IEEE WCET (Wireless Certification): AREAS OF EXPERTISE

Area 1 - RF Engineering, Propagation, & Antennas

Tasks:

01.01 Calculate link budgets to evaluate system performance and reliability based on received signal level and fade margin (examples might include satellite, microwave link, base station to mobile station, wireless LAN, PAN, and free space optics).

01.02 Calculate path loss for various RF transmission systems (examples might include between isotropic or dipole reference antennas, base station to mobile station, base station to repeater, earth station to satellite, LOS/NLOS paths, and clutter losses) and under varying atmospheric conditions (examples might include inversion layers, ducting, and variations in K factor).

01.03 Evaluate the effects of different fading models (examples might include Rayleigh and lognormal) and empirical path loss models on the received signal strength in various signal propagation environments (examples might include flat terrain, rolling hills, urbanized areas, and indoor environments [such as buildings or tunnels] with losses caused by walls, ceilings, and other obstructions).

01.04 Calculate and evaluate the effects on the received signal of path-related impairments, such as Fresnel Zone blockage, delay spread, and Doppler shift of a signal received by a moving receiver.

01.05 Calculate the polarization mismatch loss for various antenna systems (examples might include fixed microwave systems, cellular and mobile radio systems, and satellite systems).

01.06 Evaluate receive diversity gain for selection, equal gain, and maximal ratio diversity system configurations.

01.07 Determine parameters related to antennas or antenna arrays (examples might include pattern, beamwidth, gain, distance from an antenna or array at which far field conditions apply, spacing, beam forming, tilt, and sectorization) and analyze the effects of these parameters on coverage.

01.08 Determine appropriate antenna spacing at base station sites to prevent inter-system and intra-system interference effects, taking into account required radiation patterns and mutual coupling effects.

01.09 Generate and evaluate coverage and interference prediction maps for cellular, mobile radio, WLAN, and similar systems.

01.10 Develop a procedure to optimize the coverage of a radio system using propagation modeling and “drive test” measurements.

01.11 Develop a block diagram of an RF system (examples might include cellular, land mobile, and WLAN) employing standard modules (examples might include filters, couplers, circulators, and mixers) and/or use lumped or distributed matching networks, microstrips, and stripline.

01.12 Make RF system measurements (examples might include swept return loss to determine antenna system performance, transmitter output power [peak or average, as appropriate], signal-to-noise ratio at a receiver front end, and co-channel and adjacent channel interference for specific types of signal spectra).

Knowledge of:

01.00.01 different types of losses (examples might include transmission line loss, antenna gain, connector losses, and path loss)

01.00.02 procedures to calculate antenna gain and free space path loss

01.00.03 statistical fading models and distance-power (path loss) relationships in different propagation environments

01.00.04 the effects of outdoor terrain and indoor structures such as walls, floors, and ceilings on signal propagation

01.00.05 indoor and outdoor coverage calculation and verification techniques

01.00.06 Es/N0, EB/N0, RSSI, NF, and other system parameters

01.00.07 the relationship between receiver noise figure, noise temperature, and receiver sensitivity and the relationship between sensitivity under static conditions and the degradation of effective receiver sensitivity caused by signal fading in different propagation conditions

01.00.08 external noise sources and their impact on the S/N ratios of received signals, and of techniques for measuring the impact of external noise

01.00.09 basic antenna system design and use including antenna types (examples might include omnidirectional, panel, parabolic, dipole array, indoor antennas), antenna patterns, gain and ERP, antenna size, antenna polarization, receive and transmit diversity (examples might include MIMO) antenna systems, and proper antenna installation to provide for coverage, interference mitigation, and frequency reuse

01.00.10 adaptive antenna methods and techniques

01.00.11 subscriber unit, mobile, and device antennas and their performance characteristics

01.00.12 use of test equipment such as network analyzers, spectrum analyzers, and TDRs

01.00.13 co-channel and adjacent channel interference analysis and measurement methods and techniques

01.00.14 filters, power dividers, combiners, and directional couplers

Area 2 - Wireless Access Technologies

Tasks:

02.01 Analyze multiple access schemes for various technologies.

02.02 Analyze spectrum implications in wireless access system design (examples might include applications, TDD/FDD, inter-modulation, LOS/NLOS, coverage/capacity).

02.03 Analyze design considerations and perform system design to eliminate coverage holes and to optimize capacity/coverage in urban/indoor areas.

02.04 Design a wireless access system (examples might include AP placement and channel selection) according to given bandwidth requirements, coverage, and other considerations.

02.05 Test devices with respect to interference issues in various operating environments (examples might include TDMA, CDMA, WCDMA, WLAN, 802.15).

02.06 Perform co-location interference analysis for systems (examples might include TDMA, CDMA, WCDMA, WLAN, 802.15, and GSM).

02.07 Compute the required bandwidth for a wireless system given certain network conditions (examples might include BER, flow count, and protocols in use).

02.08 Analyze the tradeoffs (examples might include bandwidth versus BER) of various error detection and correction techniques.

02.09 Analyze the tradeoffs (examples might include bandwidth versus power efficiency) and capacity implications of various power control schemes.

02.10 Calculate frequency re-use factor.

02.11 Design fundamental elements/attributes of wireless network systems (examples might include cellular, 802.16, WLAN, and satellite).

02.12 Analyze the steps involved in the process of handoff for various wireless systems (examples might include UMTS, CDMA2000, 802.16, and WLAN).

Knowledge of:

02.00.01 multiple access and multiplexing schemes (examples might include TDMA, CDMA, OFDMA, FDMA, and SDMA)

02.00.02 technology standards and their evolution (examples might include WCDMA, CDMA2000, 802.11, 802.15, and 802.16)

02.00.03 error detection and correction techniques

02.00.04 objectives of power-control schemes and their operation

02.00.05 handoff/mobility management

02.00.06 paging functions

02.00.07 the major components of a wireless network topology

Area 3 - Network and Service Architecture

Tasks:

03.01 Analyze service platforms including service enablers (examples might include messaging and positioning) and service creation/delivery (examples might include Open Service Access and Parlay).

03.02 Analyze IP addressing schemes for various technologies (examples might include Mobile IP, IPv4, and IPv6).

03.03 Design and test quality of service (QoS) (examples might include design and plan for adequate resources, selecting priority schemes, queuing strategies, and call administration control) for VoIP and IMS-based services.

03.04 Select and test a load-balancing scheme.

03.05 Analyze IP routing (examples might include interpreting an IP routing table).

03.06 Analyze ad hoc routing and mesh protocols, and suitability for various deployment scenarios.

03.07 Perform capacity planning using traffic engineering principles.

03.08 Perform error tracking and trace analysis on protocol control messages for specific systems.

03.09 Analyze the evolution of mobile networks to enable IP multimedia services (including circuit-switched to packet-switched network evolution).

03.10 Analyze intra- and inter-domain roaming.

03.11 Analyze the functioning of TCP/IP major transport protocols (examples might include TCP, UDP, and RTP) in the context of wireless communications.

Knowledge of:

03.00.01 IMS (IP multimedia subsystems) and its architecture, including session control and switching plane

03.00.02 VoIP/IP-multimedia protocols

03.00.03 wireless service enablers evolution

03.00.04 location and positioning techniques

03.00.05 load balancing principles in the context of wireless communications

03.00.06 IP routing and mobile IP networking and addressing schemes

03.00.07 error tracking and trace analysis techniques

03.00.08 circuit switched and packet switched data and packet cellular networks and the differences between them

03.00.09 roaming and roaming controls

03.00.10 TCP/IP including transport protocols

Area 4 - Network Management and Security

Tasks:

04.01 Design a fault monitoring system (examples might include using SNMP TRAP/NOTIFICATION).

04.02 Design a performance monitoring system (examples might include using SNMP GET/SET).

04.03 Develop/specify types and methods of alarm reporting for an installation.

04.04 Compute availability and reliability metrics from both the “network performance” and “system designer” perspectives (related to equipment failure).

04.05 Assess the potential impacts of known security attacks on wireless systems (examples might include virus, worm, DoS, and impersonation).

04.06 Plan corresponding solutions to known security attacks.

04.07 Monitor, log, and audit security-related data.

04.08 Analyze security vulnerabilities and prepare/recommend corrective actions.

Knowledge of:

04.00.01 quality of service (QoS) monitoring and control

04.00.02 fault management

04.00.03 configuration management

04.00.04 authentication, authorization, and accounting (AAA) principles and mechanisms

04.00.05 types of security attacks on wireless networks

04.00.06 protocols to secure wireless networks

04.00.07 security-violation events logging and monitoring

04.00.08 security issue management and resolution

04.00.09 network management protocols (examples might include simple network management protocol [SNMP])

04.00.10 performance metrics pertinent to various access networks

04.00.11 IP security, Encapsulation Security Payload (ESP), Internet Key Exchange, and digital signature

04.00.12 MIB, RMON, and Internet Control Messaging Protocol (ICMP)

04.00.13 Intrusion Detection Systems, DDoS Attacks, and traceback techniques

Area 5 - Facilities Infrastructure

Tasks:

05.01 Determine the power consumption of a unit of communications equipment.

05.02 Determine the power consumption for a facility containing communications equipment.

05.03 Analyze the electrical protection requirements (includes grounding/earthing, bonding, shielding, and lightning protection) and design the electrical protection layout for a wireless telecommunications facility.

05.04 Determine the required antennas for the facility and their required positions on a structure.

05.05 Coordinate with other users when implementing a communications system in a shared location.

05.06 Develop a specification for the required structure for a wireless base station facility based on the required antenna sizes and elevations above ground.

05.07 Determine the required cable, antennas, and materials to implement an in-building wireless network.

05.08 Determine the required number of racks on which to mount the equipment and the rack layout and placement, taking into account the maintainability of the equipment.

05.09 Evaluate equipment compliance with industry standards, codes, and site requirements such as NEBS specifications, and ANSI, ETSI, IEC, and other applicable standards.

Knowledge of:

05.00.01 procedures to determine the power consumption of wireless communications equipment

05.00.02 how to determine the power required to support a site

05.00.03 the application of AC and DC power systems

05.00.04 the application of alternative energy sources to wireless communications facilities

05.00.05 heating, ventilation, and air conditioning (HVAC) requirements

05.00.06 equipment racks, rack mounting spaces, and related hardware

05.00.07 electrical protection (including grounding/earthing, bonding, shielding, and lightning protection)

05.00.08 basic waveguides and transmission lines

05.00.09 tower specifications and standards

05.00.10 physical security requirements

Area 6 - Agreements, Standards, Policies, and Regulations

Tasks:

06.01 Assess service and equipment quality.

06.02 Prepare specifications for purchasing services and equipment, and evaluate the responses.

06.03 Verify compliance with regulatory requirements (examples might include licensing, standards, rules, and regulations).

06.04 Select and analyze frequency assignments.

06.05 Perform standardized homologation tests as required by regulatory or standardization bodies.

06.06 Evaluate compliance with health, safety, and environmental requirements.

06.07 Perform conformance/interoperability analyses of systems and components.

06.08 Analyze the use of licensed vs. unlicensed spectrum.

06.09 Obtain licenses and permits where required.

Knowledge of:

06.00.01 regulatory requirements (examples might include international, national, and local)

06.00.02 spectrum licensing

06.00.03 spectrum characteristics, availability, and management

06.00.04 local and site-specific rules and regulations

06.00.05 electrical safety (examples might include UL, EC, CSA, and IEEE C.95)

06.00.06 frequency assignment databases and online tools

06.00.07 modulation anomalies (examples might include cross modulation, modulation products, harmonics, and quantization impact)

06.00.08 health, safety, and environmental issues

06.00.09 equipment type approval processes/requirements

Area 7 - Fundamental Knowledge

Knowledge related to electrical engineering

00.00.01 fundamental AC/DC circuit analysis

00.00.02 mathematics including probability, statistics, and Boolean arithmetic

00.00.03 operation of complex test instruments, including oscilloscopes, spectrum analyzers, network analyzers, TDRs, and signal generators

00.00.04 Fourier frequency spectrum and transforms

00.00.05 basic printed circuit board design considerations

00.00.06 transmission theory and lines, antennas, basic optics, and basic electromagnetic wave theory and applications

00.00.07 power calculations (examples might include dB, dBm, and dBx)

00.00.08 basic concepts of queuing theory and traffic analysis

00.00.09 basic signal processing (examples might include analog, digital, and statistical)

00.00.10 basic concepts related to optical communications

00.00.11 basic electronic system-level block diagrams

00.00.12 basic power supply design

Knowledge related to communication systems

00.00.13 basic communication and information theory (analog and digital)

00.00.14 basic telephony (including signaling, switching, and transmission)

00.00.15 noise impairments

00.00.16 basic EMI, EMC, and interference

00.00.17 frequency allocations and reuse

00.00.18 how to identify and locate appropriate industry technical standards, codes, and other applicable requirements

00.00.19 modulation techniques for analog (examples might include AM, FM, and PM)

00.00.20 modulation techniques for digital (examples might include FSK, PSK, and QAM)

00.00.21 wireless multiple-access schemes (examples might include FDMA, TDMA, CDMA, and variants)

00.00.22 basic satellite communications

00.00.23 digital data transmission formats (examples might include E1/T1 and OC-n/SDH)

00.00.24 basic components of RF circuitry

00.00.25 basic RF circuit design

00.00.26 basic RF coupling, radiation, and antenna theory concepts

00.00.27 measurements for RF circuits and sub systems, such as output power, receiver sensitivity, noise figure, linearity performance, and spectral performance

Knowledge of general engineering management:

00.00.28 project management methods and processes

00.00.29 fundamental engineering economics

00.00.30 design and configuration for ease of maintenance

00.00.31 documentation and configuration control schemes

00.00.32 IEEE Code of Ethics