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Certified Wireless Network Administrator (CWNA)
PW0-106

Chapter 1
Overview of Wireless Standards, Organizations, and Fundamentals

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Chapter 1 Overview

- History of WLAN
- Standards Organizations
- Core, Distribution, and Access
- Communications Fundamentals

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History of WLAN

- 19th century research on electrical magnetic radio frequency (RF)
- First used by United Stated during WWII
- Spread spectrum patented in 1942 but not implemented until 1962
- University of Hawaii developed ALOHAnet in 1970 to communicate between the islands

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History of WLAN (continued)

- 900 MHz low speed commercial networks were developed in the 1990's
- IEEE began discussing WLAN standardization in 1991
- IEEE 802.11 was ratified in 1997
- Initially deployed in warehousing and manufacturing environments

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History of WLAN (continued)

- IEEE 802.11b was ratified in 1999
- Introduced 11 Mbps transmission speed
- Faster data rate and price decreases ignited sales in home and small office environments
- More than 1.75 billion Wi-Fi chipsets shipped in 2012

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Standards Organizations

- Regulatory Domain Authorities, such as the Federal Communications Commission (FCC)
- International Telecommunications Union Radiocommunication Sector (ITU-R)
- Institute of Electrical and Electronics Engineers (IEEE)
- Internet Engineering Task Force (IETF)
- Wi-Fi Alliance
- International Organization for Standardization (ISO)

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Regulatory Domain Authorities

- Regulates communications within the country of jurisdiction
- Typically regulates
  - Licensed spectrum
  - Unlicensed spectrum

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Regulatory Domain Authorities (continued)

- Five areas of RF typically regulated
  - Frequency
  - Bandwidth
  - Maximum power of the intentional radiator (IR)
  - Maximum equivalent isotropically radiated power (EIRP)
  - Use (indoor and/or outdoor)
  - Spectrum sharing rules

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Regulatory Domain Authorities (continued)

- FCC rules are published in the Code of Federal Regulations (CFR)
- Divided into 50 titles
- Title 47, Telecommunications
  - Relevant to wireless
- Titles are divided into parts
- Part 15, “Radio Frequency Devices”
  - Contains rules and regulations regarding 802.11

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International Telecommunication Union Radiocommunication Sector (ITU-R)

- Global hierarchy for management of the RF spectrum worldwide
- Tasked by the United Nations
- Maintains database of worldwide frequency assignments
- Coordinates spectrum management through five administrative regions

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Institute of Electrical and Electronics Engineers (IEEE)

- Mission is to *"foster technological innovation and excellence for the benefit of humanity"*
- Global professional society
- More than 400,000 members worldwide
- Best known for its LAN standards
  - IEEE 802 project

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Institute of Electrical and Electronics Engineers (IEEE) (continued)

- Subdivided into working groups
- Groups develop standards that address specific problems or needs
- Group numbers assigned sequentially; eg. 802.1, 802.2, …
- Revisions or amendments are assigned sequential letters
  - eg. 802.11a,b,c,…ac,ad,ae…

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Internet Engineering Task Force (IETF)

- Goal to *make the Internet work better*
- No membership fees
- Open to anyone
- Part of the Internet Society (ISOC)
- Made up of many working groups
- A working group creates documents known as a Request for Comments (RFC)

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Wi-Fi Alliance

- Global, nonprofit industry association
- More than 550 member companies
- Devoted to *promoting the growth of WLANs*
- Main task is to provide hardware certification testing
- Founded in 1999 as the Wireless Ethernet Compatibility Alliance (WECA)
- Changed its name in 2002

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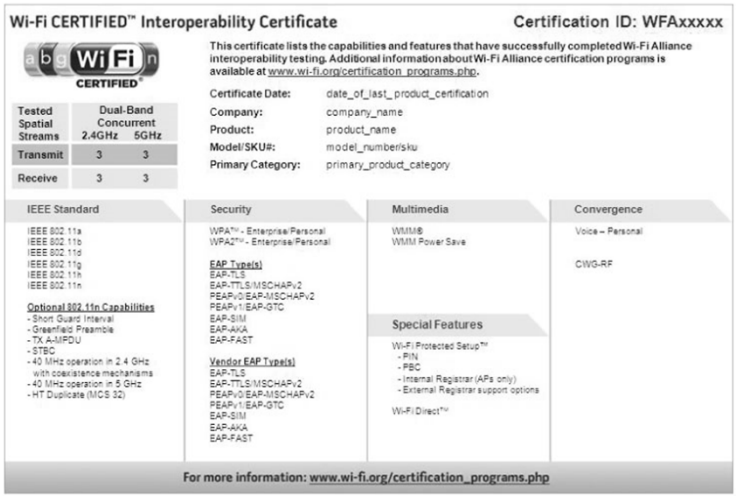
Example of Wi-Fi Interoperability Certificate



Wi-Fi CERTIFIED™ Interoperability Certificate **Certification ID: WFAxxxxx**

Wi-Fi CERTIFIED

This certificate lists the capabilities and features that have successfully completed Wi-Fi Alliance interoperability testing. Additional information about Wi-Fi Alliance certification programs is available at www.wi-fi.org/certification_programs.php.

Certificate Date: date_of_last_product_certification
Company: company_name
Product: product_name
Model/SKU#: model_number/sku
Primary Category: primary_product_category

Tested Spatial Streams	Dual-Band Concurrent 2.4GHz	5GHz
Transmit	3	3
Receive	3	3

IEEE Standard

IEEE 802.11a
IEEE 802.11b
IEEE 802.11d
IEEE 802.11g
IEEE 802.11h
IEEE 802.11n

Optional 802.11n Capabilities
- Short Guard Interval
- Greenfield Preamble
- TX A-MPDU
- STBC
- 40 MHz operation in 2.4 GHz with coexistance mechanism
- 40 MHz operation in 5 GHz
- HT Duplicate (MCS 32)

Security

WPA™ - Enterprise/Personal
WPA2™ - Enterprise/Personal

EAP Type(s)
EAP-TLS
EAP-TTLS/MSCHAPv2
PEAPv0/EAP-MSCHAPv2
PEAPv1/EAP-GTC
EAP-SIM
EAP-AKA
EAP-FAST

Vendor EAP Type(s)
EAP-TLS
EAP-TTLS/MSCHAPv2
PEAPv0/EAP-MSCHAPv2
PEAPv1/EAP-GTC
EAP-SIM
EAP-AKA
EAP-FAST

Multimedia

WMM®
WMM Power Save

Special Features

Wi-Fi Protected Setup™
- PIN
- PBC
- Internal Registrar (APs only)
- External Registrar support options

Wi-Fi Direct™

Convergence

Voice – Personal

CWG-RF

For more information: www.wi-fi.org/certification_programs.php

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Wi-Fi CERTIFIED Programs

- Core Technology & Security
- Wi-Fi Multimedia (WMM)
- WMM Power Save (WMM-PS)
- Wi-Fi Protected Setup - Security
- Wi-Fi Direct
- CWG-RF – Multimedia
- Voice Personal - Application

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Wi-Fi CERTIFIED Programs (cont.)

- Voice Enterprise
- Tunneled Direct Link Setup
- Passpoint
- WMM-Admission Control
- IBSS with Wi-Fi Protected Setup
- Miracast

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International Organization for Standardization (ISO)

- Global, nongovernmental organization
- Responsible for Open Systems Interconnection (OSI) model
- OSI model developed in the late 1970s

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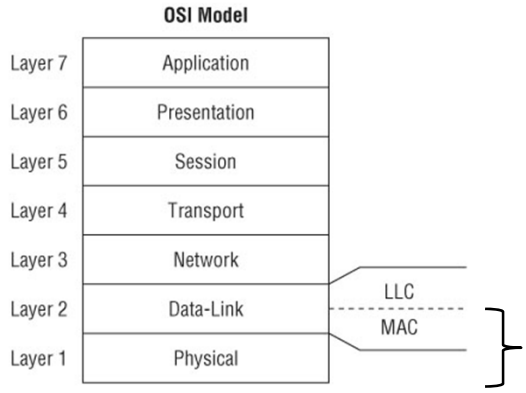
OSI Model and 802.11



The IEEE 802.11-2012 standard defines mechanisms only at the Physical layer and MAC sublayer of the Data-Link layer

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Core, Distribution, and Access

- Core
  - High-speed backbone
  - Performs high-speed switching
- Distribution
  - Routes traffic between VLANs and subnets
  - Wireless bridging between buildings
- Access
  - Delivery of traffic to end user
  - Typically where 802.11 operates

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Communications Fundamentals

- Amplitude
- Wavelength
- Frequency
- Phase
- Carrier Signals
- Keying Methods
  - Amplitude Shift Keying (ASK)
  - Frequency Shift Keying (FSK)
  - Phase Shift Keying (PSK)

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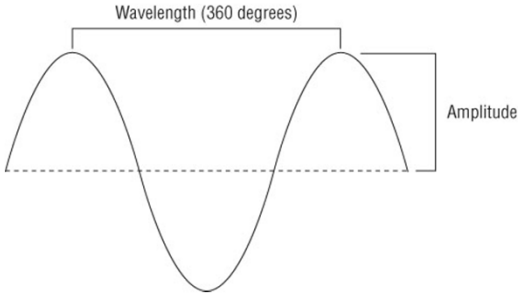
Amplitude and Wavelength

- Wavelength is the distance between similar points on back-to-back waves
- Typically measured from peak to peak



Amplitude is the height, force, or power of the wave

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Frequency

- Number of waves generated per second
- One wave = one oscillation
- Measured in hertz (Hz)
- Hertz = one oscillation per second
- 2.4 GHz = 2.4 billion oscillations per second

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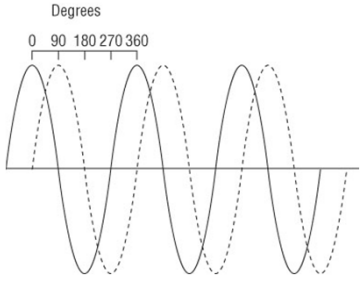
Phase

- Relationship between two waves with the same frequency
- Measured in degrees
- One wavelength = 360 degrees



These waves are 90 degrees out of phase

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Carrier Signal

- Data consists of 0 and 1 bits
- RF signal can represent data by fluctuating or altering its RF properties
- Properties that can be altered
  - Amplitude
  - Frequency
  - Phase

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Keying Methods

- Method of manipulating a signal to represent multiple pieces of data
- Three types of keying methods
  - Amplitude-shift keying (ASK)
  - Frequency-shift keying (FSK)
  - Phase-shift keying (PSK)
- Two techniques used to represent data
  - Current state
  - State transition

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Keying Techniques

- Current State
  - Current value of the signal is used to distinguish between 0s and 1s
  - Current value or level at a specific time
- State Transition
  - A change or transition of the signal is used to distinguish between 0s and 1s
  - Presence of a change or lack of presence of a change determines 0 or 1

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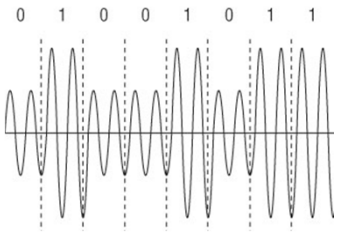
Amplitude-Shift Keying (ASK)

- Amplitude or height of a signal represents the binary data
- Current state technique
- One level represents 0
- Different level represents 1



An example of ASK (ASCII code of an upper-case K)

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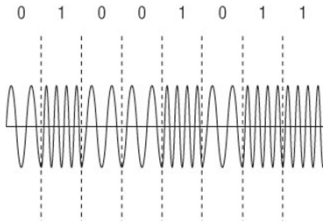
Frequency-Shift Keying (FSK)

- Frequency of the wave is varied to represent the binary data
- Current state technique
- One frequency represents 0
- Different frequency represents 1



An example of FSK (ASCII code of an upper-case K)

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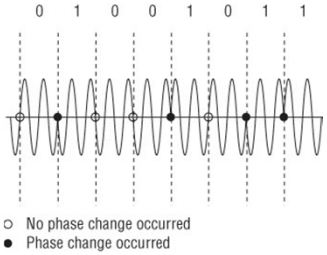
Phase-Shift Keying (PSK)

- Phase of the wave is varied to represent the binary data
- State transition technique
- Change of phase represents 0 or 1
- Lack of phase change represents 1 or 0



An example of PSK (ASCII code of an upper-case K)

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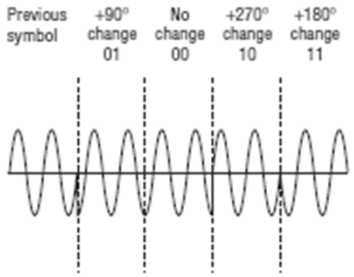
Multiple Phase-Shift Keying (PSK)

- Can encode multiple bits per symbol
- Uses four phases, each of which is capable of representing two binary values (00, 01, 10, or 11



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Chapter 1 Summary

- History of WLANs
- Roles of standards organizations
- Relationship between 802.11 and Core, Distribution, and Access
- Communications Fundamentals
  - Amplitude
  - Wavelength
  - Frequency
  - Phase
  - Carrier signals & keying methods