSC A/78 | |
| c. Other | |
| 4. Considerations for Monitoring over various interfaces | |
| a. MPEG over IP | |



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| | b. MPEG over RF |
| | c. MPEG over ASI |
| C. Fault Isolation and Troubleshooting | 1. Isolate the cause of problems within a system |
| | a. Utilize various levels of test for MPEG compliance |
| | b. Visual test (manual – what to look for) |
| | c. Audio test (manual – what to listen for) |
| | d. A/V Sync |
| | e. Using MPEG analysis |
| | f. Using IP network analysis |
| | g. Troubleshooting IP network problems |
| | i. Provisioning |
| | ii. Firewalls/Security |
| | iii. IGMP Connectivity |
| | iv. Equipment Configuration problems |
| | v. Device Failure |
| | vi. Contention/Capacity |
| 2. Troubleshooting RF/QAM | a. Using Spectrum Analyzers |
| | b. Use of Professional IRD |
| | c. MPEG comparison pre/post modulation |
| | d. Considerations for Switched Digital |
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| D. Common Artifacts | |
| E. Performance Management | 1. Describe differences between system monitoring and performance management |
| | 2. FCAPS |
| | 3. Trend Analysis |
| | a. Diurnal trends/usage patterns |
| | b. Throughput/capacity |

V. Digital Video Systems Deployment

| Competency | Knowledge, Skills, and Abilities |
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| A. Applying a design to a field site | 1. Site survey |
| | a. Understanding power, HVAC, space and network capacity and firewall availability and requirements within the headend |
| | b. Understanding required network bandwidth from headend to edges |
| | c. Understanding impact on spectrum allocation and line up |
| | d. Understanding service group sizing and node sizes as they influence a design |
| | e. Understanding interactions between the to-be deployment with coexisting services and applications |



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| | 2. Site specific BOMs |
| | 3. Rack elevations and network design / IP schema planning and documentation |
| | 4. Set-top compatibility |
| | 5. Review of design with the site |
| | 6. Documentation of configuration parameters (e.g. settings, power levels, port counts and allocations) |
| | 7. Failover designs as applicable |
| B. Pre-deployment planning and preparation | 1. Business value justification to site |
| | 2. Documentation of as-is and to-be situations |
| | 3. Development of deployment schedule per site (and across sites as applicable) |
| | 4. Scheduling of maintenance windows |
| | 5. Scheduling this activity aligning with other projects on-going at the site |
| | 6. Billing and provisioning interfacing inc. product definitions |
| | 7. Identification of cutover order (by hub, SG, etc.) |
| | 8. Development of M&Ps including identification of order of tasks |
| | 9. Pre-deployment checklists |
| | 10. Back out procedures |
| | 11. Confirm all software components, releases, revisions and their compatibility |
| | 12. Verify connectivity between components |
| | 13. Call center documentation and forecast for elevated volume |
| | 14. Equipment installation and staging |
| | 15. Test plan development |
| | 16. Operational impact assessment |
| | 17. Operational support plan |
| | 18. Identification of human resources and equipment |
| | 19. Training / Knowledge transfer |
| | 20. Gather performance metrics and estimates of impact |
| C. Managing a deployment transition | 1. Key phases in launching a new product: headend test, employee / friendly testing, hub / SG node testing, full launch |
| | 2. Review of any bugs from each stage of pre-deployment and deployment testing. |
| | 3. Execution of M&Ps and tracking against plan |
| | 4. Recording steps against planned timeline |
| | 5. Track any bugs / unexpected behavior |
| | 6. Implementing billing changes or authorizations |
| | 7. Monitor log files on affected devices |
| D. Closing out a | 8. True up design drawings against actual |
| | 1. Issue Management (characterize any unexpected behavior, |



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| deployment program | trouble-shoot and identify workarounds and long term solutions) |
| | 2. Tracking of customer care impact of launch / transition |
| | 3. Compare performance metrics against expectations |
| | 4. Confirm and track plan to transition from any workarounds to a long term solution |
| | 5. Formal acceptance, sign off, including lessons learned |
| | 6. Operational Support recommendations |
| | 7. Deployment recommendations |
| | 8. Additional training re: support tools as necessary |
| | 9. Preventative maintenance scheduling |
| | 10. Documentation of trouble-shooting tips captured during all phases |
| | 11. Maintenance of daily logs |
| | 12. Tracking of maintenance fees, warranties etc. |

Revised 5/9/14