



Wireless Network Technician - (WNT)

Competency Requirements

This competency listing is an identification of individual topics in which a network professional that is expected to obtain knowledge of the operation and maintenance of wireless networking concepts, RF and IR propagation and modulation technologies, which are applicable to all the various specialty areas of the wireless networking industry. This includes basic knowledge concepts of wireless communication systems and network architecture installation including applications of protocols and standards. This also includes service and skills applicable to all of the functions required to safely and completely install, secure, maintain, troubleshoot and provide support of wireless networking systems, data communications and electronic equipment. Prior comprehension of Radio Frequency (RF) knowledge is suggested, but not required.

Once the certified **Wireless Network Technician (WNT)** has acquired these skills and knowledge, the **WNT** will be able to enter employment in any part of the networking industry. Acquiring minimal training in areas unique to the specific products, the **WNT** should become a productive member of the networking industry workforce.

The **WNT** can be used as a Stand-Along ETA Certification or as the Journeyman Option specialty exam for the Certified Electronics Technician, CET. A **Wireless Network Technician** must be knowledgeable in the following technical areas:

1.0 Wireless Communication History and Regulation

- 1.1. Developments in wireless telegraphy
 - 1.1.1. Explain the relationship between the magnetic field and the electric field of a propagated electromagnetic wave
 - 1.1.1.1. Describe interference and mitigation techniques
 - 1.1.2. Describe the relationship between frequency and wavelength
 - 1.1.2.1. Selection of narrow band frequencies
 - 1.1.2.2. Selection of wide-band frequencies
 - 1.1.2.3. Frequency manipulation
- 1.2. Radio Frequency (RF) energy propagation
 - 1.2.1. Describe radio waves based upon their propagation characteristics
 - 1.2.2. Explain and identify basic radio system architecture
 - 1.2.2.1. Transmitter
 - 1.2.2.2. Receiver
- 1.3. Antenna characteristics
 - 1.3.1. Describe the radiated direction pattern produced by a transmitting antenna
 - 1.3.2. Explain gain and loss
- 1.4. Explain the term modulation
 - 1.4.1. List the differences between baseband, narrowband and wideband
 - 1.4.2. Describe the characteristics and attributes for three types of modulation
 - 1.4.2.1. Amplitude Modulation (AM)
 - 1.4.2.2. Frequency Modulation (FM)
 - 1.4.2.3. Phase Modulation
- 1.5. Infrared (IR) Frequency propagation
- 1.6. National Regulatory Management
 - 1.6.1. Explain the importance the Federal Communications Commission (FCC)
 - 1.6.2. Identify the differences in organizations that establish, maintain and publish standards for the national wireless communications industry
 - 1.6.2.1. American National Standards Institute (ANSI)
 - 1.6.2.2. Telecommunications Industry Association (TIA)
 - 1.6.2.3. Cellular Telecommunications & Internet Association (CTIA)
 - 1.6.2.4. Institute of Electrical and Electronic Engineers (IEEE)
 - 1.6.2.5. National Electrical Code® (NEC®)
 - 1.6.2.6. Occupational Safety and Health Administration (OSHA)
- 1.7. International Wireless Standards
 - 1.7.1. Distinguish how different international standards led to the formation of the European Telecommunications Standards Institute (ETSI)
 - 1.7.2. Explain the advantages for International standardization

- 1.7.3. Identify the reasons that led to the development of the Global System for Mobile Communications (GSM)
- 1.7.4. Describe the contributions the International Telecommunications Union (ITU) made to the International wireless community
 - 1.7.4.1. Differentiate between Sectors: ITU-R, ITU-T, and ITU-D
 - 1.7.4.2. World Radiocommunications Conferences (WRCs) of ITU-R
- 1.7.5. Explain the role of the International Organization for Standardization (ISO)

2.0 Wired and Wireless Network Architectures

- 2.1. Describe the different types of computer networks
 - 2.1.1. Local Area Network (LAN)
 - 2.1.2. Virtual Local Area Network (VLAN)
 - 2.1.3. Metropolitan Area Networks (MAN)
 - 2.1.4. Wide Area Networks (WAN)
 - 2.1.5. Storage Area Network (SAN)
 - 2.1.6. Body Area Networks (BAN)
- 2.2. Describe the following network services
 - 2.2.1. Differentiate between peer-to-peer versus server-based networks
 - 2.2.2. Compare the different network infrastructures and services available
 - 2.2.2.1. File sharing and file management
 - 2.2.2.1.1. Differentiate between data storage applications
 - 2.2.2.2. Peripheral integration and sharing
 - 2.2.2.3. Email
 - 2.2.2.4. Remote Access Servers (RAS)
 - 2.2.2.5. Communication and application servers
 - 2.2.2.5.1. Explain the different types of point-to-point proxy servers
- 2.3. Describe the different network topologies
 - 2.3.1. Mesh
 - 2.3.2. Bus
 - 2.3.3. Star
 - 2.3.4. Ring
 - 2.3.5. Hybrid
- 2.4. Discuss the Open Systems Interconnection model (OSI)
 - 2.4.1. List the layers of the OSI model
 - 2.4.2. Describe each layer of the OSI model
 - 2.4.3. Explain the function of each layer within the OSI model
 - 2.4.3.1. Explain how Wi-Fi™ systems use specific OSI layers to format data and control the data to conform with 802.11 standards

3.0 Wired and Wireless Network Protocols and Standards Management

- 3.1. Network Communication Protocols
 - 3.1.1. Describe knowledge of media access control (MAC) addresses - function and purpose
 - 3.1.1.1. Distinguish Organizationally Unique Identifier (OUI) MAC section
 - 3.1.1.2. Explain the basics of hexadecimal coding
 - 3.1.2. Explain common internet protocol (IP) addressing on LANs
 - 3.1.2.1. Explain dotted decimal notation
 - 3.1.3. Identify IPV4 and IPV6 addresses
 - 3.1.3.1. Explain how IPV4 and IPV6 are used for network connectivity
 - 3.1.4. Explain the functions and constraints of various network protocols
 - 3.1.4.1. Transmission Control Protocol (TCP)
 - 3.1.4.2. User Datagram Protocol (UDP)
 - 3.1.4.3. Sequenced Packet Exchange (SPX)
 - 3.1.4.4. File Transfer Protocol (FTP)
 - 3.1.4.5. Simple Mail Transfer Protocol (SMTP)
 - 3.1.4.6. Reverse Address Resolution Protocol (RARP)
 - 3.1.4.7. Layer 2 Tunneling Protocol (L2TP)
 - 3.1.4.8. Point-to-Point Tunneling Protocol (PPTP)
 - 3.1.4.8.1. Explain how a virtual private network (VPN) extends a private network across a public network using PPTP connections
 - 3.1.4.8.2. Differentiate between a VPN and a proxy server

- 3.1.4.9. Simple Network Management Protocol (SNMP)
- 3.1.4.10. Identify the differences and uses of HyperText Transfer Protocol (HTTP) and HyperText Transfer Protocol Secure (HTTPS)
- 3.2. Network Communication Media
 - 3.2.1. List the different types of wired media
 - 3.2.2. Determine the proper use of wired media for different network applications by:
 - 3.2.2.1. identifying the different types of twisted pair Ethernet cables and connectors
 - 3.2.2.2. identifying the differences in coaxial cables and connectors
 - 3.2.2.3. identifying the differences in optical fiber cables and connectors
 - 3.2.2.4. Explain how cable network providers use fiber-to-copper converters:
 - 3.2.2.4.1. Describe how an optical network terminator (ONT) works
 - 3.2.3. Describe the different types of wireless media
 - 3.2.4. Compare the classification differences in wireless media
 - 3.2.4.1. Terrestrial microwave
 - 3.2.4.1.1. List microwave frequencies
 - 3.2.4.2. Satellites
 - 3.2.4.2.1. Identify the advantages and differences between:
 - 3.2.4.2.1.1. Low Earth Orbit (LEO)
 - 3.2.4.2.1.2. Medium Earth Orbit (MEO)
 - 3.2.4.2.1.3. Geosynchronous Equatorial/Geostationary Orbit (GEO/GSO)
 - 3.2.4.3. Cellular
 - 3.2.4.3.1. Define codes that apply to cellular DAS installations
 - 3.2.4.4. IEEE wireless technologies
 - 3.2.4.4.1. 2.4 GHz frequency
 - 3.2.4.4.2. 5.8 GHz frequency
 - 3.2.4.4.3. 802.11 (WLAN/Wi-Fi™)
 - 3.2.4.4.4. 802.15.1 (Bluetooth®)
 - 3.2.4.4.5. 802.15.3 (mmWave PAN)
 - 3.2.4.4.6. 802.15.4 including (Low Rate WPAN) (Zigbee) (HART)
 - 3.2.4.4.7. 802.15.5 Mesh Networking
 - 3.2.4.4.8. 802.15.6 (BAN)
 - 3.2.4.4.9. 802.16 (WiMAX)
 - 3.2.4.4.10. Z-Wave® (Z-Wave® Alliance)
 - 3.2.4.5. Explain types of optical wireless communications
 - 3.2.4.5.1. Infrared (IR) light communications
 - 3.2.4.5.1.1. Summarize Infrared Data Association (IrDA) specifications
 - 3.2.4.5.2. Explain visible light communications
 - 3.2.4.5.3. Explain how Li-Fi (Visible Light Communication-VLC technology) can turn LED lamps into internet and data broadcast transmitters
- 3.3. Network Standards
 - 3.3.1. Explain the shared access technology involved with local area networking
 - 3.3.2. Explain Carrier Sense Multiple Access with Collision Detection (CSMA/CD)
 - 3.3.2.1. Define the terms 'backoff' and 'wirespeed' when used with CSMA/CD
 - 3.3.2.2. Explain why CSMA/CD is not needed in modern Ethernet networking
 - 3.3.3. Recognize the differences in the collection of IEEE 802.3 (Ethernet) standards
 - 3.3.4. Differentiate between 802.3 and 802.11 standards
 - 3.3.5. Explain the utilization and define 10/100/1000Base specifications

4.0 Wireless Networks

- 4.1. Cellular Network Intersystem Operation
 - 4.1.1. Identify cellular radio-communications intersystem operation standards and FCC licensing requirements
 - 4.1.2. Identify cellular network components
 - 4.1.3. Describe the operation capabilities of a mobile switching center
 - 4.1.4. Explain the importance of a home location register database

- 4.1.5. Explain when a visitor location register is used
- 4.1.6. List the equipment and functional elements used in a cellular base station
- 4.2. Network Communication Registration and Authentication
 - 4.2.1. Identify procedures used in the registration and authentication of a mobile station
 - 4.2.2. Describe the sequence of steps used in Cellular Authentication and Voice Encryption (CAVE) authentication
 - 4.2.3. List steps involved to ensure successful cellular network call processing
- 4.3. Mobile Network Management
 - 4.3.1. Describe the limitations of the TCP/IP suite in a mobile environment
 - 4.3.2. Compare the distinction between portable versus mobile IP addressing
 - 4.3.3. Explain the characteristics and functions of a mobile IP router
 - 4.3.4. Describe the general characteristics of Home Agent and Foreign Agent
 - 4.3.5. Explain the process of tunneling and encapsulation
 - 4.3.6. Describe the fundamental steps involved in managing registration and authentication of a mobile IP station
- 4.4. Wireless Local Area Networks (WLAN)
 - 4.4.1. Explain what a Service Set Identifier (SSID) is and how it is used
 - 4.4.2. Interpret knowledge of the basic functions of network devices:
 - 4.4.2.1. routers
 - 4.4.2.2. switches
 - 4.4.2.3. repeaters
 - 4.4.2.4. end-devices
 - 4.4.2.5. servers
 - 4.4.3. Explain the fundamental principles governing hubs, switches, routers and access points
 - 4.4.4. Explain the use of Orthogonal Frequency Division Multiplexing (OFDM) used in High Performance Radio Local Area Networks (HIPERLAN)
 - 4.4.5. Identify and compare differing characteristics between ETSI's HIPERLAN and IEEE 802.11 standards
 - 4.4.6. Explain and list the general characteristics for each 802.11a/b/g/n/ac/ad/ah/ax
 - 4.4.6.1. Explain the advantages and disadvantages of 2.4 GHz and 5GHz transmissions
 - 4.4.7. Describe IEEE 802.11i Robust Security Network (RSN) and Wi-Fi™ Protected Access (WPA) advantages for your net work
 - 4.4.8. Explain how to configure and utilize an Ad-hoc network
 - 4.4.9. Describe the principles and characteristics of Bluetooth® technology
 - 4.4.9.1. Explain Adaptive Frequency-Hopping (AFH)
 - 4.4.9.2. Identify characteristics of spread spectrum
 - 4.4.9.2.1. Differentiate between Frequency-Hopping Spread Spectrum (FHSS) and Direct-Sequence Spread Spectrum (DSSS)
 - 4.4.9.3. Describe Bluetooth® Low Energy (BLE) technology
 - 4.4.10. Explain the spread spectrum allocations used for unlicensed WLANs
 - 4.4.10.1. Identify how physical carrier sensing and virtual carrier sensing work
 - 4.4.11. Identify the principles and characteristics of Li-Fi (802.11bb) transmission technology

5.0 Wireless Broadband Networks

- 5.1. Broadband Network Communication
 - 5.1.1. Define and describe the term “Broadband Network”
 - 5.1.2. Explain the use of fiber optics cabling in broadband technology
 - 5.1.3. Explain the operational and physical differences between old telephony Digital Subscriber Line (DSL), Coaxial RG-6, twisted-pair and optical cabling
 - 5.1.4. Compare the functional difference between Integrated Services Digital Network (ISDN) and DSL
- 5.2. Multichannel Multipoint Distribution Service (MMDS)
 - 5.2.1. Define Multichannel Multipoint Distribution Service (MMDS)
 - 5.2.2. Describe the microwave propagation characteristic of a MMDS
 - 5.2.3. Explain the 12-sector MMDS cell plan
 - 5.2.4. Compare the different types of MMDS modulation methods
 - 5.2.5. Describe the available MMDS spectrum allocation

- 5.2.6. Compare the frequency band plans of the Multipoint Distribution Service (MDS), Instructional Television Fixed Service (ITFS), and MMDS
- 5.3. Local Multipoint Distribution Service (LMDS)
 - 5.3.1. Explain the operational characteristics of a LMDS
 - 5.3.2. Describe the frequency band plan for LMDS
 - 5.3.3. Explain the calculations used for system capacity in the LMDS band
- 5.4. Wireless Local Loop (WLL)
 - 5.4.1. Explain the difference between a copper-wired local loop and a WLL
 - 5.4.2. List the advantages of a WLL over a copper-wired local loop
 - 5.4.3. Describe the services offered through a WLL
- 5.5. Broadband Free-Space Optical System
 - 5.5.1. Describe a free-space optical system
 - 5.5.2. Explain the advantages of a free-space optical system over a closed broadband system
 - 5.5.3. Explain the bandwidth options provided by free-space optical networks
- 5.6. Identify the frequency bands assigned to fixed wireless service providers

6.0 Network Security

- 6.1. Identify key points required for a typical network enterprise disaster plan
- 6.2. Identify network security tools and procedures to:
 - 6.2.1. safeguard against virus attacks
 - 6.2.2. monitor activities
- 6.3. Describe backup tools used in safeguarding critical resources to include:
 - 6.3.1. software
 - 6.3.2. hardware
- 6.4. Describe Domain Name System (DNS) attack mitigations to include:
 - 6.4.1. Denial of Service (DoS)
 - 6.4.2. Distributed Denial of Service (DDoS)
 - 6.4.3. Define a “botnet” and what it can/may do
- 6.5. Explain the Secure Socket Layer (SSL) in network cybersecurity
- 6.6. Explain the purpose for wireless encryption keys
 - 6.6.1. Temporal Key Integrity Protocol (TKIP)
 - 6.6.2. Advanced Encryption Standard (AES)
 - 6.6.3. Counter Mode with Cipher Block Chaining Message Authentication Code Protocol (CCMP) (IEEE 802.11i)
- 6.7. Describe what Media Converters are and why they are needed
- 6.8. Define Remote Authentication Dial In User Service (RADIUS) protocol
 - 6.8.1. Explain why RADIUS is needed for IEEE 802.11F Inter-AP Protocol communications across distribution systems
- 6.9. Explain IEEE 802.1x and the Extensible Authentication Protocol (EAP) framework
- 6.10. Describe wireless network security protocols (IEEE 802.11i)
 - 6.10.1. Wi-Fi™ Protected Access (WPA3, WPA2 and WPA)
 - 6.10.1.1. Wired Equivalent Privacy (WEP)
 - 6.10.2. advantages of WPA3/WPA2 over WPA and WEP
 - 6.10.3. Robust Security Network (RSN)

7.0 Advanced Wireless Systems

- 7.1. Generations of Wireless Standards
 - 7.1.1. Describe the goal of the IMT-2000 and IMT-Advanced initiatives
 - 7.1.2. Summarize third (3G), fourth (4G) and fifth generation (5G) wireless standards
 - 7.1.2.1. Explain the advantages of newer generation wireless communications such as Long Term Evolution-Advanced (LTE-A) over the prior wireless/wired generations such as Global Packet Radio Service (GPRS)
 - 7.1.3. Identify current obstacles and challenges to deployment of 5G
 - 7.1.3.1. Explain Integrated Access and Backhaul
 - 7.1.3.2. Describe 5G concepts for consumers
 - 7.1.3.2.1. Describe ‘Wireless Broadband’ access for enhanced mobile use (enhanced mobile broadband: eMBB)
 - 7.1.3.2.2. Define ‘Ultra-Reliable Low Latency’ communications (URLLC)
 - 7.1.3.2.3. Explain Virtual Reality (VR) concepts
 - 7.1.3.2.4. Compare 3D TV and VR for consumers

- 7.1.3.2.5. Identify IoT devices using 5G (massive Machine Type Communications - mMTC)
- 7.1.4. Identify the key components of the Global System for Mobile communications (GSM)
 - 7.1.4.1. Explain how the Authentication Center (AuC) is used
 - 7.1.4.2. Identify the role of the Home Locator Register (HLR)
 - 7.1.4.3. Explain what how a Security Information Management (SIM) card is used
- 7.1.5. Explain differences of W-CDMA and CDMA2000 (Code Division Multiple Access)
- 7.1.6. Explain Authentication and Key Agreement (AKA) protocol and procedures that support entity authentication
 - 7.1.6.1. Describe how to use EAP and protected (PEAP) methods
 - 7.1.6.2. Identify security authentication methods used for 5G AKA and 5G EAP-AKA
- 7.1.7. Explain the operational characteristics of UWC-136 (Universal Wireless Communications): part of ITU: IMT-2000 Specification
- 7.2. Advanced Wireless Technologies
 - 7.2.1. Explain how the modulation techniques used in Orthogonal Frequency Division Multiplexing (OFDM) can reduce interference
 - 7.2.2. Explain how intersymbol interference (ISI) and delay spread can limit data transmission rates
 - 7.2.3. Describe the design features used in Ultra-Wideband (UWB) technology
 - 7.2.3.1. Differentiate between UWB characteristics and BLE
- 7.3. Identify the characteristics of near-field communication (NFC)
 - 7.3.1. Differentiate NFC versus UWB characteristics
- 7.4. Explain how Low Power, Wide Area (LPWA) networking technology protocols are used in IoT and Machine-to-Machine applications
 - 7.4.1. Differentiate between LoRa™ and NB-IoT
 - 7.4.2. Differentiate between NB-IoT and LTE-M

End of Wireless Network Competencies Listings; (with 7 major Categories)

Find An ETA Test Site:

https://www.etai.org/test_sites.html

Suggested Additional Wireless Study Material and Resources:

Useful WNT courses, white papers, discussion and videos can be found at the following web sites:

http://compnetworking.about.com/od/wireless/WiFi_Wireless_Networks_and_Technology.htm;
<https://www.techopedia.com/definition/26186/wireless-network>; <https://support.microsoft.com/en-us/windows/setting-up-a-wireless-network-97914e31-3aa4-406d-cef6-f1629e2c3721>;
<https://www.wi-fi.org/who-we-are>; www.sciencewriter.net; <https://www.lifewire.com/building-a-wireless-home-network-816562>;
<https://www.computernetworkingnotes.com/ccna-study-guide/types-of-wireless-network-explained-with-standards.html>; [LoRa Alliance®](https://www.lo-ranetworking.com/);
<https://www.sciencedirect.com/topics/computer-science/intersymbol-interference>;
https://www.tutorialspoint.com/digital_communication/index.htm; www.ieee.org;
https://grouper.ieee.org/groups/802/11/Reports/802.11_Timelines.htm

or by contacting ETA® International for other WNT resources: www.etai.org and 1-800-288-3824

Designing and Deploying 802.11 Wireless Networks, 2E; Geier; ISBN 978-1587144301; Cisco Press; 2015

LAN Wiring, 3E; Trulove; ISBN 978-0071459754; McGraw-Hill/TAB Electronics; 2006

Wireless Communication Networks and Systems; Beard, Stallings; ISBN 978-0133594171; Pearson; 2015

Computer Networks and Internets, 6E; Comer; ISBN 978-0133587937; Pearson, 2014

Telecommunications and Data Communications Handbook, 2E; Horak; ISBN 978-1-0470396070; Wiley-Interscience; 2008

Guide Design and Implement Local and Wide Area Networks, 3E; Palmer, Sinclair; ISBN 978-0619216115; Cengage Learning; 2019

Network Warrior, 2E; Donahue; ISBN 978-1449387860; O'Reilly Media, 2011

Wiring for Wireless Sites; Ira Wiesenfeld, P.E.; ISBN 978-1401810375; Thompson Delmar Learning; 2002; pp. 260

Practical Antenna Handbook, 5E; Joseph Carr & George (Bud) W. Hippisley; ISBN 978-0071639583; McGraw-Hill/Tab Electronics; 2011; pp.784

Modern Electronic Communication, 9E; Jeff Beasley & Gary M. Miller; ISBN 978-0132251136; Prentice Hall; 2007; pp.992

Handbook of Radio & Wireless Technology; Sam Gibilisco; ISBN 978-0070230248; McGraw-Hill Professional; 1999; pp.640

Telecom, Datacom and Networking for Non-Engineers; Coll; ISBN 978-1894887052; Teracom Training Institute; 2013

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