Wireless Network Technician – WNT
Competency Requirements

The Certified Wireless Network Technician is 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. Once the WNT has acquired these skills and knowledge, the technician will be able to enter employment in any part of the networking industry. With minimal training in areas unique to the specific products, the WNT should become a productive member of computer industry workforce. Candidates who are interested in taking the WNT exam are not required to pass the Associate, or basic electronics, exam.

1.0 History of Wireless Communication

- 1.1 Developments in Wireless Telegraphy
  - 1.1.1 Indentify advancements in wireless communications made by Guglielmo Marconi and Heinrich Hertz.
  - 1.1.2 Understand the importance of Sir John Fleming's Vacuum Tube contribution
  - 1.1.3 Describe Edwin Howard Armstrong's use of Fessenden's machine
  - 1.1.4 Explain how Lee DeForest's use of regenerative feedback proved to be beneficial in amplifiers
  - 1.1.5 Explain the development and use of Superheterodyne circuits
    - 1.1.5.1 Selection of narrow band frequencies
    - 1.1.5.2 Selection of wide-band frequencies
    - 1.1.5.3 Frequency manipulation
      - 1.1.5.3.1 Sum, difference and the two original frequencies
  - 1.1.6 Understand the limitation of an early Tuned Radio Frequency receiver
  - 1.1.7 Explain the differences between AVC and AGC
  - 1.1.8 Explain the development and use of different types of early modulation techniques
    - 1.1.8.1 Amplitude Modulation
    - 1.1.8.2 Frequency Modulation
- 1.2 National Regulatory Management
  - 1.2.1 Explain how the importance of losing the Titanic established the Radio Service Bureau in 1912
  - 1.2.2 List the four different electromagnetic spectrum divisions brought about by the Radio Wireless Act of 1912
  - 1.2.3 Explain the Communications Act of 1934
    - 1.2.3.1 Titles I, II, III , IV and V
    - 1.2.3.2 Federal Communications Commission
  - 1.2.4 Describe the Wireless Telecommunications Bureau (WTB)
  - 1.2.5 Identify the differences in organizations that establish, maintain and publish standards for the national Wireless Communications industry
    - 1.2.5.1 American National Standards Institute (ANSI)
    - 1.2.5.2 Telecommunications Industry Association (TIA)
    - 1.2.5.3 Cellular Telecommunications & Internet Association (CTIA)
    - 1.2.5.4 Institute of Electrical and Electronic Engineers (IEEE)
    - 1.2.5.5 National Telecommunications and information Administration (NTIA)
      - 1.2.5.5.1 Office of Spectrum Management (OSM)
  - 1.2.6 Explain the major changes that occurred in the telecommunications regulatory environment from 1980 to 1996
    - 1.2.6.1 AT&T
    - 1.2.6.2 Electronic communications Privacy Act of 1986
    - 1.2.6.3 Cellular Telephones
    - 1.2.6.4 Radio paging
    - 1.2.6.5 Customer records and confidentiality
    - 1.2.6.6 Satellite transmissions
    - 1.2.6.7 Telecommunications Act of 1996
      - 1.2.6.7.1 Telephone Service
      - 1.2.6.7.2 Telecommunications Equipment manufacturing

1.2.6.7.3 Cable television
1.2.6.7.4 Radio and television broadcasting
1.2.6.7.5 The Internet and online computer services

1.3 International Wireless Standards
1.3.1 Understand how different international standards lead to the formation of the European Telecommunications Standards Institute (ETSI)
1.3.2 Explain the advantages for International standardization
1.3.3 Indentify the reasons that led to the development of the Global System for Mobile Communications (GSM)
1.3.4 Describe the contributions the International Mobile Telecommunications (ITU) made to the International wireless community
1.3.4.1 World Radio Communications Conferences (WRCs)
1.3.5 Explain what led to the formation of the International Organization for Standardization (ISO) in 1947

1.4 Maritime Wireless Telecommunications Standards
1.4.1 Explain how Title 47, Code of Federal Regulations, Part 80 regulates all use of radio onboard foreign or domestic vehicles in U.S. ports and water
1.4.2 Explain the importance of the International Maritime Organization (IMO)
1.4.3 Understand the composition of the Global maritime Distress and Safety System
1.4.3.1 Terrestrial radio communications systems
1.4.3.2 Satellite radio communications systems
1.4.3.2.1 NAVTEX
1.4.3.2.2 COSPAS-SARSAT
1.4.3.2.3 Inmarsat

2.0 Wired Network Architectures

2.1 Computer Networks
2.1.1 Define the functions of a computer network
2.1.2 Describe the different types of computer networks:
2.1.2.1 Local Area Networks (LAN)
2.1.2.2 Metropolitan Area Networks (MAN)
2.1.2.3 Wide Area Networks (WAN)
2.1.2.4 Storage Area Network (SAN)

2.2 Network Services
2.2.1 Explain the differences between peer-to-peer vs. server-based networks
2.2.2 Compare the different network infrastructures and services available
2.2.2.1 File sharing and file management
2.2.2.2 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

2.3 Network Topologies
2.3.1 Describe the different network topologies
2.3.1.1 Mesh
2.3.1.2 Bus
2.3.1.3 Star
2.3.1.4 Ring
2.3.1.5 Hybrid

2.4 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 Understand the function of each layer within the OSI model

3.0 Wired and Wireless Network Protocols and Standards

3.1 Network Communication Protocols
3.1.1 Explain the functions and constraints of various network protocols
3.1.1.1 Transmission Control Protocol (TCP)
3.1.1.2 User Datagram Protocol (UDP)

- 3.1.1.3 Sequenced Packet Exchange (SPX)
- 3.1.1.4 File Transfer Protocol (FTP)
- 3.1.1.5 Simple Mail Transfer Protocol (SMTP)
- 3.1.1.6 Reverse Address Resolution Protocol (RARP)
- 3.1.1.7 Layer 2 Tunneling Protocol (L2TP)
- 3.1.1.8 Point-to-Point Tunneling Protocol (PPTP)
- 3.1.1.9 Simple Network Management Protocol (SNMP)

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 applications
- 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
  - 3.2.4.2 Satellites
  - 3.2.4.3 Cellular
  - 3.2.4.4 Infrared

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)
- 3.3.3 Define the terms backoff and wirespeed when used with CSMA/CD
- 3.3.4 Understand the differences in the collection of IEEE 802.3 standards
- 3.3.5 Compare the differences between 802.3 and 802.11 standards
- 3.1.6 Explain the utilization and define 10/100/1000Base specifications

4.0 Radio Communications Fundamentals

4.1 Electromagnetic Spectrum
- 4.1.1 Describe a transverse electromagnetic wave
- 4.1.2 Explain the relationship between the magnetic field and the electric field of a propagated electromagnetic wave
- 4.1.3 Describe the relationship between frequency and wavelength
- 4.1.4 Explain the purpose of using the powers of ten to express calculated values of frequency and wavelength
- 4.1.5 Describe the procedure for calculating and converting wavelength to meters and feet
- 4.1.6 Identify the ITU standard names used for section allocation of the radio spectrum

4.2 Radio Frequency Propagation
- 4.2.1 Identify radio waves based upon their propagation characteristics
  - 4.2.1.1 Ground waves
  - 4.2.1.2 Sky waves
  - 4.2.1.3 Line of sight waves
- 4.2.2 Describe the use of the Decibel and logarithms to calculate power and voltage
- 4.2.3 Explain the characteristic and differences in propagation problem areas
  - 4.2.3.1 Interference
  - 4.2.3.2 Path loss
  - 4.2.3.3 Atmospheric effects
  - 4.2.3.4 Fading and Multipath
  - 4.2.3.5 Fresnel zones
  - 4.2.3.6 Ground Curvature
- 4.2.4 Describe the mathematical relationship between distance and horizon when working with the earth's curvature
  - 4.2.4.1 Antenna heights
  - 4.2.4.2 Link budgets
- 4.2.5 Explain and identify basic radio system architecture
  - 4.2.5.1 Transmitter
  - 4.2.5.2 Receiver

4.3 Antenna characteristics
- 4.3.1 Describe the radiated angular direction pattern produced by a transmitting antenna
- 4.3.2 Explain the gain for an isotropic radiator
- 4.3.3 List three common types of microwave antenna feed assemblies

- 4.3.4 Describe the operating principles behind phased array antennas
- 4.4 Modulation Basics
  - 4.4.1 Explain the term modulation
  - 4.4.2 List the differences between baseband, narrowband and wideband
  - 4.4.3 Describe the characteristics and attributes for three types of modulation
    - 4.4.3.1 Amplitude modulation
    - 4.4.3.2 Frequency modulation
    - 4.4.3.3 Phase modulation
  - 4.4.4 Compare the differences between channel spacing and channel bandwidth
  - 4.4.5 Describe the differences between simplex, half duplex and full duplex
- 4.5 Digital modulation
  - 4.5.1 Describe the principles and fundamental concepts for Amplitude Shift Keying (ASK)
  - 4.5.2 Explain how Phase Frequency Shift Keying (PFSK) can improve overall quality of a transmission
  - 4.5.3 Explain the theory used in Phase Shift Keying (PSK)
  - 4.5.4 List the advantages of Quadrature Amplitude Modulation (QAM)
  - 4.5.6 Explain the use of voice compression and voice compression bit rates

5.0 Cellular Radio

- 5.1 Early Design of Mobile Radio Systems
  - 5.1.1 Describe the difficulties that delayed the introduction of cellular communication in the U.S.
  - 5.1.2 Identify when the first U.S Mobile Telephone Service (MTS) was developed to provide a Public Switched Telephone Network for wireless mobile subscribers
  - 5.1.3 Explain the goals for a cellular radio network
- 5.2 Cellular Radio Architecture
  - 5.2.1 Describe the characteristics for the separate components of cellular radio architecture:
    - 5.2.1.1 Mobile Switching Center (MSC)
    - 5.2.1.2 Home Location Register (HLR)
    - 5.2.1.3 Visitor Location Register (VLR)
    - 5.2.1.4 Authentication Center (AuC)
    - 5.2.1.5 Cellular Base Station Transceiver
    - 5.2.1.6 Base Station Controller
    - 5.2.1.7 Mobile Stations
  - 5.2.2 Define cellular reuse pattern
  - 5.2.3 Describe between cell size and carrier-to-interference ratio
  - 5.2.4 Explain the concept of cell sizing, sectoring and a 7-cell reuse factor
  - 5.2.5 Explain the principles and characteristics for the three main access protocols
    - 5.2.5.1 Frequency Division Multiple Access (FDMA)
    - 5.2.5.2 Time Division Multiple Access (TDMA)
    - 5.2.5.3 Code Division Multiple Access CDMA)
  - 5.2.6 Explain the signaling format used in Advanced Mobile Phone Service (AMPS)
  - 5.2.7 Explain identification number formats used in mobile handsets
  - 5.2.8 Explain the principles behind paired channels and frequency offset
  - 5.2.9 Describe the phases of communication within the AMPS call process
  - 5.2.10 Identify the differences between forward and reverse link channels
- 5.3 Personal Communications Services
  - 5.3.1 Explain the characteristic differences between cellular and Personal Communication Services (PCS)
  - 5.3.2 Explain the fundamentals of Global Cellular and PCS frequency bands
  - 5.3.3 Compare the differences between Global System for Mobile Communication (GSM) standards
    - 5.3.3.1 GSM 400
    - 5.3.3.2 GSM 900
    - 5.3.3.3 GSM 1800
    - 5.3.3.4 GSM 1900
  - 5.3.4 Explain the difference between traffic channels and control channel
  - 5.3.5 Explain how to calculate gross bits and net bit rates for a GSM frame
  - 5.3.6 Explain CDMA and Spread Spectrum principles

5.3.7 Describe the fundamental characteristics of the four Spread Spectrum methods
5.3.7.1 Direct Sequence Spread Spectrum (DSSS)
5.3.7.2 Frequency-Hopping Spread Spectrum (FHSS)
5.3.7.3 Time-Hopped spread Spectrum (THSS)
5.3.7.4 Chirped FM Pulsed Spread Spectrum (CFMPSS)
5.3.8 Explain CDMA modulation and rate adaptation
5.3.9 Describe the process utilized for demodulation and dispreading of the CDMA carrier
5.3.10 Compare CDMA handoff, soft handoff and control functions

6.0 Wireless Networks

6.1 Cellular Network Intersystem Operation
6.1.1 Identify cellular radio-communications intersystem operation standards and FCC licensing requirements
6.1.2 Identify cellular network components
6.1.3 Describe the operation capabilities of a mobile switching center
6.1.4 Explain the importance of a home location register database
6.1.5 Explain when a visitor location register is used
6.1.6 List the equipment and functional elements used in a cellular base station
6.2 Network Communication Registration and Authentication
6.2.1 Identify the procedures used in the registration and authentication of a mobile station
6.2.2 Describe the sequence of steps used in Cellular Authentication and Voice Encryption (CAVE) authentication
6.2.3 List steps involved to ensure successful cellular network call processing
6.3 Mobile Network Management
6.3.1 Describe the limitations of the TCP/IP suite in a mobile environment
6.3.2 Explain the differences between IPv4 and IPv6
6.3.3 Compare the distinction between portable vs. mobile IP addressing
6.3.4 Explain the characteristics and functions of a mobile IP router
6.3.5 Describe the general characteristics of Home Agent and Foreign Agent
6.3.6 Explain the process of tunneling and encapsulation
6.3.7 Identify and understand the fundamental steps involved in registration and authentication of a mobile IP station
6.4 Wireless Local Area Networks
6.4.1 Explain the spread spectrum allocations used for unlicensed Wireless Local Area Networks (WLAN)
6.4.2 Explain the use of Orthogonal Frequency Division Multiplexing used in High Performance Radio Local Area Networks (HIPERLAN)
6.4.3 Identify and compare differing characteristics between HIPERLAN and 802.11 standards
6.4.5 Explain and list the general characteristics for 802.11a/b/g/n
6.4.6 Describe the advantages of WPA2 over WPA and WEP
6.4.7 Explain how to configure and utilize an Ad-hoc network
6.4.8 Explain the fundamental principles governing hubs, switches, routers and access points
6.4.9 Describe the principles and characteristics of Bluetooth technology

7.0 Wireless Broadband Networks

7.1 Broadband Network Communication
7.1.1 Describe and define the term broadband network
7.1.2 Explain the use of Fiber-optics in broadband technology
7.1.3 Explain the operational and physical differences between Digital Subscriber Line (DSL) and cable
7.1.4 Compare the functional difference between Integrated Services Digital Network (ISDN) and DSL
7.2 Multichannel Multipoint Distribution Service
7.2.1 Define Multichannel Multipoint Distribution Service (MMDS)
7.2.2 Describe the microwave propagation characteristic of a MMDS
7.2.3 Explain the 12-sector MMDS cell plan
7.2.4 Compare the different types of MMDS modulation methods
7.2.5 Describe the available MMDS spectrum allocation

- 7.2.6 Compare the frequency band plans of the Multipoint Distribution Service (MDS), Instructional Television Fixed Service (ITFS), and MMDS.

7.3 Local Multipoint Distribution Service
- 7.3.1 Explain the operational characteristics of a Local Multipoint Distribution Service (LMDS)
- 7.3.2 Describe the frequency band plan for LMDS
- 7.3.3 Explain the calculations used for system capacity in the LMDS band

7.4 Wireless Local Loop
- 7.4.1 Explain the difference between a copper-wired local loop and a wireless local loop (WLL)
- 7.4.2 List the advantages of a WLL over a copper-wired local loop
- 7.4.3 Describe the services offered through a WLL

7.5 Broadband Free-Space Optical System
- 7.5.1 Describe a Free-space optical system
- 7.5.2 Describe the advantages of a Free-space optical system over a closed broadband system
- 7.5.3 Explain the bandwidth options provided by free-space optical networks.

8.0 Satellite Communications Systems

8.1 Basics of Satellite Communication
- 8.1.1 Define the functions a satellites systems three basic subsystems
  - 8.1.1.1 Space segment
  - 8.1.1.2 Earth station segment
  - 8.1.1.3 Ground

8.2 Satellite Orbits
- 8.2.1 Describe different types of Earth orbits
- 8.2.2 Compare the elements of an Earth orbit
  - 8.2.2.1 Perigee
  - 8.2.2.2 Apogee
  - 8.2.2.3 Ascending node
  - 8.2.2.4 Descending node
- 8.2.3 Explain the functions of a geostationary satellite orbit and a geosynchronous satellite orbit
- 8.2.4 Explain the differences between a Low Earth Orbit (LEO) and Medium Earth Orbit (MEO)
- 8.2.5 Explain the operational characteristics of Polar Orbit (PO) satellite
- 8.2.6 Determine the distance from the Earth to a satellite using time-lapse and speed of light calculations

8.3 Satellite Frequency Utilization
- 8.3.1 Explain how the FCC Code of Federal Regulations, Title 47, Part 25 regulates frequency band utilization satellite communication
- 8.3.2 Describe the functions and operation characteristics of the Fixed Satellite Service (FSS)
- 8.3.3 List the two main categories of spectrum allocation for the Mobile Satellite Service (MSS)
- 8.3.4 Explain the purpose of the Radio Determination Satellite Service (RDSS)
- 8.3.5 Describe the principle behind satellite band frequency reuse

8.4 Satellite Design elements and features
- 8.4.1 Describe the main elements and their functions of satellite system bus architecture
- 8.4.2 Describe the two types of attitude control used in satellite stabilization

8.5 Terrestrial Satellite Stations
- 8.5.1 List the advantages for the use of parabolic dishes and an associated array for satellite Earth stations
- 8.5.2 Explain the formulas used to calculate antenna gain for satellite Earth stations
- 8.5.3 Explain the features that determine the bandwidth of a parabolic antenna
- 8.5.4 Explain the calculations used to determine the beamwidth of a satellite Earth Station
- 8.5.5 Explain the term dual-polarization in conjunction with antenna feed system of a satellite earth station

8.6 Global Positioning System
- 8.6.1 Explain the importance of a Global Positioning System (GPS)
- 8.6.2 Explain the functional characteristics of a Global Positioning System (GPS)
- 8.5.2 List the operational differences between the Russian Global Navigation Satellite System and the U.S. Global Positioning System

9.0 Advanced Wireless Systems

- 9.1 Third Generation and Fourth Generation Wireless Standards
  - 9.1.1 Describe the goal of the IMT-2000 and IMT-Advanced initiatives
  - 9.1.2 Describe third generation (3G) and fourth generation (4G) wireless standards
  - 9.1.3 Explain the advantages of 4G wireless over 3G communication
  - 9.1.4 Identify the differences of W-CDMA and CDMA2000
  - 9.1.5 Explain the operational characteristics of UWC-136
- 9.2 Advanced Wireless Technologies
  - 9.2.1 Explain the modulation techniques used in Orthogonal Frequency Division Multiplexing (OFDM)
  - 9.2.2 Explain how intersymbol interference and delay spread can limit data transmission rates
  - 9.2.3 Describe the design features used in Ultra-Wideband (UWB) technology
  - 9.2.4 Explain the functional characteristics of the Teledesic Satellite Network

End of Wireless Network Competencies Listings (with 9 major Categories)

Course suggested prerequisite: Associate C.E.T. or equivalent

Notes:

The purpose in distributing the above Competencies list is to provide a detailed syllabus for electronics educational institutions and instructors. Also to go further and explain what the student should be able to do with each of the items included in the Categories and Competencies listings.

Find An ETA Test Site:

http://www.eta-i.org/testing.html

Suggested Study Material and Resources:

Maintaining & Repairing PCs,5E; Brooks; ISBN 978-0132409810; Prentice Hall, 2006;
-Available through ETA at 800-288-3824 or online at http://www.eta-i.org/

Enhanced Wireless Networking Certification; Max Main; ISBN 978-0130930156; Prentice Hall, 2002

Network+ Guide to Networks; Dean; ISBN 978-1423902454; Course Technology; 2009

Guide Design and Implement Local and Wide Area Networks, 3E; Palmer, Sinclair; ISBN 978-0619216115; Course Technology; 2009

Mastering LANs; Anderson, Minasi; ISBN 978-0782122589; Sybex, Inc.; 1999

Communications Systems and Networks; Horak, Miller; ISBN 978-1558514850; M & T Books; 1996

Troubleshooting, Maintaining & Repairing PCs, 5E; Bigelow; ISBN 978-0072132724; Osborne/McGraw-Hill; 2001

LAN Wiring; Trulove; ISBN 978-0071459754; McGraw-Hill/TAB Electronics

Upgrading and Repairing PCs, 20E; Mueller; ISBN 978-0789747105; Que Publishing, 2011

Network Warrior; Donahue; ISBN 978-059611510; O'Reilly Media, 2007

Computer Networks and Internets, 5E; Comer; ISBN 978-0136066989; Prentice Hall, 2008

Designing and Deploying 802.11n Wireless Networks; Geier; ISBN 978-1587058899; Cisco Press; 2010

please see numerous white papers available from various sources
http://compnetworking.about.com/od/wireless/WiFi_Wireless_Networks_and_Technology.htm

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