

## SCTE·ISBE DOCSIS® Engineering Professional Certification

### Scope

The SCTE·ISBE **DOCSIS Engineering Professional Certification (DEP)** certifies knowledge in the subject matter related to the elements and implementations of DOCSIS 1.0 through DOCSIS 3.1 specifications.

Specific topics include:

- Architecture
  - HFC Fundamentals
  - DOCSIS Entities
  
- DOCSIS Layering
  - CM and CMTS Protocol Layering
  - DOCSIS Physical Layer
  - DOCSIS MAC Layer
  
- DOCSIS Operations
  - DOCSIS Differences
  - DOCSIS QoS Mechanisms
  - Data Forwarding
  - CM/CMTS Interaction
  - Performance Aspects
  - DOCSIS Security Concerns
  - Troubleshooting
  
- DOCSIS Enablement
  - Installation
  - Security
  - DOCSIS Set-Top Gateway

## I. Architecture

Competency	Knowledge, Skills, and Abilities
A. HFC Fundamentals	1. HFC Network Elements
	a. Optical fiber
	b. Coaxial cable
	c. Amplifiers
	d. Passive coaxial components
	e. Optical network passives
	f. Optical transmitters
	g. Optical amplifiers
	h. Optical receivers
	2. HFC Fundamental Concepts
	a. Analog and digital signals
	b. Digital modulation
	c. Signal to noise ratio (SNR)
	d. Carrier to noise ratio (CNR)
	e. Downstream and upstream RF
	f. Channelization
	i. OFDM
	g. Topology
	h. Linear distortions
	i. Micro-reflections
	ii. Amplitude tilt
	iii. Group delay
	i. Non-Linear Distortions
i. Common path distortion (CPD)	
ii. Continuous wave (CW) interference	
iii. Composite second order (CSO)	
iv. Composite triple beat (CTB)	
B. DOCSIS Entities	1. Evolution of DOCSIS
	2. Standardization
	3. CableLabs certification and qualification process
	4. Reference architecture
	5. Cable modem (CM)
	6. Cable modem termination system (CMTS)

	7. Converged cable access platform (CCAP)
	8. Back office servers
	a. Dynamic host configuration protocol (DHCP)
	b. Time of day (ToD)
	c. Trivial file transfer protocol (TFTP)

## II. DOCSIS Layering

Competency	Knowledge, Skills, and Abilities
A. CM and CMTS Layering	1. Protocol layer comparisons
	a. OSI and TCP/IP protocol stacks
	b. DOCSIS CMTS stack
	c. DOCSIS CM stack
B. DOCSIS Physical Layer	1. DOCSIS physical layer
	2. Upstream physical layer
	a. Modulation
	b. Coding
	c. Preamble prepend
	d. Spectral shaping
	e. Transmit pre-equalization
	f. Transmit power
	g. Burst profiles
	h. Fidelity requirements
	i. Time division multiple access (TDMA)
	i. Mini slot size
	j. Advanced time division multiple access (A-TDMA)
	k. Synchronous code division multiple access (S-CDMA)
	l. Orthogonal frequency division multiplexing (OFDM)
	m. TDMA versus A-TDMA
	n. TDMA versus S-CDMA
	o. S-CDMA spreading
	p. S-CDMA framing
	q. OFDMA
	r. Upstream LDPC
	3. Downstream physical layer
	a. Downstream modulation
i. Profiles	

	b. Downstream coding
	c. Interleaving
	d. CMTS clock generation
	e. OFDM Channel
	4. RF Characteristics
	a. Carrier to noise ratio (CNR)
	b. Bit error ratio (BER)
	c. Modulation error ratio (MER)
	d. Error vector magnitude (EVM)
	e. Constellation analysis
	f. Frequency to time domain
	g. Fast Fourier transform (FFT) Sizing
	h. Capacity optimization
	5. Downstream MPEG transmission convergence (TC)
	a. MPEG transport stream (MPEG-TS)
	b. MPEG header for DOCSIS
	c. MPEG payload for DOCSIS
	6. Corrective techniques
	a. Forward error correction (FEC)
	b. Bit / byte interleaving
	c. Channel change
	d. Frequency hop
	e. Long-loop automatic gain control (AGC) / automatic level control (ALC)
	f. Low density parity check (LDPC)
C. DOCSIS MAC Layer	1. MAC frame formats
	2. MAC management messages
	a. MAC domain descriptor (MDD)
	3. Upstream bandwidth allocation
	4. Timing and synchronization
	5. Upstream contention resolution
	6. Encryption support
	7. Downstream channel bonding
	8. Upstream channel bonding
	9. Bonding groups
	10. Load balancing
	11. Traffic engineering
	12. Logical channels
	13. Subcarrier Assignments
	14. Interlacing

D. Service Groups	1. MAC domains
	2. Upstream service group (SG)
	3. Downstream service group (SG)
	4. Service group (SG) sizing

### III. DOCSIS Operations

Competency	Knowledge, Skills, and Abilities
A. Differences between DOCSIS 1.0, 1.1, 2.0, 3.0 and 3.1	<ol style="list-style-type: none"> <li>1. DOCSIS 1.0 (define/describe/contrast)</li> <li>2. DOCSIS 1.1 (define/describe/contrast)</li> <li>3. DOCSIS 2.0 (define/describe/contrast)</li> <li>4. DOCSIS 3.0 (define/describe/contrast)</li> <li>5. DOCSIS 3.1 (define/describe/contrast)</li> </ol>
B. DOCSIS Quality of Service (QoS) Mechanisms	<ol style="list-style-type: none"> <li>1. Packet classification</li> <li>2. Service flows</li> <li>3. QoS parameters</li> <li>4. Upstream service flow scheduling services</li> <li>5. Pre-DOCSIS 3.0 concatenation and fragmentation</li> <li>6. DOCSIS 3.0 continuous concatenation and fragmentation</li> <li>7. Payload header suppression (PHS)</li> <li>8. QoS definitions</li> <li>9. Upstream Profiles</li> <li>10. Pilot Structures</li> </ol>
C. Data Forwarding	<ol style="list-style-type: none"> <li>1. CMTS OSI layer 2 forwarding</li> <li>2. CMTS OSI layer 3 forwarding</li> <li>3. Multicast forwarding</li> </ol>
D. CMTS / CM Interaction (CM registration, service flows, bandwidth allocation)	<ol style="list-style-type: none"> <li>1. Cable modem initialization and registration process                             <ol style="list-style-type: none"> <li>a. Scanning and synchronizing to downstream</li> <li>b. Upstream channel parameters</li> <li>c. Timing adjustment</li> <li>d. Service identifier (SID)</li> <li>e. Initial ranging</li> <li>f. IPv4 connectivity</li> <li>g. IPv6 connectivity</li> <li>h. Network time stamp</li> <li>i. DOCSIS configuration file download</li> <li>j. Registration</li> <li>k. Privacy initialization</li> <li>l. CPE provisioning</li> </ol> </li> <li>2. Dynamic service</li> <li>3. Dynamic bonding change</li> </ol>

E. Performance Aspects	1. Request / grant mechanisms
	2. Transmission control protocol (TCP) windowing
	3. Channel bonding
	4. Bandwidth efficiency vs. robustness tradeoff
	5. DOCSIS latency issues
	6. System throughput versus per user data rates
	7. Sleep Mode
F. DOCSIS Security Concerns	1. DOCSIS cable modem secure software download (SSD)
	2. Public key infrastructure (PKI)
	3. Baseline privacy interface (BPI)
	4. Baseline privacy interface plus (BPI+)
	5. Digital Certificates
G. Troubleshooting	1. Common network issues
	2. Constellation analysis
	3. DOCSIS 3.0 channel bonding
	4. RF impairments
	5. RF impairment on DOCSIS modem state
	6. Impulse coefficient and pre-equalization analysis
	7. Proactive Network Maintenance

#### IV. DOCSIS Enablement

Competency	Knowledge, Skills, and Abilities
A. Installation	1. Access network design
	2. Downstream considerations
	3. Upstream considerations
	4. Cabling the system
	5. Ensuring installation success
	6. Channel placement
	7. Distributed Access Architecture
B. Security	1. DOCSIS 1.1 security and provisioning
	2. DOCSIS 3.0 security and provisioning
	3. DOCSIS 3.1 security and provisioning
	4. DOCSIS BPI and provisioning
	5. IP Security
	6. Secure software download (SSD)
	7. Access control lists



C. DOCSIS Set-top Gateway	1. Out of band (OOB) communications path
	2. DOCSIS set-top gateway (DSG) infrastructure
	3. DSG Tunnels
	4. Tunnel types
	5. DSG traffic

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