

SCTE Broadband TelecomCenter Specialist (BTCS) Competencies

Scope

The Broadband TelecomCenter Specialist (BTCS) certifies knowledge in maintenance and troubleshooting of the inside plant facilities to ensure minimal system outages, maximum reliability, and standards compliance for optimal operations. This certification includes knowledge of advanced entertainment, data and voice networks within the headend. Topic categories include:

- Facilities
- Baseband Signaling
- Digital Telephony over Cable
- RF/Photonic Signals
- Tests and Measurements

I. Facilities

Competency	Knowledge, Skills, & Abilities
<p>A. HVAC</p> <p>Demonstrate an understanding of the important principles regarding planning, installing, and caring for an effective headend operating climate.</p>	<ol style="list-style-type: none"> 1. Calculations 2. Pressurization 3. Maintenance 4. Climatization 5. Humidification
<p>B. Fire Protection</p> <p>Demonstrate working knowledge of the purpose, procedures, theory, and operation of headend fire protection equipment and its related components.</p>	<ol style="list-style-type: none"> 1. Guidelines 2. FM200 3. Dry pipe systems
<p>C. Security/ Safety</p> <p>Demonstrate familiarity of OSHA, safety, and security regulations and practices relating to headend site layout and personnel.</p>	<ol style="list-style-type: none"> 1. Facility access <ol style="list-style-type: none"> a. Physical security agreements with programmers 2. OSHA compliance 3. Confined space

<p>D. Monitoring</p> <p>Demonstrate working knowledge of the operation, procedures, and practices relating to headend and network system monitoring.</p>	1. Equipment
	2. Fire
	3. Burglar
	4. Power
	5. Environmental
<p>E. Equipment/Cabinets</p> <p>Demonstrate an understanding of headend rack design relating to organization, specifications, and environmental performance.</p>	1. Naming Conventions
	2. Structural
	3. Air flow
<p>F. Bonding/Grounding</p> <p>Demonstrate working knowledge of the theory, architecture, methods, procedures, and specifications used to ensure proper headend and facility grounding practices.</p>	1. Grounding Grids
	2. Lightning/Surge Protection
	3. Acceptable non-intrusive testing of ground requirements
	4. Honoring established grounds
	5. Common grounding practices and techniques
	6. RF shielding
<p>G. Powering</p> <p>Demonstrate an understanding of commercial and backup headend powering and the associated safety implications.</p>	1. Commercial Powering
	a. Surge Protection
	2. Backup Powering
	a. Batteries
	i. Calculation of run times
	ii. Storage and disposal
	iii. Handling and safety
	iv. Testing

	b. DC powering
	c. UPS
	3. Backup Generators
	a. Diesel
	b. Propane, natural gas
	4. Commercial powering
	5. Power safety
	6. Load Management
H. Layout and Cabling Demonstrate working knowledge of headend cable routing methods and practices, including labeling, as well as cable and connector types.	1. Cabling Management
	a. Types of Cables
	b. Labeling/Wire Run Lists
	c. Colors
	d. Bundling
	e. Routing best practices
	i. Isolation

II. Baseband Signaling

Competency	Knowledge, Skills, & Abilities
<p>A. Analog</p> <p>Demonstrate an understanding of the concepts of analog RF and baseband audio and video signals, the various types, their standards, testing procedures, and maintenance operations.</p>	1. Baseband Audio
	a. Fundamental Concepts
	i. Loudness
	ii. Phase
	iii. Sound Pressure
	iv. Balanced/Unbalanced
	b. Stereo
	i. BTSC
	ii. Dolby AC3
	c. Audio Processing
	i. Unity Gain
	ii. Equalization
	iii. Headroom
	d. Levels, standards, measurements, testing, distribution
	2. Baseband Video
	a. Fundamental Concepts
	i. Interlace Scanning
	ii. Aspect Ratio
	iii. Chrominance
	iv. White Peak
	v. Viewing Distance
	b. NTSC Components
	i. Synchronization and Timing
ii. Picture Components	
iii. Color Components	
iv. Vertical Blanking Interval	
(a) Data	
(b) Structure	

	c. Other Video Formats
	i. PAL
	ii. SECAM
	d. Video Processing Equipment
	i. Distribution Amplifiers
<p>B. Digital</p> <p>Demonstrate an understanding of the concepts of LAN, WAN and DOCSIS protocol networks, their architecture and components, the purpose of protocols, standards of operations, system management and Emergency Alert Systems.</p>	1. Data Networking Basics
	a. Protocols
	i. OSI Model
	ii. TCP/IP
	(a) IP
	(b) ARP
	(c) ICMP
	(d) TCP
	(e) UDP
	b. Equipment addressing
	i. Internet address structure
	ii. MAC addresses
	c. LANs and WANs
	i. Routing Protocols
	(a) IGMP
	(b) IP Multicast
	ii. Internetworking Equipment
	d. Equipment Interconnections
	i. ASI
	ii. SDI
	iii. GigE
	2. DOCSIS
	a. Specifications
	b. CMTS
	i. Provisioning Protocols
	(a) DHCP
	(b) TOD
(c) TFTP	
(d) DSG	

	(i) Tunnels
	ii. Transmission
	(a) Upstream
	(i) RF performance specifications
	(ii) Interface specifications
	(iii) Map
	(b) Downstream
	(i) RF performance specifications
	(ii) Interface specifications
	(c) Network Side Interface
	iii. Traffic Management
	(a) Bandwidth Allocation
	(b) QoS
	(c) CoS
	iv. Provisioning Data Services
	(a) Single ISP
	(b) Multiple ISPs
	(i) Policy based routing
	(ii) Source-based routing
	(iii) MPLS
	v. PMD Sublayer
	(a) Downstream RF
	(b) Upstream RF
	(c) RF Combining/Splitting
	vi. ISP Connections
	(a) Protocols
	(i) ATM
	(ii) T1/T3
	(iii) SONET
	(b) NAPs
	vii. Security
	(a) Conditional Access

	(b) Baseline Privacy
	(c) BPI+
	3. Modems
	a. Dial-up Modems
	i. Modem Standards
	(a) V.90/92
	ii. DOCSIS Telco Return
	(a) RAS
	b. DOCSIS CM
	i. Provisioning
	(a) Scanning
	(b) Configuration Files
	(c) Status Indicators
	(d) Provisioning Sequence
	ii. RF Performance
	c. CPE Interface
	i. Ethernet
	ii. USB
	iii. Wireless
	(a) 802.11
	d. Application Protocols
	i. HTTP
	ii. FTP
	iii. SMTP
	4. Digital Video and Audio
	a. Fundamentals of Digital
	i. Data Frames
	(a) Structure of Frames
	(i) MPEG Frames
	(ii) Ethernet Frames
	(iii) Packets
	(b) Error Control
	(i) Error Detection
	(ii) Error Correction

	b. Analog-to-Digital Conversion
	i. Conversion Steps
	(a) Sampling
	(b) Quantization
	(c) Encoding
	ii. Compression Formats
	(a) MPEG
	(b) Lossy vs. Lossless Compression
	iii. Digital Video
	(a) Digital Video Processing
	(b) EAS Messaging – SCTE 18
	(c) ATV Formats
	(i) HDTV
	(ii) Aspect Ratio
	iv. Digital Audio
	(a) Formats
	(b) Compression
	(c) Processing
	(i) Pre/de-emphasis
	(ii) A/D Conversion
	(iii) Multiplexers
	(iv) Demultiplexers
	(v) Edge Platforms
	5. Video Services
	a. Conditional Access Systems
	i. Addressable Systems
	(a) Controllers
	(i) Data Streams
	(ii) Addressing
	(b) Terminals
	(i) Address Schemes
	(ii) Data Stream Location

	b. Narrowcast Services
	i. VOD
	(a) Characteristics
	(b) Operation
	ii. NVOD
	iii. Switched Digital Video
	iv. ETV
	v. PPV
	(a) Characteristics
	(b) Operation
	c. Interactive TV
	i. EBIF
	ii. Tru-2way Applications
	iii. Service Impairments
	(a) Latency
	(b) Communication Interruptions
	d. Server management
	i. Centralized Servers
	(a) Content Management
	(b) Content Provisioning
	ii. Decentralized Servers
	(a) Content Management
	(b) Content Provisioning
	iii. Server Equipment
	(a) Disk Arrays
	(b) Failover Architectures
	(c) Platforms
	e. Commercial Insertion
	i. Analog Insertion
	(a) Cueing Systems
	(b) Performance Impairments
	ii. Digital Ad Insertion
	(a) SCTE 30
	(b) SCTE 35

	(c) Cueing Systems
	(d) Audience Segmentation
	(e) Performance Impairments
	iii. Emergency Alert Systems

III. Digital Telephony over Cable

Competency	Knowledge, Skills, & Abilities
<p>A. Public Switched Telephone Network</p> <p>Demonstrate working knowledge of the Public Switched Telephone Network, its components, what a Central Office does, and how the network is managed.</p>	1. Network Structure
	a. Central Office
	i. Classes of Central Offices
	ii. Functions of the Central Office
	iii. Network Timing and Synchronization
	b. Trunk, and Local Loop
	i. Signaling and Control
	ii. Classification and Use
	iii. Media
	(a) Physical Connections
	iv. CLLI codes
	c. Organizational Structure
	i. Local Exchange Carriers
	(a) ILEC and CLEC
	ii. Interexchange Carriers
	(a) Role
	(b) LATAs
	d. Numbering Plans
	i. North American Numbering Plan
	(a) Area Code
	(b) Exchange code
	(c) Station code
	ii. International Numbering Plan
iii. Number Portability	
e. Customer Premises Equipment	
f. PBX, CBX	
i. Station Sets	
ii. Key Systems	

<p>B. Switching</p> <p>Demonstrate working knowledge of the various telephony switches. List the types of switches, how they operate, and what switching methods they can employ.</p>	1. Functions of the local switch
	a. Call Processing
	i. Call Detection and Digit Collection
	ii. Provisioning
	(a) Dial tone
	(b) Feature sets
	iii. Call triggers
	iv. Call termination
	2. Signaling Systems
	a. CCS
	b. SS7
	3. Types of Switches
	a. Digital
	i. Stored Program Control
	ii. Components
b. Switching Methods	
i. Time Division	
ii. Space Division	
<p>C. Transmission</p> <p>Demonstrate working knowledge of transmission methods employed in a Public Switched Telephone Network including methods of multiplexing. Describe the PSTN interface options and their basic operation.</p>	1. Multiplexing
	a. Frequency Division Multiplexing
	b. Time Division Multiplexing
	i. North American Digital Hierarchy
	ii. Channels and Framing Mechanisms
iii. Multiplexers	

	c. Code Division Multiplexing
	2. Transmission Methods
	a. Asynchronous
	b. Synchronous
	c. Code Division Multiplexing
	3. Error Conditions
	4. PSTN Interface Options
	a. T1/DSx/OCx
	b. GR-303
D. Broadband Telephony Demonstrate working knowledge of the concept of broadband telephony, its components, protocols, and transport methods.	1. Constant Bit Rate
	a. Functions of the HDT
	i. Interface to local switch
	ii. Line concentration
	iii. Termination of RF inputs
	iv. Termination of connections to digital switch
	v. RF spectrum management
	vi. Voice line provisioning
	b. Access Techniques
	i. TDMA
	ii. CDMA
	2. IP Telephony (PacketCable)
	a. Telephony functions of CMTS
	i. Termination of RF inputs
	ii. Termination of connections to router/switch
	iii. RF spectrum management
	iv. Voice line provisioning
	b. Call Management Server
	i. Call Agents
	c. Gateways
	i. Media Gateway Controller
	ii. Media Gateway
	iii. Signaling Gateway

	d. Announcement Servers
	e. MTAs
	3. Session Initiation Protocol (SIP)
	a. Over the top telephony
	4. IP Multimedia Subsystem (IMS)
	5. Media Gateway Control Protocol (MGCP)

IV. RF/Photonic Signals

Competency	Knowledge, Skills, & Abilities
<p>A. Modulation, Demodulation, and Procession</p> <p>Define Modulation and Demodulation. Demonstrate working knowledge of the basic operating principals of Analog and Digital Modulation, as well as Advanced Modulation Techniques. Demonstrate an understanding of the purpose and basic operating principles of signal processors, modulators, and demodulators.</p>	1. Modulation and Demodulation
	a. Analog Modulation
	i. NTSC Modulators
	(a) Theory of Operation
	(b) Set up
	ii. NTSC Demodulators
	(a) Theory of Operation
	(b) Set up
	b. Digital Modulation
	i. Modulation Techniques/Formats
	(a) FSK
	(b) xVSB
	(c) xPSK
	(d) xQAM
	(e) Symbol Rate
	(f) Bandwidth
	(g) I and Q components
	ii. Advanced Modulation Techniques (DOCSIS 2.0)
	(a) TDMA
	(b) CDMA
	(c) OFDM/COFDM
	(d) SCDMA
c. Processors	
i. NTSC Processors	
a) Theory of Operation	
b) Set up	
ii. ATSC Processors	
a) Theory of Operation	
b) Set up	

<p>B. Signal Transmission and Reception</p> <p>Demonstrate working knowledge of the concept of signal transmission and reception with regard to headends, including fiber transportation systems. Demonstrate an understanding as to the purpose and operation of error detection and correction.</p>	1. Off Air Reception
	a. Tower Structures and Requirements
	i. Self-supporting Structures
	ii. Guyed Structures
	iii. Lighting Requirements
	b. Pre-amplifiers
	c. Signal Attributes
	d. Antennas
	i. Types
	ii. Arrays
	2. Satellite Reception
	a. Types of Antennas
	i. C-band
	ii. KU band
	iii. Multibeam
	iv. LNB/LNC
	v. Powering Systems
	b. Alignment
	i. Satellite Spacing
	ii. Orbital Arc
	c. Signal Characteristics
	i. Transmission
	ii. Amplification Techniques
	iii. Power Dividers
	d. Antenna Performance
	i. Gain
	ii. Noise
	e. Receivers
i. Theory of Operation	
ii. IRDs/IRTs	
iii. DVB-S, DVB-S2, Digicipher II	
iv. Decryption/Authorization	

	3. Fiber transport
	a. Direct modulation
	b. External modulation
	c. Signal characteristics
	d. Types of fiber optic media
	i. Single mode
	ii. Multi mode
	4. Microwave
	a. Antenna Types
	b. Signal Characteristics
	i. Transmission/Reception
	ii. Signal Amplification
	c. Transmission Line
	d. Antenna Performance
	e. Systems
	i. Point-to-Point
	ii. Point-to-Multipoint
	5. Channelization
	a. Identification
	i. EIA Numbering
	b. Frequency Assignments
	i. Standard Frequencies
	ii. HRC Frequencies
	iii. IRC Frequencies
	6. RF Signal Combining
	a. Signal Grooming
	b. Filters
	i. Bandpass
	ii. Bandstop
	iii. High Pass
iv. Low Pass	
c. Forward and Return	
i. Broadcast	
ii. Narrowcast	

	d. Port-to-Port Isolation
	e. Insertion Loss
	7. Multiplexing
	a. Time Based
	i. TDM
	ii. STDM
	b. Frequency Based
	i. FDM
	ii. OFDM
	iii. CWDM
	iv. DWDM
	c. Transmission
	i. Asynchronous
	ii. Synchronous
	iii. Bisynchronous
	a) Eb/No
	8. Formats
	a. MPEG
	i. Components
	ii. Transmission Standards
	b. Signal Protection
	i. Encryption
	ii. Conditional Access
	c. Flow Control Mechanisms
	9. Error Detection and Correction
	a. Error Checking
	i. Process
	ii. Techniques
	b. Frequency Hopping
	c. Forward Error Correction (FEC)
	i. Interleaving
	(a) Byte
	(b) Bit

V. Tests and Measurements

Competency	Knowledge, Skills, & Abilities
<p>A. Test Equipment and its Applications</p> <p>Demonstrate working knowledge of the theory and operation of the various types of test equipment, as well as their applications.</p>	1. Baseband Equipment
	a. Oscilloscope
	b. Waveform Monitor
	c. Vectorscope
	d. Digital Multimeters
	e. Signal Generators
	f. MPEG Analyzer
	g. Protocol Analyzers
	h. Precision Demodulators
	2. RF Equipment Theory and Application
	a. Spectrum Analyzer
	i. Specifications, Tolerances
	b. Signal Level Meter
	i. Specifications, Tolerances
	c. Signal Generator
	i. Upstream testing
	d. Power Meter (Thermal)
3. Photonic Equipment	
a. Optical Spectrum Analyzer	
b. OTDR	
c. Optical Power Meter	
<p>B. Testing and Maintenance</p> <p>Demonstrate working knowledge of the equipment and methods used to test Digital Video, Audio, and Digital Performance. Demonstrate an understanding of measurement techniques and troubleshooting procedures, and how these techniques can be used to correct impairments.</p>	1. Digital Performance Metrics and Tests
	a. Video Tests
	i. Types of Tests
	ii. Test Signals
	iii. Performance Standards and References
	b. Audio Tests
	i. Insertion Gain
ii. Gain vs. Frequency Distortion	

	iii. Channel Separation
	iv. Signal-to-Noise
	v. Level and Relative Loudness Measurements
	c. Digital Tests
	i. QAM Level
	ii. Constellation
	iii. MER
	iv. Equalizer graphs
	v. Bit Error Rate (BER) (pre- and post-FEC)
	vi. Group Delay
	vii. In-Channel Response
	viii. Eye Diagram
	ix. EVM
	x. Adaptive Equalizer Performance
	xi. Packet Loss
	xii. MOS
	xiii. Temporal
	(a) Jitter
	(b) Delay or Latency
	(c) Group Delay
	2. Measurement Techniques
	a. Transmission Channel
	i. Amplitude
	ii. Carrier-to-Noise
	iii. Carrier-to-Interference
	iv. Zero-span
	b. Data Tools
	i. SNMP
	ii. CMTS
	iii. OSS

	3. Testing and Troubleshooting
	a. HFC Network
	i. Downstream Monitoring
	ii. Upstream Monitoring
	b. PSTN Interface
	i. BERT
	ii. Calculation
	4. Impairments and Mitigation
	a. Impairment Sources
	i. Baseband Impairments
	(a) Sampling Error
	(b) Quantizing Error
	ii. RF Impairments
	(a) Ingress
	(b) Noise
	(c) Distortions
	(i) Linear
	(ii) Nonlinear
	(d) Interference
	iii. Power per Hertz Theory