



CCIE Wireless Exam (350-050) Quick Reference

Roger Nobel
Federico Ziliotto
Federico Lovison
Fabian Riesen
Erik Vangrunderbeek

Cisco Press



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About the Authors

Roger Nobel is a customer support engineer at the Cisco Systems Technical Assistance Center (TAC) in Switzerland. He joined Cisco in 2000 as a project engineer. He owns a Swiss-Engineer degree from the University of Applied Sciences Winterthur/Zurich with specialization in software engineering and transmission technologies. He holds CCIE Wireless (#23679), CWNA, and CWSP (#400138).

Fabian Riesen is technical leader at the Cisco Systems Technical Assistance Center (TAC) in Switzerland. He joined Cisco in 1999 as a project engineer. He owns a Swiss-Engineer degree from the University of Applied Sciences Winterthur/Zurich with specialization in software engineering and transmission technologies. He holds CCIE ISP-Dial and CCIE Wireless (#6268). Fabian was a reviewer for the Cisco Press book *Deploying and Troubleshooting Cisco Wireless LAN Controllers* and is the author of one of the CCIE Wireless Written and Lab examinations.

Federico Ziliotto joined Cisco in 2007 as a customer support engineer (CSE) at the Technical Assistance Center (TAC) in Belgium, where he specialized in solving high severity issues for worldwide customers with particular focus on wireless networks, network admission control (NAC) setups, identity-based networking (IBN), and 802.1X, AAA solutions, and Cisco TrustSec. Federico owns an engineering degree from the University of Padova, Italy, with specialization in telecommunications. He is double CCIE #23280 in Wireless since January 2009 and Routing & Switching since April 2011. In June 2011 he moved to a new position as systems engineer in Cisco France, in the Solution and Technology Practice (STEP) team, where he currently collaborates with the pre-sales teams in security- and mobility-related projects.

Federico Lovison is a customer support engineer at the Cisco Systems Technical Assistance Center (TAC) in Belgium. He joined Cisco in 2007 as a CSE. He owns an engineering degree from the University of Padova with specialization in telecommunications. He holds CCIE Wireless (#23307).

Erik Vangrunderbeek is CCIE wireless product manager within Learning@Cisco. Based out of Brussels, Belgium, he is responsible for the exam design and content development process for both the CCIE Wireless written and lab exams. Erik joined Cisco in 1999 and holds CCIE #9145.

Chapter 1

Planning and Designing 802.11 Wireless Technologies

Wireless Introduction

To Be Wireless

With the introduction of wireless LAN (WLAN), IP networks are now also available for those applications on which wired technologies are not suitable or no wired connectivity is available at all. The following are a few wireless use cases:

- **Home ISP connectivity:** Consumer products
- **Building-to-building connectivity:** Point-to-point and multipoint
- **“Last mile” ISP connectivity:** Rural Internet access
- **Mobility applications:** Car rental returns and parcel deliveries
- **Enterprise network extension:** Reduce, move, add, and change/mobile office environment

Although WLAN appears to be “just another LAN type/protocol,” the nature of wireless is to be a shared medium, and shared not only between a certain workgroup but also shared across the walls, across the building, and with your neighbor. On top of normal networking issues, WLAN adds a couple of new challenges, such as Layer 1 (radio frequency [RF]) issues; a set of L2 protocols, such as IEEE 802.11; and the need for agencies to regulate the use of this shared medium.

Layer 1: Radio Frequencies

Radio frequencies are high-frequency, alternating current (AC) signals that are radiated into the air through an antenna, creating radio waves. Radio waves propagate away from the antenna in a straight line in all directions at once, just like light rays from a bulb. More light bulbs spread around the room will provide better overall lighting. This translates into a stronger average signal for mobile clients. When radio waves hit a wall, door, or any obstruction, there is attenuation of the signal, which weakens the signal and can reduce throughput. The signal can also be reflected or refracted.

Industrial, Scientific, and Medical (ISM) Radio Bands

WLAN devices work in a frequency range (wavebands) that belongs to the industrial, scientific, and medical (ISM) radio bands. The ISM band was originally reserved internationally for the use of RF electromagnetic fields for industrial, scientific, and medical purposes other than communications. In general, communications equipment must accept any interference generated by ISM equipment.

Within the ISM band, WLAN devices use wavebands as follows:

- Bluetooth 2450-MHz band
- HIPERLAN 5800-MHz band
- IEEE 802.11/WiFi 2450-MHz and 5800-MHz bands

Cisco WLAN technologies use the IEEE 802.11 range, which is what this book focuses on.

WLAN Organizations and Regulations

You should be familiar with the following WLAN organizations and regulations:

- **FCC (Federal Communications Commission), www.fcc.gov:** Regulates the use of wireless devices in the United States.
- **ETSI (European Telecommunications Standards Institute), www.etsi.org:** Chartered to produce common standards in Europe.
- **IEEE (Institute of Electrical and Electronic Engineers), www.ieee.org:** Creates and maintains operational standards.
- **Wi-Fi Alliance, www.wi-fi.com:** Promotes and tests for WLAN interoperability.
- **WLANA (WLAN Association), www.wlana.org:** Educates and raises consumer awareness regarding WLANs.
- **CCX (Cisco Compatible Extensions):** The CCX specification is for makers of 802.11 wireless LAN chips to ensure compliance with the Cisco proprietary WLAN protocols. For example, Cisco Lightweight Extensible Authentication Protocol (LEAP) and Extensible Authentication Protocol-Flexible Authentication via Secure Tunneling (EAP-FAST) are part of CCX.

IEEE 802.11 Standards and Protocols

802.11 Alphabet Soup

In June 1997, the IEEE finalized the initial standard for WLANs: IEEE 802.11. Each amendment has been published with a letter in addition to the 802.11. Those letters are often used to name features, data rates, and so on.

Here is a typical example: IEEE 802.11a defined operations in the 5-GHz band. The radio interface operating at 5 GHz is therefore called the “A radio.”

In 2007, the IEEE consolidated all amendments into a new 802.11 standard. Table 1-1 gives a summary of the standards in place at the time of this writing.

Table 1-1 IEEE 802.11 Standard Overview

Name	Description	Obsoleted By
802.11	Original standard defining 1- and 2-Mbps 2.4-GHz RF and IR. All the following are amendments to this standard.	802.11-2007
802.11a	This standard defines Orthogonal frequency-division multiplexing (OFDM) 54-Mbps operation in the 5-GHz band.	802.11-99
802.11b	Enhancements to 802.11 to support 5.5 Mbps and 11 Mbps in the 2.4-GHz band.	802.11-99
802.11c	Defines bridging operations for 802.11. 802.11c has been included as a chapter in the 802.1D standard concerning wireless bridging.	802.1D
802.11d	International roaming extensions. Adds a country field in beacons and other frames. Adds countries not defined by the original standard.	802.11-2001
802.11e	Quality of service (QoS) features. Wi-Fi Multimedia (WMM) is a subset of 802.11e.	802.11-2007
802.11F	Set of recommendations (optional) defining the Inter-Access Point Protocol (IAPP) for exchanging client security context between access points (AP). This amendment was withdrawn in 2006.	802.11-2003
802.11g	Defines effective radiated power – OFDM (ERP-OFDM) modulation in 2.4 GHz, enabling 54 Mbps with backward compatibility with 802.11b.	802.11-2003
802.11h	Amendment for spectrum and transmit power management. It adds Dynamic Frequency Selection (DFS) to avoid radar in the 5-GHz band as well as Transmit Power Control (TPC) to the 802.11a specification.	802.11-2007
802.11i	Wi-Fi Protected Access (WPA) was an early subset of 802.11i, whereas Wi-Fi Protected Access 2 (WPA2) is the full 802.11i implementation. It defines Robust Security Network's (RSN), Advanced Encryption Standard (AES), and Temporal Key Integrity Protocol (TKIP) encryptions.	802.11-2007
802.11j (2004)	Amendment specific for regulation in Japan allowing use in the 4.9-GHz band.	802.11-2007
802.11-2007	Currently the latest revision of the standard, including amendments for 802.11a through 802.11j (except for .11c and .11F).	—
802.11k	Proposed amendment that defines radio management. It will facilitate roaming in an Extended Service Set (ESS) by helping to choose the best access point available (load balancing).	—
802.11l	Reserved and will not be used.	—
802.11m	An ongoing task group charged with the maintenance of the standard. It periodically produces the revisions as well as clarifications and modifications.	—

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