

## SCTE Broadband Distribution Specialist (BDS)

### Scope

The SCTE **Broadband Distribution Specialist (BDS)** certifies knowledge in the subject matter related to the RF distribution of signals. All aspects of the network from the optical node to the distribution tap are included in this certification curriculum.

Specifics include:

- System Architectures—design principles and HFC architecture
- Distribution Components—actives, passives and coaxial cable
- Signal Types—analog, modulation schemes, frequency spectrum and impairments
- Troubleshooting and Maintenance—sweeping, FCC Rules, return path, test equipment, status monitoring and troubleshooting techniques
- Construction—coaxial cable handling, cable placement, bonding and grounding, activation and testing
- Field Safety—personal protective equipment, ladders, pole climbing, equipment and vehicle operation, battery handling

### I. Systems Architectures

Competency	Knowledge, Skills, and Abilities
A. Explain the basic principles used to design and map the coaxial portion of the HFC network.	1. Describe Unity Gain
	2. Describe the cable system mapping process
	a. Identify the common symbols found on cable system strand and design maps
	i. End of line readings
	ii. Data boxes (tombstones)
	b. Name three types of system maps; distinguish between the following:
	i. Strand
	ii. Design
	iii. As-built
	3. Define the following powering elements and identify considerations when designing system power:
	a. Standby power
	b. Powering topologies i. Centralized



	ii. Distributive
	c. Emergency power sources for standby power supplies
	d. Power grids
	e. Power supplies
	f. Cable powering
	4. Define the following RF principles and identify considerations when designing coaxial cable plant:
	a. Levels
	b. Tilt
	c. RF power addition/voltage addition
	d. Amplifier cascades and spacing
B. Describe the network architectures related to RF signal distribution.	1. Define each of the following architectures:
	a. Tree and branch
	i. Define Trunk
	ii. Define Feeder
	b. HFC
	i. Hub
	c. Fiber deep
	i. Node plus x
	ii. Node plus 0 (passive network)
	iii. RF over glass (RFOG)
	d. Gigabit Ethernet Passive Optical Network (GPON)
	2. Define the following two-way cable system configurations and identify the general frequency division for each:
	a. Sub-split
	b. Split-shift (DOCSIS 3)
	c. Mid-split
d. High-split	



## II. Distribution Components

<b>Competency</b>	<b>Knowledge, Skills, and Abilities</b>
<p>A. Explain the use and function of active devices used in the coaxial portion of the HFC network.</p>	1. Name the types of amplifiers
	a. Trunk amplifier
	i. Bridger modules
	b. Express amplifier
	c. Distribution amplifiers
	ii. Line extender
	2. Explain the following amplifier characteristics:
	a. Operating Parameters
	b. Types of Amplifiers
	c. Application of amplifiers
	d. Specification sheets
	e. Internal Design
	3. Describe the following active device alignment methods:
	a. Manual
	b. AGC/ASC
	c. Reverse
	4. Explain the relevance of each of the following calculations to active devices:
	a. Unity gain
	b. Ohm's Law
	c. Decibel Theory
	d. Noise/Distortions
e. Return Loss	
f. Reverse	
5. Define the following active device plug Ins	
a. Diplex Filters	
b. Pads/Equalizers	
c. Trim Devices	
d. Feeder makers	
e. Couplers	
f. Fusing	
<p>B. Explain the use and function of RF and optical nodes.</p>	1. Explain the following node characteristics:
	a. Operating Parameters
	i. Forward signals
ii. Reverse signals	



	b. Optical input power
	c. Specifications
	2. Explain the difference between dBm and dBmV (optical vs. electrical signals)
C. Explain the use and function of passive devices used in the coaxial portion of the HFC network.	1. Explain the following passive device RF and AC properties
	a. Fusing/Shunts
	b. Return Loss
	c. Isolation
	d. Passband
	2. Identify and describe the following passive devices, their corresponding map symbols, and level calculations:
	a. Line splitters
	b. Directional couplers
	c. Power Inserters
	d. Taps
	i. Directional taps
	ii. Addressable taps
	iii. Power-passing taps
e. In-line equalizers	
f. Reverse conditioners	
D. Explain the use and function of coaxial cable used in the HFC network.	1. Hardline cable connectors
	a. Demonstrate cable preparation
	b. Identify the types of connectors
	i. Housing to housing
	ii. Pin
	iii. Feed through
	iv. 90, 180
	v. Terminators
	c. Describe Connectorization
	i. Prep
	ii. Torque
	2. Define the following coaxial cable properties:
	a. Impedance
	b. Velocity of propagation
	c. Inductance
	d. Capacitance
e. Attenuation	
f. Shielding	



	g. DC Loop Resistance
	3. Describe proper coaxial cable handling in the following situations:
	a. Bending radius
	b. Lashing
	c. Environmental damage
	4. Define Return Loss and its effects in the following situations:
	a. Structural Return Loss (SRL)
	b. Impedance mismatches
	5. Identify and define each of the following components of coaxial cable:
	a. Center conductor
	b. Dielectric
	i. Air
	c. Jacket
	d. Flooding compound



### III. Signal Types

Competency	Knowledge, Skills, and Abilities
A. Describe the following characteristics of analog signals.	1. NTSC
	a. Components and locations
	i. Video
	ii. Audio
	iii. Color burst
	b. Bandwidth
	c. Transmission
	2. Pilot carriers
	3. PAL
B. Describe the following characteristics of digital signals.	1. Explain digital fundamentals:
	a. Binary system
	i. Fundamentals
	ii. Numbering
	iii. Coding of information
	2. Name the components of the digital signal
	a. Basics of digital signals
	i. Define digital
	b. Explain analog to digital (A/D) conversion
	i. Fundamentals of conversion
	ii. Define decoding
	iii. Define pulse-code modulation (PCM)
	iv. Define codec
	3. Digital Multiplexing
	a. Multiple Streams in 6 MHz bandwidth
	b. MPEG
	c. Compression ratios
	d. Multiplexing (with respect to DOCSIS)
	i. Time Division Multiplexing (TDM)
	ii. Frequency Division Multiplexing (FDM)
	(a) Broadband spectrum digital signal frequency allocation
	iii. ATDMA
	iv. SCDMA
	e. Describe two-way signal flow
	4. Out of band (OOB) signaling
	a. Define OOB signaling



	b. Explain how is OOB signally used
	5. Explain channel mapping
	6. Explain structure of messages through the introduction of the following:
	a. Frames
	b. Packets
	c. Open Systems Interconnection Basic Reference Model (OSI Reference Model; OSI Model)
	7. Identify RF carrier levels for digital QAM/channel
	8. Define the following transmission metrics:
	a. Data rate
	b. Symbol rate
	i Payload
	ii Overhead
	iii Throughput
	(a) QoS - quality vs. quantity of signal
(b) Service Level Agreement (SLA)	
C. Describe upstream signal types.	1. Modem
	2. Set-top box (STB)
	3. Telco return
	4. Status monitoring
	a. Node monitoring
	b. Power supply monitoring
D. Describe the following modulation schemes.	1. Analog
	a. Amplitude Modulation (AM)
	b. Frequency Modulation (FM)
	c. Phase modulation (PM)
	2. Digital
	a. Frequency-shift keying (FSK)
	b. Quadrature phase-shift keying (QPSK)
	c. Quadrature amplitude modulation (QAM)
E. Describe the frequency spectrum for the following.	1. Analog forward/ reverse
	a. Bandwidth
	b. Channel allocation/frequencies
	2. Digital forward/ reverse
	a. Contrast upstream and downstream characteristics
F. Describe the following cable	1. Noise
	a. Thermal noise



network Impairments.	b. Impulse noise
	c. Carrier-to-Noise (C/N) ratio
	2. Distortions
	a. CSO
	b. CTB
	c. XMOD
	3. Interfering Signals
	a. Common Path Distortion (CPD)
	b. Hum modulation
	c. Ingress/Egress
	4. Reflections



#### IV. Troubleshooting and Maintenance

Competency	Knowledge, Skills, and Abilities
A Describe the test equipment used during cable network maintenance and troubleshooting.	1. Spectrum analyzer
	2. Signal Level Meter (SLM)
	a. Display readouts of an analog channel features
	b. Identify the following digital display features:
	i QAM analyzer
	(a) Modulation Error Rate (MER)
	(b) Bit Error Ratio (BER)
	(i) Bit Error Rate Test (BERT)
	(c) DOCSIS stats
	(d) Constellation characteristics
	(e) Constellation interpretation
	c. Return test
	i Signal generator (for example, DSAM, RSVP)
	ii Modem service certificate
	(a) Web-based application / modem emulator
	d. Video and audio carrier measurements
	e. Maintenance and care
	i Charging
	ii Calibration - accuracy verification
	iii Channel plans
	f. RF operating parameters
	3. Test TV
	a. Tracking picture and/or sound impairments
	b. Diagnosing bad customer TV
	4. Volt Ohm Meter (VOM)/Digital Multi-Meter(DMM)
	a. Using resistance function
	i Isolating shorts
	ii Identifying opens
	iii Cable identification
	b. Using voltage function
i Checking for hot (electrified) chassis condition	
5. Signal leakage detector	
a. Ingress	
i Definition	
ii Symptoms	



	iii Appearance
	iv Sources
	v Detection
	vi Repair
	vii Technician's role; escalation procedures
	b. Egress
	i Definition
	ii Symptoms
	iii Sources
	iv Equipment
	v Detection
	(a) Measuring 20 $\mu$ V/m
	vi Repair
	vii Technician's role; escalation procedures
	c. System monitoring
	i Cumulative Leakage Index (CLI)
	(a) Definition/requirement
	6. Cable Locator
	a. Locating underground cables
	b. Identifying utility colors and flags
	7. Time Domain Reflectometer (TDR)
	a. Definition
	b. Explain how to use a TDR to locate faults
	8. Line toner
	a. Definition
	b. Application and Use
	9. Polarity tester
	a. Definition
	b. Application and use
	10. Return Path tester (example, RSVP)
	a. Definition
	b. Application and use
	11. Butt set (voice applications)
	a. Definition
	b. Application and use
	12. VOM (voice applications)
	a. Definition
	b. Application and use
	13. Wire ID (voice applications)



	a. Definition
	b. Application and use
	14. Wire mapper (voice applications)
	a. Definition
	b. Application and use
	15. Brown meter (loop tester) (voice applications)
	a. Definition
	b. Application and use
	16. Banjo (voice applications)
	a. Definition
	b. Application and use
	17. Cable modem emulator
	a. Definition
	b. Application and use
	c. Definition
	d. Provide examples for:
	i Downstream
	ii Upstream
	18. MOS – Mean Opinion Score
	a. Definition (what constitutes this score)
	19. Perceptual Evaluation of Speech Quality (PESQ)
	a. Speech quality assessment
B Recognize and understand the divide and conquer (also called the isolation or half-split) method of troubleshooting.	1. Explain the steps in the troubleshooting process:
	a. Symptom analysis
	i Verify problem symptoms with customer
	b. Problem isolation
	c. Divide and conquer
	d. Problem resolution/repair
	e. Confirm problem resolution/repair
	2. Diagnose equipment problems:
	a. Identify signal issues
	b. Interpret premises signal level readings (too high; too low)
	c. List the procedures for troubleshooting the set-top box and interactive program guide (IPG)
	3. Ability to troubleshoot forward and return path
C Recognize common analog and digital signal impairments.	1. Identify the name and/or cause following analog signal impairments such as:
	a. Snow (no picture)



	b. Blue TV screen
	c. Snowy picture
	d. Snowy picture on channels 2 through 6 only; lines in picture
	e. Ghosting
	f. Flash or blip in picture
	g. Herringbone pattern
	h. Horizontal bars (hum bars)
	i. Diagonal lines (Intermodulation beats)
	j. CB radio interference
	k. Randomly flashing lines or flashing picture
	i Electrical interference from an in-house appliance
	ii FM noise
	l. "Sparklies"
	i Terrestrial interference - outage in spring/fall (satellite/sun outages)
	m. Scrambled picture
	2. Identify the name and/or cause following digital signal impairments such as:
	a. Tiling (freezing)
	b. Blocking
	c. Jerkiness
	d. Smearing
	e. Artifacts
	f. Object retention
	g. Robotic voice
	h. Echo
	i. Dropped call
	j. Voice break up
	k. Slow web page
	l. Server not found
	m. Lip synch
	n. No picture / black screen
	3. Media Impairments
	a. Name a typical cause of the following digital impairments
	i BER
	ii Latency



	iii Jitter
	iv Packet Loss
D Describe basic cable plant sweeping techniques.	1. Describe the use of sweep systems in maintaining the coaxial portion of the cable plant. Explain the following:
	a. Sweeping Techniques
	b. Sweeping Forward and Return
	c. Injection Points for sweep System
	2. Describe the following types of Sweep Systems:
	a. Low Level
	b. High Level
	c. Carrier
	3. Unity Gain
E Define the Federal Communications Commission (FCC) and how the rules apply to the following:	1. Performance Requirements
	a. CLI
	b. C/N and S/N
	c. CSO
	d. CTB
	2. Proof of Performance (POP) Tests
	a. Describe POP tests
	b. Explain what the POP tests accomplish
	c. Time frames
F Describe considerations when maintaining and troubleshooting the forward and return plant.	1. Unity gain
	a. Amplifier output levels
	b. Tap output levels
	c. Cable loss
	d. Insertion loss
	2. Understand individual system design performance in addition to FCC requirements
	3. Identify common causes of group delay
	4. MER
	5. BER
	6. Describe the effects of the following:
	a. Bad splitters
	b. Poor cabling
	c. Bad amplifiers
	d. Long amplifier cascades



	7. Frequency response
	a. Peak-to-valley (flatness)
	8. Define outage
	a. Total
	b. Service
	i Video
	ii Voice
	iii Data
	c. Single channel
9. Environmental considerations	
G Define status monitoring and explain its purpose as a tool for maintenance.	1. Explain the purpose of system monitoring
	2. Power supplies
	a. Stand-by vs. main power
	b. Voltage and amperage
	3. Performance monitoring
	4. Nodes
	5. Modem return path
H Describe cable network preventive maintenance considerations.	1. Fix broken lashing wire
	2. Housing gaskets
	a. RFI gasket
	b. Water seal



## V. Construction

Competency	Knowledge, Skills, and Abilities
A Describe the cable and equipment used in cable telecommunications construction, and its proper handling and testing.	1. Physical Handling
	a. Delivery and acceptance
	b. Proper unloading procedures
	c. Proper loading procedures
	d. Proper cable storage
	2. Coaxial Cable Testing
	a. Structural return loss testing
	b. Impedance/TDR and cable length testing
	c. Attenuation testing
	3. Cable construction equipment
	a. Aerial construction equipment
	i Mechanical bender
	ii Bender board
	iii Corner block (90)
	iv Corner block (45)
	v Single roller block
	vi Economy block
	vii Multiple cable block
	viii Crossover bracket
	ix Setup bracket
	x Strand brake
	xi Setup chute
	xii Dynamometer
	xiii Cable guide
	xiv Cable lasher
	xv Lay-up stick
	xvi Cable lifter
	xvii Wire-raising tool
xviii Cable positioned	
xix Multiple cable puller	
xx Cable overlap puller	
xxi Cable block pusher	
b. Underground construction equipment	
i Cable winch	
ii Cable sheave	



	iii Cable shoe
	iv Reel brake
	v Pulling grip
	vi Breakaway swivel
	vii Reel stands
	viii Cable trailer
B Explain aerial cable placement considerations, including inspection, clearances, and installation.	1. Cable acceptance testing
	a. Physical inspection
	b. Electrical inspection
	2. Hardware specifications
	3. Clearances and separations
	4. Pole framing
	5. Strand installation
	a. Strand dead-ends
	b. False dead-ends
	c. Self-supporting duct
	6. Guying
a. Guy lead and height	
b. Measure pull	
c. Determining guy strand size	
7. Coaxial cable installation	
a. Set-up procedures	
b. Installation procedures	
8. Cable roller (single or multiple) usage	
9. Cable overlashing	
10. Expansion loops	
11. Tree trimming	
C Explain underground cable placement considerations, including open trench, boring, and plowing installations.	1. General Information
	a. Research local, state, and federal guidelines
	b. Traffic
	c. Qualifications
	d. Safety
	e. Report
	f. Quality
	2. Open trench construction methods
	a. Considerations
	b. Preparation
c. Cable and conduit installation	
d. Trench restoration	



	e. Open trench – street cut construction
	3. Directional boring construction
	a. Considerations
	b. Data requirements
	c. Installation by the boring method
	4. Plowing construction
	a. Preparation
	b. Methods
	i Pull plowing
	ii Chute plowing
	5. Risers
	6. Duct and conduit systems
	7. Pull line
	8. Pulling cable and innerducts
	9. Placement equipment
	10. Pulling lubricants
	11. Duct seal
D Describe the underground enclosures used in cable plant construction.	1. Pedestals
	2. Vaults and handholds
	3. Sealed enclosures
	4. Placing pedestal enclosures
	5. Pad installation
	6. Equipping enclosures
	7. Grade-level manholes
	8. Splicing
	9. Termination
E Describe cable plant bonding and grounding practices.	1. Grounding subsystems
	2. Materials
	3. Conduit use with grounding conductors
	4. Grounding electrodes
	5. Soil
	6. Corrosion protection
	7. Installation procedures
F Demonstrate coaxial cable preparation and connectorization.	1. Semiflex coaxial cables
	a. Cable inspection
	b. Cable preparation
	2. QR cable
	a. Cable inspection
	b. Cable preparation



	3. MC <sup>2</sup> cable
	a. Cable inspection
	b. Cable preparation
	4. General connector installation
G Describe the process of coaxial cable activation and testing for new construction.	1. Preliminary component testing
	a. Cable verification
	b. Passive device verification
	c. Active device verification
	2. System activation
	a. Powering the amplifiers
	b. Rough balancing
	c. System alignment
	3. System performance verification
	4. Documentation



## VI. Field Safety

Competency	Knowledge, Skills, and Abilities
<p>A Recognize the industry standard safe work practices, for Personal Protective Equipment (PPE) and other job-related tools and equipment.</p>	<p>1. Describe the eye protection used during installation and service work; explain the minimum industry-adopted rating</p>
	<p>a. ANSI rating</p>
	<p>2. Describe hearing protection used during installation and service work; explain the minimum industry-adopted rating:</p>
	<p>a. ANSI rating</p>
	<p>3. Describe footwear worn during installation and service work; explain the minimum industry-adopted rating:</p>
	<p>a. ANSI rating</p>
	<p>4. Describe clothing worn (and not worn) during installation and service work.</p>
	<p>5. Describe work gloves worn during installation and service work.</p>
	<p>6. Describe hardhats used during installation and service work; explain the minimum industry-adopted rating:</p>
	<p>a. ANSI rating</p>
	<p>7. Describe voltage testers used during installation and service work; explain use and maintenance.</p>
	<p>a. Foreign voltage detector</p>
	<p>8. Describe safety vest used during installation and service work; explain the following types of safety vests and when each is used:</p>
	<p>a. Class 1</p>
	<p>i School crossing</p>
	<p>b. Class 2</p>
	<p>i Up to 50 MPH</p>
	<p>c. Class 3</p>
	<p>i Over 50 MPH</p>
	<p>9. Identify the climbing equipment used during installation and service work; explain each of the following components:</p>



	a. Fall arrest systems
	b. Pole climbers (hooks)
	i Stirrup
	ii Gaff
	iii Leg iron
	iv Ankle strap
	v Climber strap and pad
	c. Body belt
	i D-rings
	ii Tool hooks
	d. Gloves
	i Gauntlet
	ii High voltage gloves (rubber gloves, liners, outer protectors)
	e. Safety Strap
	i Snap hooks
	ii Nylon strap
	10. Be aware of proper pole climbing techniques
	11. Ladders
	a. Define the following types of ladders and when each is used:
	i Step ladder
	ii Extension ladder
	iii Combination step/extension ladder
	b. Identify the parts of a ladder
	c. Describe ladder inspection before and during use
	i Explain what to do with defective ladders
	d. Describe ladder placement on the strand (including midspan) and at the pole
	e. Describe ladder usage
	f. Be aware of proper ladder handling techniques; describe the following:
	i Removing and replacing ladders on the vehicle racks
	ii Carrying methods
	iii Ascend and descend
	iv Risks



	<p>12. Poles</p> <ul style="list-style-type: none"> <li>a. Demonstrate pole inspections accomplished to ensure the pole and environment are safe</li> <li>b. Demonstrate voltage testing</li> <li>c. Define climbing space</li> <li>d. Describe electrical hazards that could be encountered when working at the pole</li> </ul>
<p>B Recognize the industry standard safe work practices with respect to vehicle use.</p>	<ul style="list-style-type: none"> <li>1. Describe safe operation and maintenance of the company vehicle             <ul style="list-style-type: none"> <li>a. Describe how to conduct daily inspections</li> <li>b. Describe how the vehicle's appearance, how it is driven, and how it is parked, reflects good customer relations</li> </ul> </li> <li>2. Describe the following traffic control devices:             <ul style="list-style-type: none"> <li>a. Signs</li> <li>b. Flagger requirements</li> <li>c. Cones                 <ul style="list-style-type: none"> <li>i Placement</li> <li>ii Tapering</li> </ul> </li> </ul> </li> <li>3. Aerial Lift Trucks             <ul style="list-style-type: none"> <li>a. Describe when an aerial lift vehicle (bucket truck) is used</li> <li>b. Describe safe practices associated with aerial lift operation, including:                 <ul style="list-style-type: none"> <li>i Use of wheel chocks</li> <li>ii Proximity awareness</li> <li>iii Fall arrest system</li> </ul> </li> </ul> </li> </ul>
<p>C Recognize the industry standard safe work practices with respect to work zone safety.</p>	<ul style="list-style-type: none"> <li>1. Describe the process of analyzing risks when driving the company vehicle             <ul style="list-style-type: none"> <li>a. Differentiate driving a company Trucks/Vans with driving a passenger car</li> <li>b. Describe how to conduct Daily Inspections</li> </ul> </li> <li>2. Identify and describe the following work zone traffic control devices and how the Manual on Uniform Traffic Control Devices (MUTCD), along with state and local policies, establishes:</li> </ul>



	a. Cone placement (channelization devices)
	b. Sign placement (warning devices)
	3. Describe traffic flow techniques
	a. flagging
D Recognize the industry standard safe work practices with respect to the work environment.	1. Describe the following hazardous materials – HAZCOM that may be encountered on the job:
	a. Identify the potential for asbestos at the job site and what to do if encountered
	b. Identify the potential for solvents at the job site and what to do if encountered
	c. Identify the potential for fiberglass Insulation at the job site and what to do if encountered
	d. Identify the potential for lead paint at the job site and what to do if encountered
	2. Describe the following extreme weather conditions and the safety precautions associated with each:
	a. Heat
	b. Cold
	c. Storms
	3. Demonstrate proper ergonomics while on the job as related to repetitive motion activities
	4. Identify potential animal encounters while on the job and describe the safety precautions to employ
	a. Wild animal
	b. Domestic animal
	5. Demonstrate proper battery handling
	a. Stand-by power supplies
	i Demonstrate safe battery handling
	b. AC and power considerations



**Society of Cable  
Telecommunications  
Engineers**

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