

SCTE®·ISBE® Broadband Wireless Specialist (BWS)

Scope

The SCTE·ISBE **Broadband Wireless Specialist (BWS)** certification describes the knowledge of an experienced field technician who will install, optimize, secure and troubleshoot wireless networks at the customer premises. The successful certification candidate has the knowledge to implement the 802.11 standards for Wi-Fi networks, ensure proper use of wireless local area network (WLAN) antennas, recognize proper use of RF signaling, deploy common low powered wireless networks and secure wireless topologies for residential single and multiple dwelling unit (MDU) customers. The candidate will also troubleshoot the most common problems of wireless networks and apply wireless network optimization techniques.

The **Broadband Wireless Specialist (BWS)** certification is one of four stand-alone Broadband Premises Specialist foundation certifications. Content includes "the how" of the wireless telecommunications installation and service. The other stand-alone premises certifications are the Broadband Premises Installer (BPI), Broadband Premises Technician (BPT) and the Broadband Premises Expert (BPE).

Specific certification topics include:

- Wireless Networks for Customer Premises
- Network Layers
- Wi-Fi Standards and Transmission
- Wi-Fi Radio Frequency Fundamentals
- Antenna Theory for Wi-Fi Networks
- Residential Wi-Fi Networks
- Wireless LAN Implementation
- WLAN Security & Common Threats
- Installing Broadband Wireless
- Troubleshooting WLANs

I. Wireless Networks for Customer Premises

Competency	Knowledge, Skills and Abilities
<p>A. Assess the different wireless agencies and their functions, regulations, standards and interoperability testing</p>	<p>1. Federal Communications Commission (FCC)</p> <ul style="list-style-type: none"> a. Licensed b. Unlicensed
	<p>2. Institute of Electrical and Electronics Engineers (IEEE)</p> <ul style="list-style-type: none"> a. Standards body b. Wireless media access control (MAC) c. Wireless security
	<p>3. Wi-Fi Alliance</p> <ul style="list-style-type: none"> a. Certification b. Interoperability testing c. Security
<p>B. Compare the different frequency bands and standards associated with wireless networks</p>	<p>1. Different frequency bands</p>
	<p>2. Standards with associated frequency bands</p>
<p>C. Describe basic antenna theory for coverage and the use of wireless extenders to increase coverage</p>	<p>1. Antenna theory and type</p>
	<p>2. Wireless extenders</p>

II. Network Layers

Competency	Knowledge, Skills and Abilities
A. Define the Open Systems Interconnection (OSI) protocol stack	1. Open Systems Interconnection (OSI) Model <ul style="list-style-type: none"> a. Layers 1 to 7
B. Identify the Open Systems Interconnection (OSI) layers as they relate to a wireless network	1. Layers of the Open Systems Interconnection (OSI) pertaining to Wi-Fi
C. Examine the media access control (MAC) layer 2 use in wireless networks	1. Media access control (MAC) control Layer 2
D. Explain layer 3 Internet protocol (IP) addressing and how it's used in wireless networks	1. Principles
	2. Request for comment (RFC) 1918
	3. Internet protocol (IP) version 6
	4. Internet protocol (IP) to Media access control (MAC) address mapping

III. Wi-Fi Standards and Transmission

Competency	Knowledge, Skills and Abilities
<p>A. Compare 802.11 Wi-Fi standards and the different transmissions methods of each standard</p>	<p>1. Wi-Fi standards in today’s cable networks</p>
	<p>2. Institute of Electrical and Electronics Engineers (IEEE) 802.11</p> <ul style="list-style-type: none"> a. 802.11a b. 802.11b c. 802.11g d. 802.11n e. 802.11ac f. 802.11ad
<p>B. Explain RF access methods</p>	<p>1. Wi-Fi</p>
	<p>2. Bluetooth</p>
	<p>3. Personal area network (PAN)</p>
<p>C. Define modulation types, channel selection and frequency bands</p>	<p>1. Modulation and access types</p>
	<p>2. Orthogonal frequency-division multiplexing (OFDM)</p>
	<p>3. Channel selection</p>
	<p>4. Frequency bands</p>

IV. Wi-Fi Radio Frequency (RF) Fundamentals

Competency	Knowledge, Skills and Abilities
<p>A. Recognize the properties of RF signals and explain the components needed to operate a wireless network</p>	1. Components of a wireless local area network (WLAN)
	2. Hardware and connection components
<p>B. Describe wavelength, amplitude and phase; and how these properties apply to wireless networks</p>	1. Wavelength
	2. Amplitude
	3. Phase
	4. RF properties used in wireless local area networks (WLANs)
<p>C. Distinguish between the causes of RF signal loss and explain how they affect wireless signal propagation</p>	1. Free Space Path Loss (FSPL)
	2. Absorption
	3. Reflection
	4. Scattering
	5. Refraction
	6. Diffusion
	7. Obstacles
	8. Multipath
<p>D. Describe Wi-Fi transmission modes and throughput</p>	1. Carrier-sense multiple access with collision avoidance (CSMA/CA)
	2. Half and full duplex
	3. Signal to noise ratio (S/N)

V. Antenna theory for Wi-Fi Networks

Competency	Knowledge, Skills and Abilities
A. Explain the properties of Wi-Fi signals	1. Electro-magnetic field (EMF)
B. Describe various antenna types and their common uses	1. Omni
	2. Patch
	3. Sector
	4. Parabolic
	5. Yagi
C. Evaluate the different antenna transmission characteristics and how they affect RF signals	1. Radiation pattern
	2. Gain and loss
	3. Diversity array
	4. Polarization
D. Calculate RF signal gain and loss	1. Calculate gain and loss
E. Describe the different types of multiple input, multiple output (MIMO)	1. Single user multiple input, multiple output (SU-MIMO)
	2. Multi user multiple input, multiple output (MU-MIMO)
F. Calculate equivalent isotropically radiated power (EIRP)	1. Equivalent isotropically radiated power (EIRP)

VI. Residential Wi-Fi Networks

Competency	Knowledge, Skills and Abilities
<p>A. Identify common wireless networks in the home</p>	1. Z-Wave
	2. ZigBee
	3. HomePlug
	4. Home Phoneline Networking Alliance (HPNA)
<p>B. Examine high level installation considerations</p>	<p>1. Cabling</p> <ul style="list-style-type: none"> a. Coax b. Twisted Pair (Ethernet)
<p>C. Define cabling standards</p>	<p>1. T568</p> <ul style="list-style-type: none"> a. T568A b. T568B
	<p>2. Universal service order codes (USOC)</p>

VII. Wireless LAN Implementation

Competency	Knowledge, Skills and Abilities
A. Describe the components of a wireless local area network (WLAN) topology	1. Basic service set (BSS)
	2. Extended service set (ESS)
B. Evaluate mesh networks as an alternative to repeaters	a. Wireless extended service set (ESS) or mesh
C. Demonstrate channel mapping concepts and reuse	1. 802.11 b/g <ul style="list-style-type: none"> a. 2.4 GHz Spectrum b. Channel Reuse
	2. 802.11 a/ac <ul style="list-style-type: none"> a. 5 GHz b. Channel Reuse
	3.
D. Differentiate wireless local area network (WLAN) framing types and explain the process of authentication and association	1. Management <ul style="list-style-type: none"> a. Authentication b. Association c. Beacon d. Probe e. Re-association
	2. Data frames
	3. Control frames <ul style="list-style-type: none"> a. ACK b. Request to send/clear to send (RTS/CTS)
	4. Authentication and association process

E. Explain the function of repeaters and extenders; describe detailed multiple input, multiple output (MIMO) and spatial streams concepts	1. Repeaters comparison
	2. Extenders comparison
	3. Multiple input, multiple output (MIMO) technologies <ul style="list-style-type: none"> a. Spatial Streams
F. Describe beamforming techniques	1. Maximum ratio combining (MRC)
	2. Transmit beamforming (TxBF)
	3. Spatial streams

VIII. WLAN Security & Common Threats

Competency	Knowledge, Skills and Abilities
A. Compare Wi-Fi encryption standards	1. Types of authentication <ul style="list-style-type: none"> a. Open b. Shared key c. Digital certificates
	2. Types of encryption <ul style="list-style-type: none"> a. Wired equivalent privacy (WEP) b. Wi-Fi protected setup (WPS) c. Wi-Fi protected access (WPA)
B. Describe Wi-Fi authentication	1. Authentication process
C. Identify common security threats	1. War driving
	2. Evil twin (Hijacking)
	3. De-authentication floods

IX. Installing Broadband Wireless

Competency	Knowledge, Skills and Abilities
A. List the steps to prepare for broadband wireless installation for cable networks	1. Gather requirements
	2. Document requirements
B. Demonstrate the information needed when gathering customer requirements	1. Understand customer requirements
	2. Both wired and wireless
	3. How will Wi-Fi be used?
	4. Site survey
C. Use information gathered for documenting existing networks	1. Existing equipment
	2. Types of networking equipment
	3. Other service providers in the home
D. Demonstrate the step-by-step procedures for installing equipment	1. Site survey
	2. Qualify drop
	3. Verify inside wiring
	4. Install cable modem
	5. Verify installation
	6. Educate customer
	7. Verify wireless services
	8. Connect to the Internet
	9. Review

<p>E. Demonstrate the procedures for installation of a wireless network</p>	<p>1. Single dwelling unit (SDU)</p> <ul style="list-style-type: none"> a. Follow Step-by-Step b. Multimedia over coax alliance (MoCA) installation
	<p>2. Multiple dwelling unit (MDU)</p> <ul style="list-style-type: none"> a. Check for interference
<p>F. Demonstrate the process for optimization of wireless networks</p>	<p>1. Planning</p> <ul style="list-style-type: none"> a. Latency b. Interference <ul style="list-style-type: none"> i. Wi-Fi ii. Non-Wi-Fi iii. Distance from access point (AP) iv. Objects
	<p>2. Antenna use</p> <ul style="list-style-type: none"> a. Signal to noise ratio (S/N) metrics
	<p>3. Change antenna type</p>
<p>G. Define power over Ethernet (PoE)</p>	<p>1. Power over Ethernet (PoE) basics</p>
	<p>2. Power over Ethernet (PoE) mid-span</p>
	<p>3. Power over Ethernet (PoE) wiring</p>
<p>H. Define protection mode and demonstrate how it pertains to a wireless local area network (WLAN) installation</p>	<p>1. 802.11g extended-rate physical (ERP)</p>
	<p>2. 802.11n high throughput (HT)</p>
	<p>1. Description</p>
	<p>2. Advantages</p>

I. Demonstrate knowledge of multimedia over coax alliance (MoCA)	3. Enhanced mode
	4. Turbo mode
	5. Implementing multimedia over coax alliance (MoCA)

X. Troubleshooting Wireless

Competency	Knowledge, Skills and Abilities
A. Review RF Fundamentals	1. Frequency
	2. Phase
	3. Wavelength
B. List Wi-Fi failures and their causes	1. High number of users
	2. Security mismatch
	3. Distance from access point (AP)
	4. Industrial, scientific and medical (ISM) band limitations
	5. Multipath

<p>C. Describe the wireless client connection process.</p>	<ol style="list-style-type: none"> 1. AP signaling 2. Probes and network selection 3. Authentication and association 4. Internet protocol (IP) assignments <ol style="list-style-type: none"> a. Verification
<p>D. Define the most common problems of wireless networks</p>	<ol style="list-style-type: none"> 1. Symptoms <ol style="list-style-type: none"> a. Intermittent Connectivity b. Decreased Throughput c. Weak Signal Strength d. Interference e. Hidden Nodes
<p>E. Demonstrate wireless optimization techniques</p>	<ol style="list-style-type: none"> 1. Specific network Situations <ol style="list-style-type: none"> a. Power b. Antenna gain c. Channel planning