SCTE®·ISBE® Broadband Fiber Installer (BFI)

Scope

The SCTE·ISBE **Broadband Fiber Installer** certification describes the knowledge of a technician who will plan, install, verify, and troubleshoot fiber networks, including service issues at the customer's premises. The successful certification candidate has the knowledge to support distinct types of radio frequency over glass (RFoG) and passive optical networks (PON), along with preparing fiber for connectivity.

The Broadband Fiber Installer (BFI) certification builds on the knowledge gained from the Broadband Premises Installer (BPI) and/or Broadband Premises Technician (BPT) certification(s).

I.   Technology, Systems & Requirements

Competency	Knowledge, Skills, and Abilities
A Recognize fiber optic network configuration and understand how optical signals flow from a fiber deep or optical distribution network (ODN) to the premises.	1. Define fiber deep
	a. Near passive optical network (PON)
	b. Node + 0
	2. Contrast fiber deep architecture with an HFC
	3. Define optical distribution network (ODN)
	a. Define passive optical network (PON)
	4. Contrast ODN architecture with an HFC
	a. Centralized split architecture
	b. Distributed split architecture
	c. Distributed tap architecture
	5. Distributed access architecture (DAA)
	a. Remote PHY
	b. Remote MAC
	6. Define in basic terms "optical signal levels"
	a. Minimum optical signal levels at the customer premises test point locations
	b. Examples of expected optical signal levels at customer premises test point locations
	i Optical signal faults and limitations
	ii Comparison of optical and coaxial signals

				iii	Optical transmission loss
B	Recognize fiber to the "x" (FTTx) network configuration and understand how optical signals flow from the optical distribution network (ODN) to the premises.	1.	Fiber to the "x" (FTTx)		
			a.	FTTH or FTTP	
			b.	FTTN	
			c.	FTTMDU	
			d.	FTTC	
			e.	FTTB	
C	Understand basic digital signal characteristics and how digital signals are used in optical distribution network (ODN).	1.	Basics of digital signals		
			a.	Define in basic terms "digital"	
			b.	Digital signal levels	
				i	Knowledge of expected signal levels at customer premises test point locations
		2.	Digital modulation		
			a.	Define in basic terms "baseband digital modulation"	
			b.	Digital multiplexing	
				i	Multiple video programs in 6 MHz or 8 MHz bandwidth
			c.	Contrast with AIM	
			d.	Describe two-way signal flow	
D	Recognize the components of a fiber deep architecture, distributed access architecture (DAA), optical distribution network (ODN).	1.	Define fiber deep, DAA and ODN components:		
			a.	Telecom center (headend, hub)	
				i	Optical transmitter
					(a) FP
					(b) DFB
				ii	Optical receiver
					(a) FP
					(b) DFB
					(c) Photodiode
				iii	Optical amplifier
					(a) EDFA
					(b) YEDFA
				iv	Optical multiplexer
				v	Optical de-multiplexer
				vi	Optical line terminal (OLT)
			b.	Optical transport network (OTN)	
			c.	Fiber deep	
				i	Multiplexing point
					(a) Aerial enclosure
					(b) Node chassis
			d.	ODN	
				i	Fiber distribution cabinet (FDC)
				ii	Aerial enclosure
				iii	Fiber pedestal
			e.	DAA	
				i	Node chassis

	f. Customer's premises
	i R-ONU (RFoG)
	ii ONU (EPON)
	iii ONT (GPON)
	2. Describe the purpose and function of the following network devices:
	a. Passive devices
	i Optical Taps
	(a) Tap function
	(b) Tap configuration
	(c) Troubleshooting the tap
	ii Optical splitters
	iii Optical couplers
	iv Splice trays
	v Splice enclosures
	vi Line power inserters (LPI)
	(a) Shunts
	vii Traps
	b. Active devices
	i Optical amplifiers
	(a) EDFA
	(i) Wavelength
	(ii) Gain
	3. Define in basic terms the following optical system wavelength allocations:
	a. Nanometers (nm)
	b. Reverse
	i Frequency
	(a) Mid-split
	ii Wavelengths
	iii Shared wavelengths
	c. Forward
	i Frequency
	(a) Mid-split
	i Wavelengths
	ii Shared wavelengths
	iii Spectrum allocation (analog, digital, SDV, VoD, HSD, Channel bonding, DOCSIS 3.1)
E Understand fiber network powering.	1. Traditional access network powering
	a. Recognize the symbols and letters that represent electrical units
	a. Voltage levels
	b. Centralized
	c. Distributed
	2. Fiber deep powering
	3. DAA powering
	4. ODN powering

II. Fiber Optic Theory

A	Describe the characteristics and properties of optical fiber and cables used within the drop system of the telecommunications network.	1.	Define the following optical drop cable physical, intrinsic and extrinsic properties:
			a. Describe the components of an optical link
			b. Wavelength vs. frequency characteristics
			i. Electromagnetic spectrum
			ii. Index of refraction
			c. Describe optical drop cable construction
			i List the physical fiber drop cable components:
			(a) Core
			(b) Cladding
			(c) Coating
			(d) Strength member
			(e) Armor
			(f) Jacket
			(g) Buffer tube
			(h) Aramid yard
			(i) Rip cord
			(j) Color code
			(i) EIA/TIA-598 color identifiers
			ii Contrast the difference between aerial and underground drop cable
			d. List typical fiber drop cable sizes (by diameter)
			e. Cables
			i. Fiber bundles
			ii. Loose tube
			1. Central
			2. Stranded
			iii. Tight buffer
			iv. Ribbon fiber
			1. Stacked
			f. Describe fiber cable attenuation properties:
			i Define in basic terms "dBm"
			ii Define in basic terms "mW"
			iii Define in basic terms "attenuation"
			iv Explain the effect cable length has on fiber cable
			v Calculate optical cable attenuation
		2.	Describe in basic terms the following optical fiber properties:
			a. Define "mode" and optical fiber types:
			i Multimode
			ii Single-mode

B	Recognize the extrinsic and intrinsic factors that create or influence optical fiber losses.	1.	Define "intrinsic"
			a. Impurities
			b. Absorption
			c. Scattering
			d. Dispersion
			e. Reflection
			i RIN
			ii Fresnel
			f. ORL
		2.	Define "extrinsic"
			a. Microbends
			b. Macrobends
			i Bending limits
			c. Fiber alignment
C	Describe the types of wave division multiplexing (WDM) used in a telecommunications network.		a. Define wave division multiplexing (WDM)
			i Wave division
			ii Effects on optical signal
			iii Applications
			iv Calculate optical attenuation
			b. Define DWDM
			i ITU Grids & Channels
			c. Define CWDM
			i Grid and Channels
D	Recognize the types of fiber connectors used in a cable operator's fiber network.	1.	Identify the fiber connectors used at the premises, along with the connector's insertion loss, reflectance and durability
			a. APC
			i SC
			b. UPC
			i LC
			ii SC
			c. ST
			d. MTRJ
			e. FC
			f. MPO
		2.	Contrast the pros and cons for the different types of connector polishes used in a fiber network
			a. Flat (True) polish
			b. FC Flat polish
			c. PC polish
			d. Super polish

III. Installation

Competency	Knowledge, Skills, and Abilities
A. Compare the fiber prep tools, cleaners and splicing equipment used in an FTTP architecture.	1. Demonstrate proper cleaning of fiber optics
	a. Wet Cleaning
	i Solvent wipes
	ii Isopropyl alcohol
	b. Dry Cleaning
	i Lint free wipes
	ii Tape wipes
	c. Wet to Dry
	2. Tools
	a. Fiber optic stripper
	b. Scissors or shears
	c. Tweezers
	d. Wire stripper
	e. Jacket stripper
B Recognize the use and function of customer premises optical devices.	1. Radio frequency over glass (RFoG)
	a. Identify all connectivity ports
	i RF
	ii Optical SC/APC
	iii Optical pass-thru
	b. Understand power configuration
	c. LED operation
	d. Identify operating frequency
	i DOCSIS 3.1
	ii MoCA 2.5
	e. Wavelengths used
	2. Ethernet passive optical network (EPON)
	a. Identify all connectivity ports
	i Twisted Pair
	ii Optical
	b. Understand power configuration
	c. LED operation
	d. Wavelengths used
	e. IPTV
	3. Gigabit passive optical network (GPON)
	a. Identify all connectivity ports
	i Optical
	b. Understand power configuration
	c. LED operation
	d. Wavelengths used
	e. IPTV
C Recognize the types of optical cables used within the drop system; describe proper handling techniques.	1. Differentiate between the fiber cable types:
	a. Underground
	b. Aerial messenger
	c. National Electrical Code (NEC) classification

		2.	Demonstrate use of the correct cable type for various customer installations
		3.	Demonstrate proper cable handling techniques:
			a. Minimum bend radius
			b. Drip loops
			c. Structural considerations
			i Fastening
			ii Attachments
			d. Describe the impact of improper handling techniques
			e. Describe the impact of improper fastening techniques
			f. Describe fiber drop fundamentals
D	Recognize the function and use of interfaces and terminations within the customer's premises.	4.	Understand the types of optical drop cables and components at the premises
		5.	Understand the types of optical connectors used at the premises
		6.	Explain the purpose and need of security shields and demonstrate installation and removal
		7.	Explain fiber drop cable preparation
		8.	Describe the following equipment interfaces and explain any unique characteristics:
			a. Waterproofing
			i Silicone grease
			ii Aqua seals/rubber gaskets
			b. Fiber splices/connectors
			i Fusion
			(a) LID
			(b) PAS
			(c) Ribbon
			ii Mechanical
			iii Air gaps
			c. Fiber handling
			i Safety
E	Recognize the proper steps for stripping and cleaning a fiber.	1.	Safety
		2.	Describe the proper stripping process
			a. Strip the jacket
			b. Strip the coating
		2.	Describe the proper cleaving process
			a. Hand cleaving
			b. Bench tool cleaving
		3.	Fiber inspection
F	Recognize the proper steps for performing a splice.	1.	Safety
		2.	Mechanical
			a. Describe the proper process for performing a mechanical splice
			b. Index matching gel
			c. Loss inspection
		3.	Fusion

		a.	Describe the proper process for performing a fusion splice
		b.	Heat-shrink sleeve
		c.	RTV sealant
		d.	Loss inspection
	4.	Splice on Connectors	
G	Recognize the basic methods and procedures of planning and installing aerial optical drop cable at the customer's premises.	1.	Explain each of the following considerations regarding aerial drop cable routing techniques during aerial drop installation:
		2.	Demonstrate proper pole attachments.
		3.	Explain each of the following pole or strand attachments when routing the drop cable from the pole:
		4.	Define aerial trespass and explain how and why it should be avoided.
H	Recognize the basic methods and procedures of planning and installing underground optical drop cable at the customer's premises.	1.	Describe underground cable layout, and how to locate, identify, open, and inspect a pedestal
		2.	Explain the purpose of using a utility location service.
		3.	Explain the following placement methods used to bury the underground drop cable:
		4.	Explain each of the following considerations regarding underground drop cable routing techniques:
I	Recognize the basic methods and procedures of attaching the optical drop cable at the tap.	1.	Define tap and each of the following as applicable to the tap; explain purpose and installation method for each of the following:
		2.	Describe how to inspect the tap and its associated equipment
		a.	Measure signal levels
J	Recognize the methods and procedures of installing exterior wire and cable at the customer's premises.	1.	Demonstrate the ability to perform a optical cable house attachment in a typical cable television system.
		a.	Demonstrate proper house attachment procedures
		b.	Explain drop cable routing at the house
		c.	Knowledge of the codes governing attachments to electrical masts
K	Demonstrate optical cable and/or ONT/ONU/R-ONU bonding practices at the customer's premises.	1.	Explain the purpose and function of the grounding electrode system.
		2.	Identify the proper locations for bonding the residential cable television drop cable
		3.	Describe the following:
		a.	Bonding blocks
		b.	Ground (bonding) wire
		i	Drop attachment
		ii	Ground electrode attachment
		4.	Demonstrate the proper bonding techniques in the following circumstances:
		a.	Single family homes
		b.	Mobile homes

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		c. Multiple dwelling units (MDUs)
L Recognize the methods and procedures of ONT/ONU/R-ONU attachment at the customer's premises.	1. Explain how to perform an attachment at a multiple dwelling unit (MDU)	
	2. Explain how to perform an attachment at a residential location	
	3. Explain how to perform an attachment at a business location	
	a. Describe the procedures for performing a disconnect	

IV. Troubleshooting and Maintenance

Competency	Knowledge, Skills, and Abilities

A Recognize the function, use, care, and maintenance of test equipment.	1. Demonstrate proper use of a video fiber scope
	   a. Inspection process
	      i Proactive
	      ii Reactive
	   b. Define end face zones
	   c. Explain metrics for each zone
	2. PON Power Meter
	   a. Defined
	   b. Applications
	3. OTDR
	   a. Defined
	   b. Operation
	      i Dead zone
	4. Visual fault locator (VFL)
	   a. Defined
	5. Reference cable modem
	   a. Defined
	6. Optical spectrum analyzer (OSA)
	   a. Defined

B Recognize the metrics used for optical network health.	1. Attenuation
	   a. Optical power related to RF power
	2. MER
	3. BER
	   a. Pre BER
	   b. Post BER
	   c. Errored seconds
	4. PNM
	5. Return noise from premises
	6. OMI

C Recognize and understand the divide and conquer (isolation) 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

D Recognize the troubleshooting areas of the OSI model.	1. Physical layer 2. Data link layer

		3.	Network Layer
		4.	Transport Layer
		5.	Session Layer
		6.	Presentation Layer
		7.	Application Layer
E	Understand the PON provisioning process	1.	Define provisioning
			a. Back-office
			b. OSS
			i Servers
		2.	List the provisioning steps
			a. DML
			i Virtual CM
			b. RFoG DOCSIS
			c. DPoE
			d. DPoG
F	Troubleshoot OBI	1.	Understand ways to mitigate optical beat interference (OBI) in an RFoG network
G	Troubleshoot HSD	1.	Ability to troubleshoot a HSD service in an optical network
H	Troubleshoot VoIP	1.	Ability to troubleshoot a VoIP service in an optical network
I	Troubleshoot Video	1.	Ability to troubleshoot a video service in an optical network
J	Understand how to conduct the following measurements	1.	OTDR
			a. Launch
			b. Dynamic range
			c. Splice
			d. Attenuation
			e. Bad splice
			f. Macrobend
			g. Isolating shorts
			h. Identifying opens
			i. Fiber identification
			j. Distance
		2.	PON power meter
			a. Optical power levels
			b. Demonstrate proper use of an optical power meter

V.   Standards

Competency	Knowledge, Skills, and Abilities
A Recognize the regulatory agencies and/or standards that govern practices for providing fiber services to the customer's premises.	1. Identify the regulatory agencies that govern fiber optic technology:
	a. IEEE
	b. SCTE
	c. ITU
	d. IEC

VI.   Safety

Competency	Knowledge, Skills, and Abilities
A Recognize the industry standard safe work practices, for personal protective equipment (PPE) and other job-related safety.	1. Knowledge of Occupational Safety and Health Act of 1970
	2. Describe the eye protection used during fiber optic installation work
	a. ANSI rating
	b. Eye exposure
	i EDFA
	ii Laser
	3. Describe hardhats used during installation and service work; explain the minimum industry-adopted rating:
	a. ANSI rating
	4. Describe voltage testers used during installation and service work; explain use and maintenance.
	a. Foreign voltage detector
	5. Fiber scraps
	6. Chemicals