Aruba Certified Mobility Associate
OFFICIAL CERTIFICATION STUDY GUIDE (EXAM HPE6-A42)

First Edition

Steven M. Sowell

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Official Certification Study Guide
(Exam HPE6-A42)
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HPE Aruba Contributors: Don McCracken, Kevin Zhu, Kimberly Graves, Venu Dhanraj Puduchery, Fardin Rahim Raoufi, Leo Banville

HPE Press Program Manager: Michael Bishop

About the Author

Steven Sowell has been an IT professional and entrepreneur since 1984, with a focus on WLAN technologies for the past 16 years. He has sold, designed, and deployed WLANs covering millions of square feet, for sporting arenas, hospitals, offices, and outdoor areas. Steven has been a courseware developer, editor, and author for fifteen years, and an industry-certified instructor and engineer since 1994. He has managed and groomed teams of technology instructors and engineers to reach the highest levels of certification, and to exceed customer expectations.

Introduction

This book is based on the Implementing Aruba Wireless course. It will help you to prepare to pass the Aruba Certified Mobility Associate (ACMA) certification exam (HPE6-A42). The material in this book will also help you to understand general wireless technologies, and to understand, deploy, and configure HPE Aruba-based WLAN systems.

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This book is designed for presales solution architects involved in supporting the sale of HPE Aruba WLAN solutions. It is also designed for engineers that need to learn how to deploy and configure these solutions.

Assumed Knowledge

This is an entry level book. As such, you do not need much prerequisite knowledge. It is assumed that you have a very basic understanding of general networking concepts, such as Ethernet, routing, and switching technology and an interest in learning about the HPE Aruba product line—physical and virtual—to help you understand customers' business issues and to propose appropriate solutions. However, you do not need expert-level knowledge in these areas to comfortably learn the material contained in this book.

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There are no prerequisite qualifications for this certification.

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This self-study guide does not guarantee that you will have all the knowledge you need to pass the exam. It is expected that you will also draw on real-world experience and would benefit from completing the hands-on lab activities provided in the instructor-led training. To pass the certification exam, you should get as much hands-on experience as possible.

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Recommended training to prepare for each exam is accessible from the exam's page in The Learning Center. See the exam attachment, "Supporting courses," to view and register for the courses.

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You are not required to take the recommended, supported courses, and completion of training does not guarantee that you will pass the exams. Hewlett Packard Enterprise strongly recommends a combination of training, thorough review of courseware and additional study references, and sufficient on-the-job experience prior to taking an exam.

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CONTENTS

1 **WLAN Fundamentals and RF Basics** 1
WLAN Organizations 2
RF bands and channels 3
2.4 GHz ISM band and channels 3
5 GHz U-NII bands and channels 4
Channel bonding 6
802.11ac 5 GHz allowed channels in FCC countries 8
Learning check 9
Answers to learning check 10
802.11 standards and amendments 10
Compare 802.11a/b/g/n/ac data standards 10
802.11h—DFS and TPC 12
802.11e—Wireless Quality of Service 13
802.11i Security 14
Wi-Fi alliance certifications 15
Other 802.11 Standards 16
802.11 Frame Types 16
Learning check 18
Answers to Learning check 19
RF Basics 19
RF coverage versus capacity 19
Channel availability 22
RF Problems 23
RF WLAN interferers 24
Aruba spectrum analysis 25
Antenna technology 28
Antenna types 28
Reading radiation patterns horizontal plane (azimuth) 29
Reading Radiation Patterns Vertical Plane (elevation) 30
Passive E-plane antenna gain 31
Passive H-Plane Antenna Gain 32
AP/Antenna mounting options 32
Single Input Single Output (SISO) 33
Multipath propagation scenario 34
Multiple Input Multiple Output (MIMO) 35

Learning check....36
Answers to learning check....36
RF transmit power....37
RF Power....37
dBm versus Milliwatts....37
dBm and mW relationships....38
Signal to Noise Ratio (SNR)....39
Effective or Equivalent Isotropic Radiated Power (EIRP)....40
Calculating EIRP....41
WLAN mobility....42
WLAN logical configuration....42
Wireless device mobility....44
Roaming....45
Learning check....46
Answers to learning check....46

2 Mobile First Architecture....47
Product line and portfolio....47
Product line....47
Aruba Controller Portfolio....48
Learning check....50
Answers to learning check....51
Controller modes....52
AP terminology....52
Controller Modes....53
Master-Local modes....54
8.x Architecture....55
Aruba OS 8.x Architecture....55
Master Controller versus Mobility Master....56
Local Controller versus Managed Node (Mobility Controller)....56
Partial versus hierarchical configuration....57
Partial configuration model....57
Hierarchical configuration model....57
8.x features....58
Loadable service modules....58
Clustering....59
The MultiZone feature....60
The Aruba solution....61
GRE tunnels....62
Campus AP deployment model....63

Remote AP and VIA deployment model....64
Branch deployment model....65
Learning check....66
Answers to learning check....66
Licensing....66
License in AOS 8.x....66
Types of licenses....66
Centralized licensing....67
License pools....68
Generating a license key....68
Enabling sharable license features....69
License SKUs for VMM and VMC....70
License SKUs for MCM and HMM....70
Calculating license requirements....71
Adding Licenses....72
Learning check....73
Answers to learning check....73

3 Mobility Master Mobility Controller Configuration....75
VM installation....75
VM requirements....75
VM Setup....76
Network Adapters....77
MM Sizing....78
VMC Sizing....78
MM configuration—VM console....79
Learning check....80
Answers to learning check....80
Hierarchy....81
GUI hierarchy....81
Hierarchical configuration model....82
The mm System group....82
The mn System group....83
Subgroups....84
Managed devices....84
Adding groups....85
Learning check....86
Answers to learning check....86
Mobility Controller setup....86
MC Zero Touch Provisioning....86
Adding MCs to the hierarchy....87

Direct MC to MM via ZTP or Script 88
Wizard installation 89
MC Directed to MM Script 91
IPSec Keys 92
ZTP Activate 93
VPN concentrator 94
MC VPN concentrator 95
Learning check 96
Answers to learning check 96
Hierarchical configuration 97
Configuration validation and distribution 99
MC local configuration 100
MC configuration 100
MC Geolocation 101
MC interface VLANs and ports 102
MC Interface port parameters 103
Learning check 104
Answers to learning check 104

4 Secure WLAN Configuration 105
WLAN components 105
WLAN deployment prerequisites 105
AP group structure 106
AP-group 106
AP group and profile structure 107
AP group profile hierarchy 108
AP group and profiles 109
Creating AP-groups 111
Committing your configuration changes 112
Learning check 112
Answers to learning check 113
Use AOS UI to create a WLAN 113
Create a new WLAN 113
New WLAN general information 114
New WLAN VLANs 117
New WLAN security 118
New WLAN access 121
Configuration pending 122
The new WLAN with virtual AP profile settings 123
The configured AP-group and profiles 124

Learning check....124
Answers to learning check....125

5 AP Provisioning....127
AP and controller communication....127
Control plane and Data plane....127
AP Boot process overview....128
Booting—Factory default AP....129
Booting after Controller provisioning....131
Communication between AP and controller....132
Learning check....133
Answers to learning check....133
Controller discovery mechanism....134
Enable Controller discovery....134
Controller discovery caveat....134
Learning check....135
Answers to learning check....135
CPSec....135
Introduction to CPSec....135
How CPSec works....136
Configure CPSec Auto-Cert-Provisioning....136
CPSec manual whitelist....137
WebUI....138
Caveats of disabling CPSec....138
Learning check....139
Answers to learning check....139
AP provisioning....139
AP provisioning overview....139
AP provisioning manually via GUI....140
AP provisioning manually via APboot....141
AP provisioning via wizard....142
AP operation....142
GRE tunnels and CLI commands....142
Identify GRE tunnels with the CLI....144
VLAN Tag in tunnel mode for an L2 deployment....145
Basic troubleshooting....146
Example—Troubleshooting AP provisioning....146
Learning check....147
Answers to learning check....147

6 WLAN Security....149
802.11 Negotiation....149
Connecting to a secure WLAN....149
802.11 Negotiation....151
Phase 2—WPA/WPA2 negotiation....152
Authentication basics....153
User authentication....153
One-way authentication....155
Two-way authentication....156
Learning check....157
Answers to learning check....157
SSID hiding....158
MAC filtering....159
Public Key Infrastructure (PKI)....160
Certificates....161
Certificate authorities....162
User authentication....163
WPA-Personal PSK....163
Authentication methods review....164
Authentication with 802.1X/EAP....164
The 802.1X/EAP authentication process....165
Extensible Authentication Protocol (EAP)....166
EAP termination....167
Learning check....168
Answers to learning check....168
Machine authentication....169
Authentication servers....169
Common Authentication servers....169
Active directory....170
Learning check....171
Answers to learning check....171
Encryption....171
Confidentiality....171
Symmetric key encryption....172
Asymmetric key encryption....173
Learning check....174
Answers to learning check....174
Wireless threat overview....174
Denial of service attacks....175
Access Points, Air Monitors, Spectrum Monitors....176

Wireless IPS process 176
Locating rogue APs 177
Client Tarpit containment 178
Learning check 179
Answers to learning check 179

7 Firewall Roles and Policies 181
Aruba integrated firewall introduction 181
Aruba firewall 181
Aruba firewall role 182
Aruba firewall policies 183
Roles, policies, and role derivation 185
Aruba role derivation example 186
Identity-based Aruba firewall 187
Centralized and consistent security 188
Learning check 188
Answers to learning check 189
Policies and rules 189
Policy rules 189
Access Control rule 190
Configuring service rule in policies 191
Application rule 192
Configuring application rule in policies 193
Aliases 193
Aliases improve workflow scalability 194
Predefined destination aliases 196
Alias USER 197
User versus any 198
Service alias 199
Learning check 200
Answers to learning check 200
Practice: What is wrong with these firewall policies? 200
Solution to policy examples 201
Global and WLAN policies 202
Global rule configuration 203
Rule for this role 204
Learning check 205
Answers to learning check 205
Roles 205
Role advanced view 206
Adding policies to roles 207

WLAN default role assignment....208
AAA profile....209
Learning check....210
Answers Learning check....211

8 Dynamic RF Management....213
Dynamic RF management introduction....213
Adaptive Radio Management (ARM)....214
How ARM works....214
Indices in ARM profile....215
ARM optimizing channel and power....216
General ARM profile configuration....217
Advanced ARM profile configuration....217
ARM caveat....218
Learning check....219
Answers to learning check....219
AirMatch....219
What is AirMatch?....219
How AirMatch works....220
AirMatch and ARM comparison....220
AirMatch optimization....221
View the AirMatch RF plan....223
Solution detail....224
AirMatch, radar, and avoiding noise....224
Configuring AirMatch....225
AirMatch LSM upgrade....225
AirMatch FAQ....226
Learning check....227
Answers to learning check....227
Legacy Client Match (CM)....228
What is CM?....228
How CM works....229
Default CM rule upgrade....230
Legacy CM caveat....231
CM on MM/MD....232
How CM works on MM/MD deployment....232
Rule-Based Client Match (RBCM)....233
CM Rule upgrade (Default ClientMatch rule)....234
RBCM Rule upgrade....235
Configuring ClientMatch....235

Learning check....236
Answers to learning check....236

9 Guest Access....237
Aruba Guest Access solution....237
Guest network with NAT....238
Guest network with dedicated WAN....239
Guest network tunnel to DMZ controller....240
Guest Network using MultiZone AP....241
L3 deployment with Guest Services....242
Captive Portal process....243
Learning check....244
Answers to learning check....244
Configuring guest WLAN using Aruba controller....244
Using the guest WLAN wizard....244
Create a guest WLAN....245
Guest WLAN general information....246
Guest WLAN VLAN....248
Guest WLAN VLAN IPv4 options....248
Guest WLAN security....250
Guest WLAN security captive portal options....251
Captive Portal Template customizations....252
Captive Portal Template—Check your work....254
Guest WLAN access....255
Device level IP address and DHCP for Guest Network....256
Learning check....257
Answers to learning check....257
Guest provisioning account....258
Create Guest provisioning account....258
Create User Guest accounts....259
Maintenance of the internal database and Guest Users....260
Learning check....261
Answers to learning check....261
Troubleshoot captive portal....262
Captive portal troubleshooting....262
Guest with preauthenticated role and Firewall Policy....262
Guest with postauthenticated role....263
WebUI Certificate....264
Certificate error....264
WebUI certificate....265

Guest Access with ClearPass 265
Add ClearPass to the Controller Server list 266
Add ClearPass Server to the server group 267
L3 authentication profile 268
Modify the pre-auth role 269
Modify the policy captiveportal 270
Testing Guest access 271
Self-Registration completed 272
ClearPass Access Tracker Tool 273
Guest Access best practices 273
Learning check 274
Answers to Learning check 274

10 Network Monitoring and Troubleshooting 275
Banner 275
Controller dashboard 276
AP dashboard 277
Client dashboard 277
Client dashboard (Cont.) 277
Trend analysis 278
WLAN dashboard 279
WLAN dashboard (Cont.) 280
Potential issues 280
Monitoring performance 281
Performance dashboard 282
Usage dashboard 284
Traffic analysis 285
Filter view 286
Details view 287
Security analysis 288
Using alerts 289
Learning check 289
Answers to learning check 290
Monitoring through Airwave 291
Airwave 291
Network overview 292
Monitoring devices 294
Monitoring clients 295

Client graphs....296
Reports....297
Learning check....297
Answers to learning check....298

11 Practice Test....299
Answers to Practice Test....305

Index....313

1 WLAN Fundamentals and RF Basics

LEARNING OBJECTIVES

- ✓ Before you begin learning about Aruba-specific implementations, you will learn about fundamental WLAN technologies and RF concepts. We begin with a discussion of WLAN organizations. You will understand Radio Frequency Bands and channels, and the standards used to regulate them. These standards ensure interoperability between devices.
- ✓ You will then learn about radio frequency coverage and interference. Your understanding of these concepts is vital to both the successful implementation and diagnosis of WLAN systems. You will learn about antenna technology and how various options can help ensure you get the right coverage in various deployment scenarios.
- ✓ How do you know if a particular implementation is successful? Of course, you will seek end user feedback and measure the performance of the network yourself. For this endeavor, you must know what metrics to explore. Toward this end, you will learn about RF power, signal strength, and how it is measured.
- ✓ We end with an introduction to WLAN mobility concepts. You will learn about one of the great advantages of WLAN systems—the ability for users to roam about while remaining connected.

WLAN Organizations

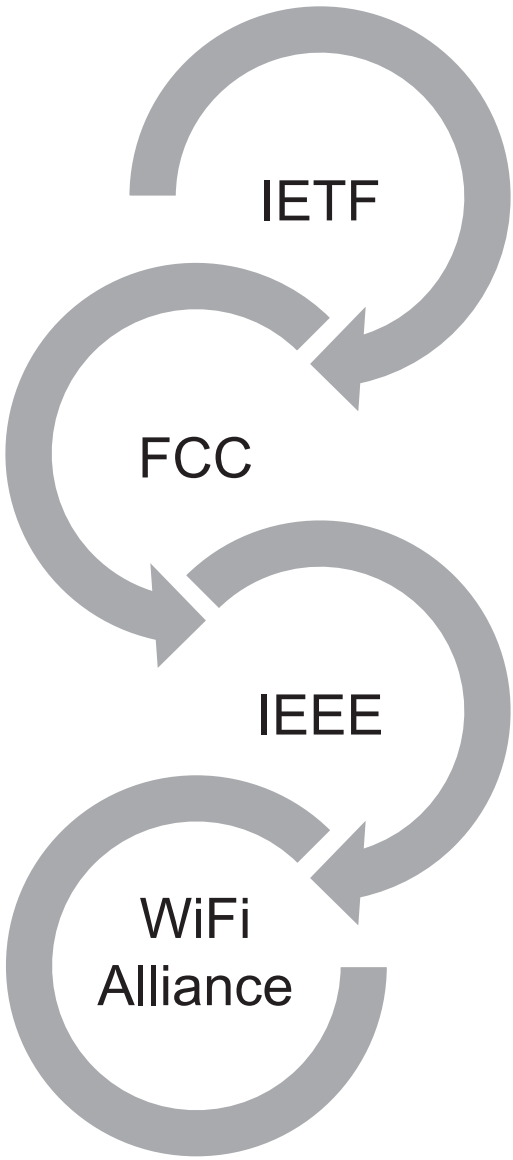

Figure 1-1 WLAN organizations

There are several organizations that develop WLAN standards (Figure 1-1). These regulatory bodies restrict how RF technology is deployed. Organizations involved in these regulations include the following:

- Internet Engineering Task Force (IETF)—International standards
- Federal Communications Commission (FCC)—Local regulatory domain for RF spectrum (United States)
- The Institute of Electrical and Electronic Engineers (IEEE)—802.11 standards
- The Wi-Fi Alliance—WLAN standards

The IETF is an international standards organization for the Internet.

The FCC places certain restrictions on power and channel usage in the US. Other countries have similar entities. For example, channel and power restrictions in Europe are controlled by the European Telecommunications Standards Institute (ETSI). In Japan, it is Nippon Telegraph (NTT).

Within the unlicensed spectrum bounds defined by the FCC, the IEEE creates the 802.11 standards. In other words, the FCC controls which frequencies in the spectrum we can use and at what power settings we can use them. The IEEE committee standardizes how data is transmitted over those frequencies.

802.11 channels, as defined in the standard, must fall within the FCC unlicensed ranges. Over the years, new technology has been introduced to improve the speed and reliability of WLANs. In response, the IEEE continues to amend standards and to create new standards.

The Wi-Fi Alliance further defines standards within the bounds set by the 802.11 standard. The Wi-Fi Alliance promotes interoperability between the vendors of WLAN equipment.

RF bands and channels

2.4 GHz ISM band and channels

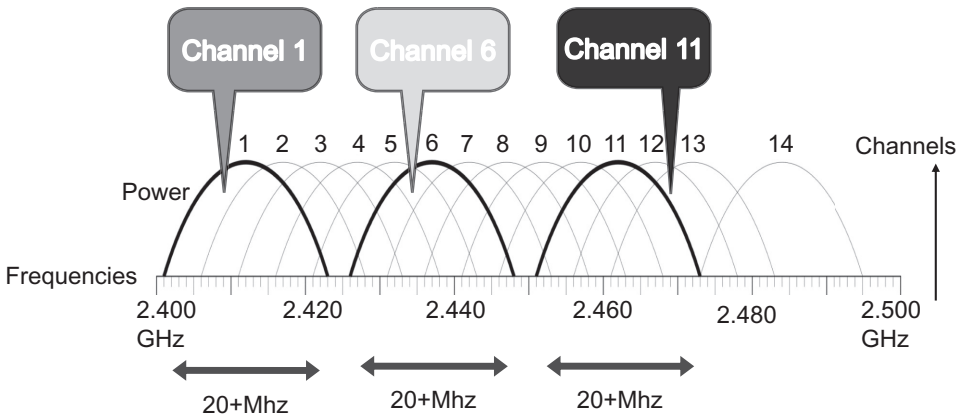

Figure 1-2 2.4 GHz ISM band and channels

The 2.4 GHz ISM (Industrial, Scientific and Medical) Band is used by 802.11, 802.11b, 802.11g, and 802.11n. Using so-called "spread-spectrum technology" data is encoded and spread across a

spectrum of frequencies, a bit over 20 MHz wide. However, the channels are only 5 MHz apart, so adjacent channels overlap. When two physically nearby APs use overlapping channels, they can hear each other's RF signals. This results in interference, which can severely degrade performance. This specific type of interference is often called "co-channel interference."

Think about having a business meeting, when multiple separate conversations occur in the same room. If two people talk loudly, it distracts others. Parts of the conversation are missed and meaning is lost. And so it is with WLANs. Due to the overlap, some or all of the transmission may be lost.

In Figure 1-2, you can see that channel 1 overlaps with channels 2–5. There is enough of a gap between channels 1 and 6, and so they do not interfere with each other. Similarly, there is a gap or space between channels 6 and 11, and so there is no co-channel interference between them.

So while there are 11 channels available in the US (13 in Europe, 14 in Japan), only channels 1, 6, and 11 are actually used. This is because they are the channels that do not interfere with each other. Other channels such as 2 and 8 may not interfere with one another because there is enough bandwidth between them, but the only channel plan that can take advantage of three usable channels in the same RF space are 1, 6, and 11.

5 GHz U-NII bands and channels

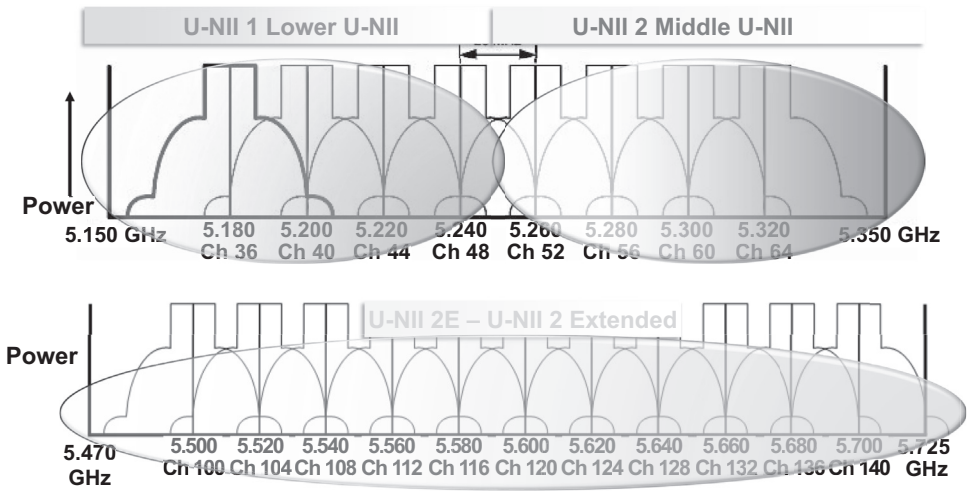

Figure 1-3 5 GHz U-NII 1, 2, 2E bands and channels

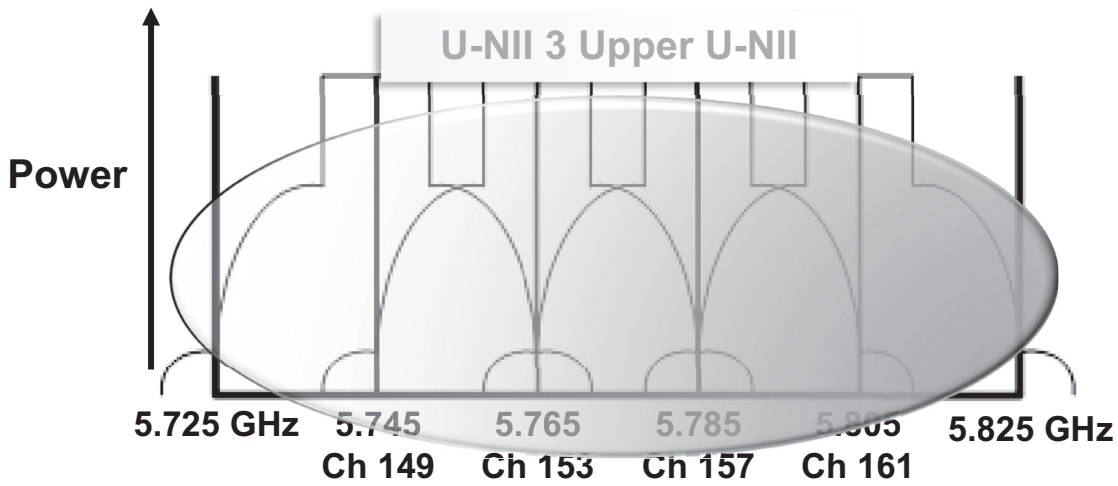

Figure 1-4 5 GHz U-NII 3 Upper U-NII bands and channels

802.11a, 802.11n, and 802.11ac use the 5 GHz Unlicensed National Information Infrastructure (U-NII) bands, as defined by the FCC. Like the 2.4 GHz band, actual channel availability can vary by country. Figures 1-3 and 1-4 show the four sets of U-NII Bands:

- U-NII 1, also known as Lower U-NII
- U-NII 2, also known as Middle U-NII
- U-NII 2E, also known as U-NII 2 Extended
- U-NII 3, also known as Upper U-NII

Originally, U-NII bands 1–3 were defined for use by 802.11a. Each of these three bands was broken into four useable channels. Look at Figure 1-3 and notice that the frequencies used in the U-NII 1 and 2 bands are contiguous. There is a gap between the U-NII 2 and 3 bands that was previously not available for unlicensed use in WLANs. The frequencies in this gap are used for aircraft and military radar systems.

As discussed later, engineers figured out how to open up this space for WLAN use, while avoiding interference with these radar systems. Soon thereafter, the U-NII 2E band was made available, adding an additional 11 channels in the 5 GHz range. (Again, depending on the country).

Originally, the Lower U-NII could be used for indoor use only, the Middle U-NII for indoor or outdoor use, and the Upper U-NII for outdoor use only. This meant that you were likely to have 8 U-NII channels that were useable for indoor WLANs. Only channels that are directly next to each other have any risk of interfering. They are usually at low enough power that there is minimal or no interference. Still, it is typically considered a best practice to avoid using adjacent channels for physically adjacent Access Points.

So, unlike the 2.4 GHz spectrum, all 5 GHz channels are usable, without risk of co-channel interference. However, many client devices lack support for certain 5 GHz channels. This is especially true of the U-NII 2e channels.

The U-NII 2 extended bands can be problematic for actual real-world use, as many NICs either do not support them, or only scan for them after other channels are scanned. However, even without the use of the U-NII 2E channels, there are still many more nonoverlapping channels in 5 GHz than 2.4 GHz. If we can get by with three usable channels on 2.4 GHz, surely eight nonoverlapping channels are fine for 5 GHz.

Channel bonding

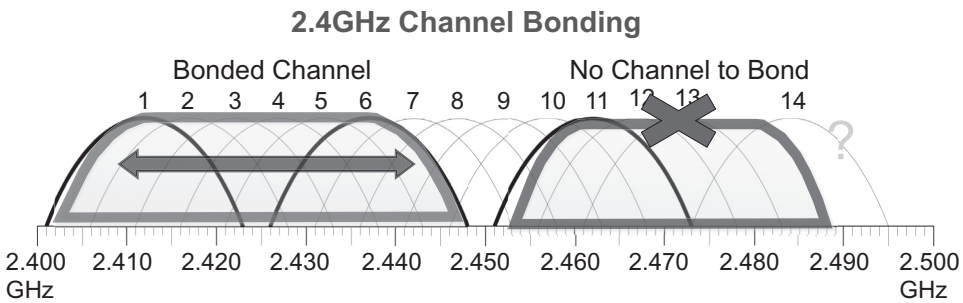

Figure 1-5 2.4 GHz channel bonding

One of the performance enhancements available in 802.11n and 802.11ac is channel bonding. Channel bonding technically does not bond two channels together (Figure 1-5). It is actually using the frequency ranges of those two channels and treating them as a single, much wider channel. This is similar to the concept of modem bonding employed years ago to achieve a higher throughput on dial-up links. Another analogy is that of "link aggregation," which bonds two or more wired Ethernet links into a single, logical link.

By having a wider channel, more information can be transmitted at a time. 802.11n is also referred to as High Throughput or HT. HT20 indicates 802.11n is deployed without channel bonding, using a standard 20 MHz wide channel. HT40 indicates 802.11n is deployed with channel bonding, using a 40 MHz wide bonded channel.

Bonding channels in 2.4 GHz is not a viable solution. With only three usable channels, bonding would effectively leave only one usable channel.

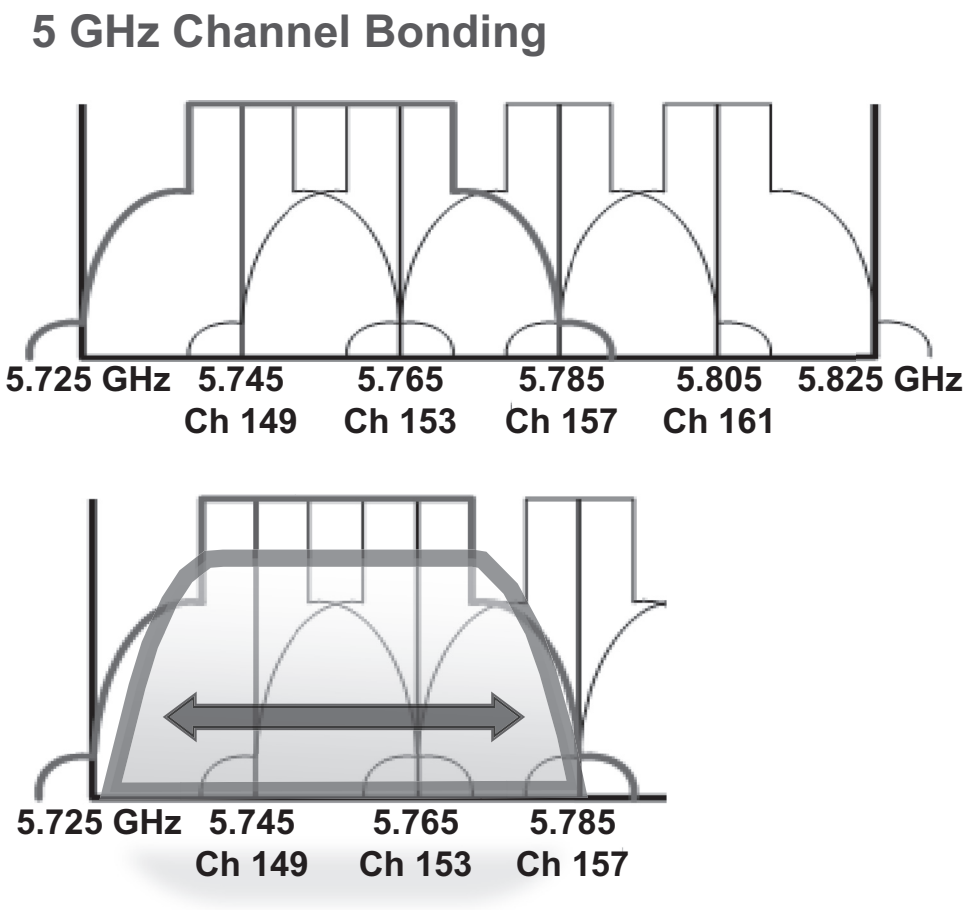

Figure 1-6 5 GHz channel bonding

Bonding is really only effective in 5 GHz for enterprise class WLANs (Figure 1-6). So, for other than home use, bonding is really a 5 GHz discussion. This becomes more evident with 80.11ac, which is purely a 5 GHz technology.