IoT Regulatory Compliance

KEYSIGHT TECHNOLOGIES

INTRODUCTION

Be Successful in a Wireless IoT World

Technology now connects everything, and everyone, everywhere. However, as the use of common wireless standards grows, congestion causes wireless communication failures, a problem that is intermittent and hard to trace. To address the congestion, standards bodies and regulatory agencies have issued recommendations and regulations to ensure effective and efficient use of the radio spectrum.

IoT device makers need to accomplish regulatory pre-compliance and compliance testing throughout the product life cycle — from design to test validation, manufacturing, and deployment. Solving design issues early in the product life cycle helps manufacturers achieve first-to-market breakthroughs to stay competitive in the marketplace.

Explore this eBook to discover deep insights into regulatory compliance test, why it is important, its test challenges, and the solutions to overcome these obstacles.

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CHAPTER 1

Why Do We Need Regulation?

Wireless technologies are evolving to cater to future needs. The industrial, scientific, and medical (ISM) band allows free, unlicensed use. Although initially reserved for industrial, scientific, and medical purposes, the fastest-growing use of these bands in recent years has been for short-range, low-power wireless communications systems. The rapid growth has caused a crowded spectrum.

To address the congestion, standards bodies and regulatory agencies have issued recommendations and regulations to ensure an effective and efficient use of the radio spectrum.

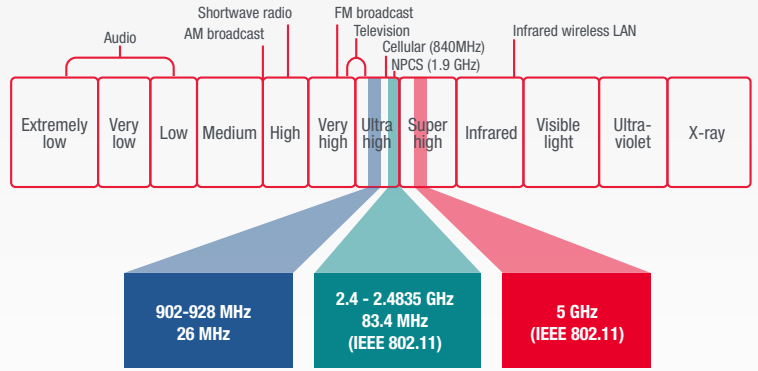

Figure 1. Diagram showing where the ISM unlicensed frequency bands are in the electromagnetic spectrum

CHAPTER 2

Complex Global Regulatory Landscape

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Complex Global Regulatory Landscape

The global regulatory landscape is very complex. Just as each country has its national cuisine, each region or country determines its own regulatory bodies and requirements.

The standards bodies and regulatory agencies include the Federal Communications Commission (FCC) in the United States (US), European Telecommunications Standards Institute (ETSI) in the European Union, Ministry of Internal Affairs and Communications (MIC) in Japan, and many others throughout the world.

Device manufacturers need to certify products in the specific countries where they are sold and not the country of origin.

CHAPTER 3

Keeping Pace with Regulatory Standards

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Updating regulatory compliance standards as wireless radio technologies evolve ensures an effective and efficient use of the radio spectrum to guarantee everyone has equal access to the ISM bands.

FCC and ETSI use different standard numbering for various operation frequency bands. They each have different practices in maintaining the standards documents.

For example, FCC Part 15.247 and 15.407 are standards for devices operating in the 2.4 and 5 GHz bands, respectively. ETSI EN 300 328 standards cover devices operating in the 2.4 GHz band, while EN 301 893 pertains to devices operating in the 5 GHz band. Standard EN 303 687 is currently under development for devices operating in the 6 GHz band.

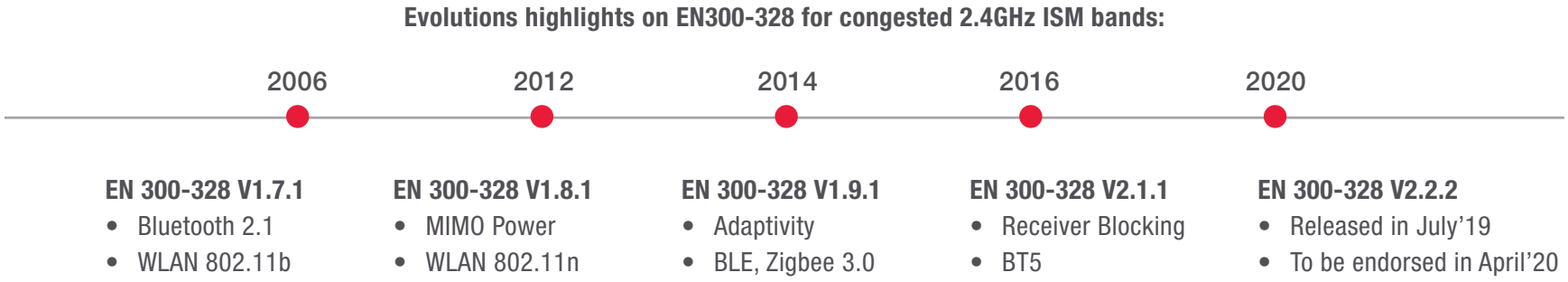

Figure 2. Evolution of ETSI regulatory standard

CHAPTER 4

Roadblocks to Global Market Access

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Roadblocks to Global Market Access

While IoT devices offer great convenience, having large numbers in a small space increases complexity in device design, test, performance, and security. Testing these devices is one of the biggest challenges for design engineers and device manufacturers — the crowded RF environments are why it is critical to address compliance testing.

Compliance is about ensuring your IoT devices adhere to radio standards and global regulatory requirements before getting market access. As shown in Figure 3, there are two main categories of certification test.

IoT device manufacturers and independent test lab managers often face challenges complying with different requirements around the world.

- Time-to-market pressure: Device designers often move quickly to meet tight product introduction schedules to ensure seamless global market penetration for their products while complying with the latest regulations.
- Complexity in the regulatory test: Regulations change from time to time, which makes regulatory testing complex.
- High capital investment: An extensive regulatory test system often requires an increased capital investment to upgrade or purchase new equipment.

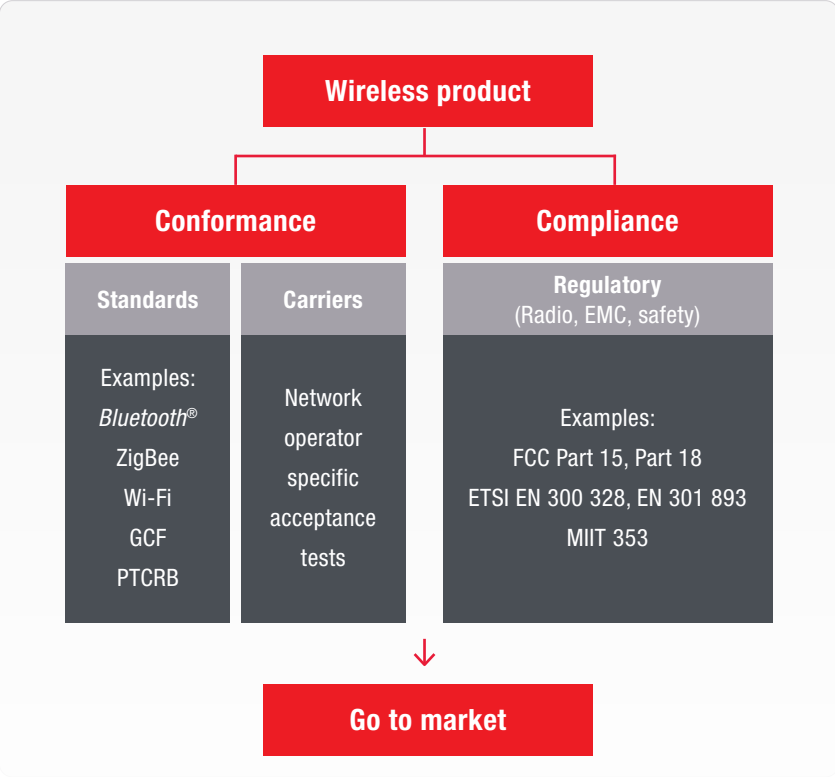
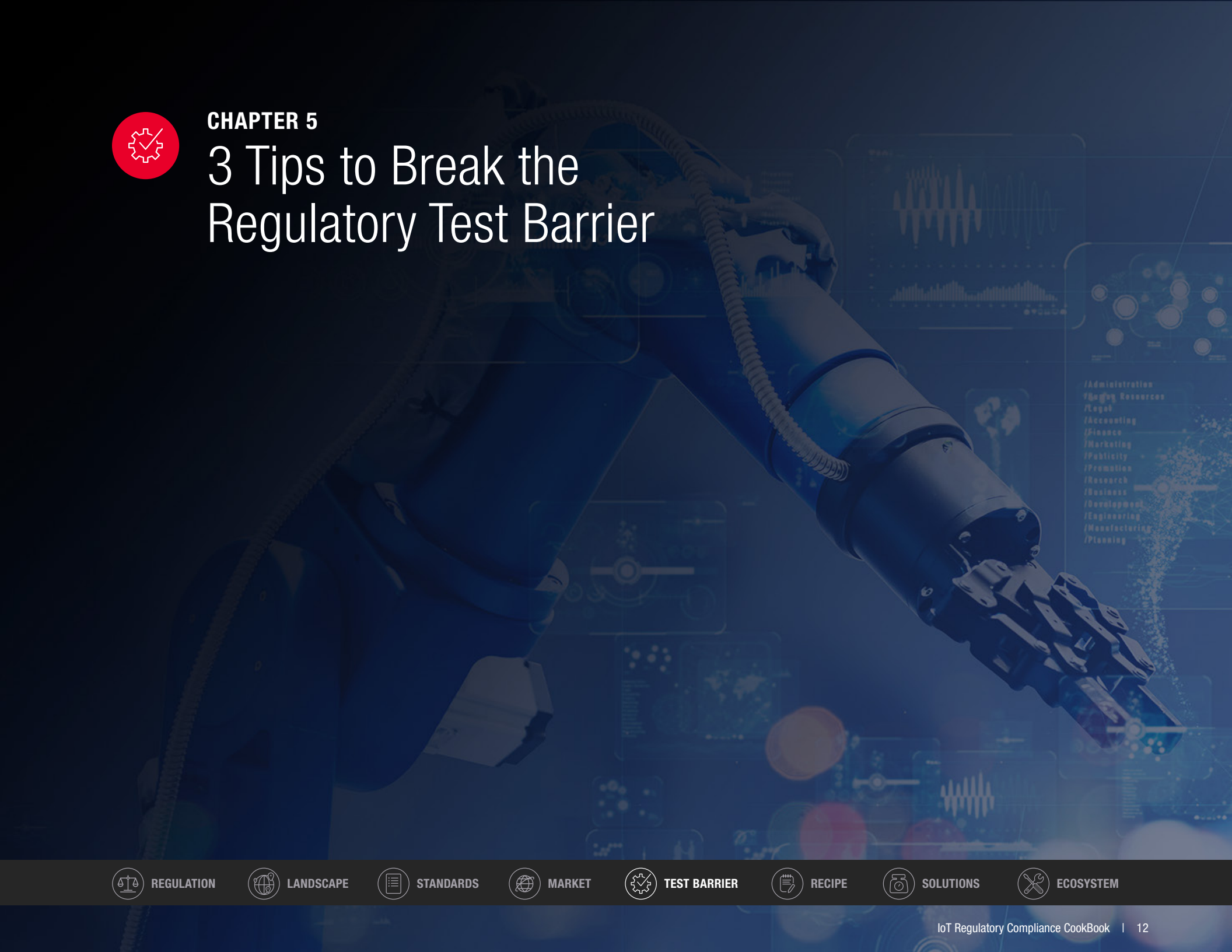


Figure 3. The two main categories of certification tests are conformance and compliance



CHAPTER 5

3 Tips to Break the Regulatory Test Barrier

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3 Tips to Break the Regulatory Test Barrier

Despite the challenges, IoT device manufacturers and independent test lab managers can keep to their product release schedule and maximize asset utilization by following these three tips.

TIP 1

Incorporate a pre-compliance test plan into your device design schedule.

For IoT device makers, it is essential to accomplish pre-compliance and compliance testing throughout the product life cycle — from design to test validation, manufacturing, and deployment. This process helps manufacturers achieve first-to-market breakthroughs while remaining competitive in the market.

TIP 2

Capitalize on automated testing to reduce pre-compliance test time.

Executing a comprehensive test plan is time-consuming. IoT device manufacturers and lab managers should use an automated test system to speed testing and provide measurement insights into failures.

TIP 3

Enhance capability and throughput with flexible, scalable system configuration and reconfiguration.

For independent test labs, it is critical to respond to urgent requests from their clients. Enhance capability and throughput with a flexible, scalable test system configuration and reconfiguration into separate test stations to address different standards and test cases.

CHAPTER 6

Your Recipe for Success

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Your Recipe for Success

ETSI adaptivity tests

ETSI's adaptivity test for the channel access mechanism (CAM) in the wireless subsystem confirms the ability of the wireless device to postpone transmitting when detecting RF energy. The test's design reduces the likelihood of collisions between different signal types and increases the tolerance of extrinsic signals.

ETSI included this test in EN 300 328 and EN 301 893 standards to ensure wireless devices can safely share the same spectrum effectively and efficiently. The wireless device should pause the transmission and leave pseudorandom time between transmissions before trying again. The challenge for this test is the tedious and long detection intervals at 1 µSec resolution, which generates a considerable amount of data. Automating adaptivity testing and data analysis will reduce test time.

Figure 4. Adaptivity test results on the left reports short idle times are few. Longer idle times on the right occur frequently.

Dynamic frequency selection tests

The dynamic frequency selection (DFS) test is a requirement established by the European Union (EU), FCC, and other regulatory bodies. The test's design ensures wireless devices operating in the unlicensed WLAN 5 GHz bands can detect and vacate any channels that interfere with military and weather radar systems operating in the 5 GHz range.

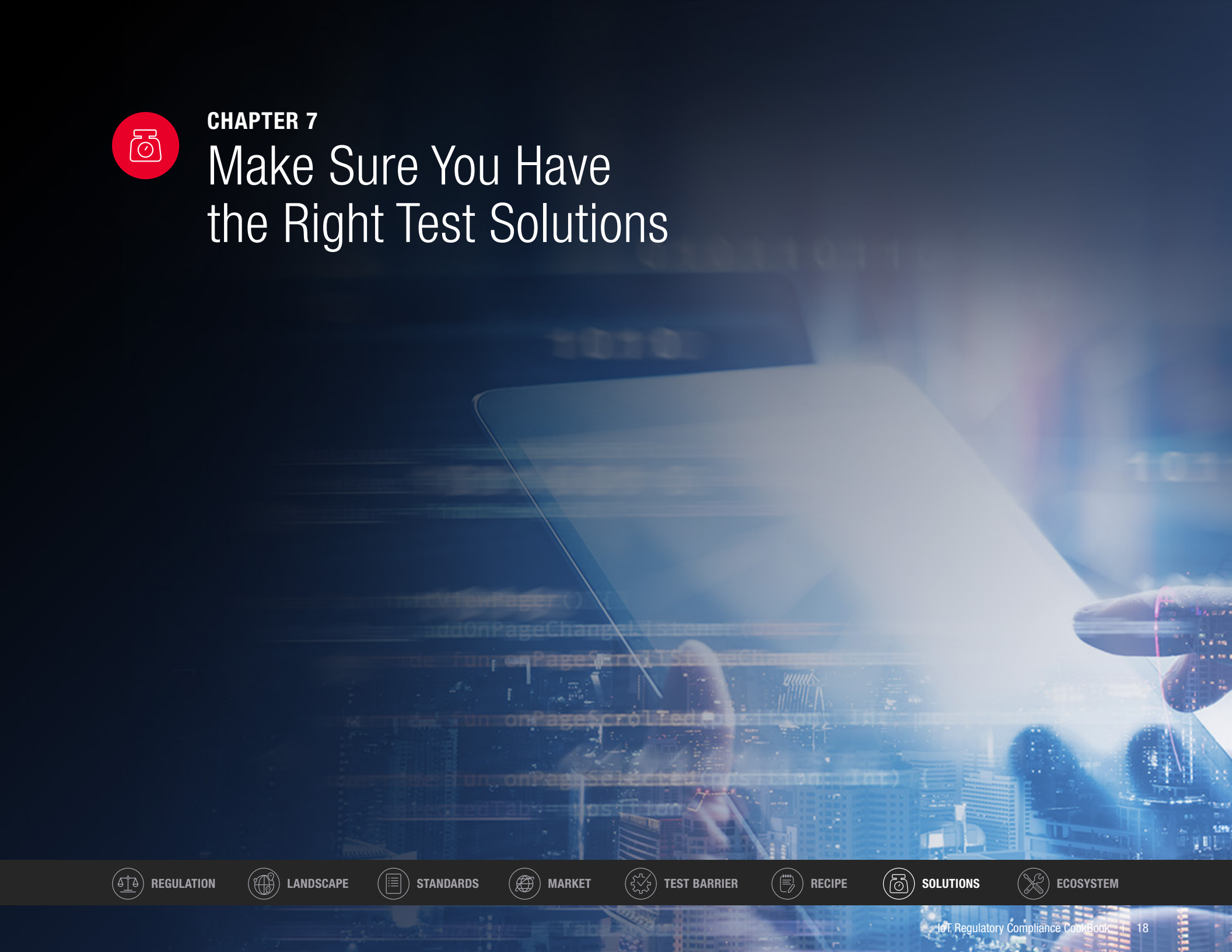
The regulatory tests for DFS are challenging because they require significant behavior sequences and timing in the radio LAN (RLAN) device. Additionally, the radar signals may be present on different channels. There are many different types of radar signals in use, and each signal type requires testing. Automated test systems can significantly reduce both the overall test time and the tedium for test engineers that comes with repetitive DFS testing tasks.

A new challenge in new bands — Wi-Fi 6E tests

Wi-Fi 6E expands from the 6 GHz ISM band up to 7.2 GHz — the FCC is allocating 1.2 GHz of additional spectrum above the present allocation. But there are already services active in the additional spectrum, and the FCC in the US has defined a new set of tests for devices used in the Wi-Fi 6E bands. The intent for these tests is to protect incumbent services — terrestrial microwave links and satellite services.

Consequently, some new test requirements address antenna patterns to avoid radiating signals above 30 degrees from the horizon. Another new operation requirement is a mechanism to use a database to identify available channels from the geographical location of the Wi-Fi 6E device. In locations of known incumbent users, unoccupied frequencies will be available, but occupied frequencies will not be allowed for use.

The Wi-Fi 6E test requirements also include a function called contention-based protocol (CBP), which is very similar to the ETSI adaptivity test. This function causes a device to detect activity on the active channels and leads it to delay transmissions until after the detected signal is gone. A semi-random delay helps determine transmission timing, avoid collisions, and increase the likelihood of success on the first transmission.



CHAPTER 7

Make Sure You Have the Right Test Solutions

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Make Sure You Have the Right Test Solutions

The new regulatory compliance tests have significantly increased the complexity of test processes. Previously, tests for power, bandwidth, and frequency were necessary to attain regulatory compliance. But new tests such as DFS, adaptivity, and CBP are now a requirement. These tests generate large volumes of data at high speed. Test systems must be able to collect, process, and analyze the data sets to verify the device's design against compliance.

Keysight's IOT0047A regulatory test solution

The Keysight IOT0047A Regulatory Test Solution is a complete, automated test system that covers ETSI, FCC, and DFS tests. As wireless standards continue to evolve, software updates can keep the test system compliant with new test requirements. It covers the latest test cases of ETSI EN300 328 / 301 893 / 303 687 (Draft), FCC Part 15.247 / 15.407, and DFS with dedicated test software.

- Get a scalable test system that supports a wide array of IoT device types and common radio formats such as WLAN, Bluetooth®, and ZigBee.
- Streamline your test automation and improve speed with a signaling test method using a companion device.
- Purchase what you need now and add more capabilities later for better capital planning.
- Reduce test complexity with readily available software, which automates the regulatory testing and report generation.

4 Test Stations: Configurable and reconfigurable

The IOT0047A is available in four upgradeable configurations. You can optimize your budget by purchasing what you need today and adding more capability later. Whichever configuration you choose, we'll keep you up to date with evolving standards via continuous software updates.

Complete ETSI, FCC, and DFS test station

This test station tests for unlicensed bands at 2.4 GHz, 5 GHz, and beyond 6 GHz.

Required solution

Hardware: Keysight signal analyzer and signal generators (analog and vector) with X8749A and X8750A test sets.

Software:

- XA5001A ETSI regulatory test software for ETSI EN 300 328 / EN 301 893 and EN 303 687 (Draft).
- XA5002A FCC regulatory test software for FCC Part 15.247 and Part 15.407.
- XA5003A DFS test software.

Non-signaling conducted test station for ETSI EN 300 328 / 301 893 / 303 687 (Draft)

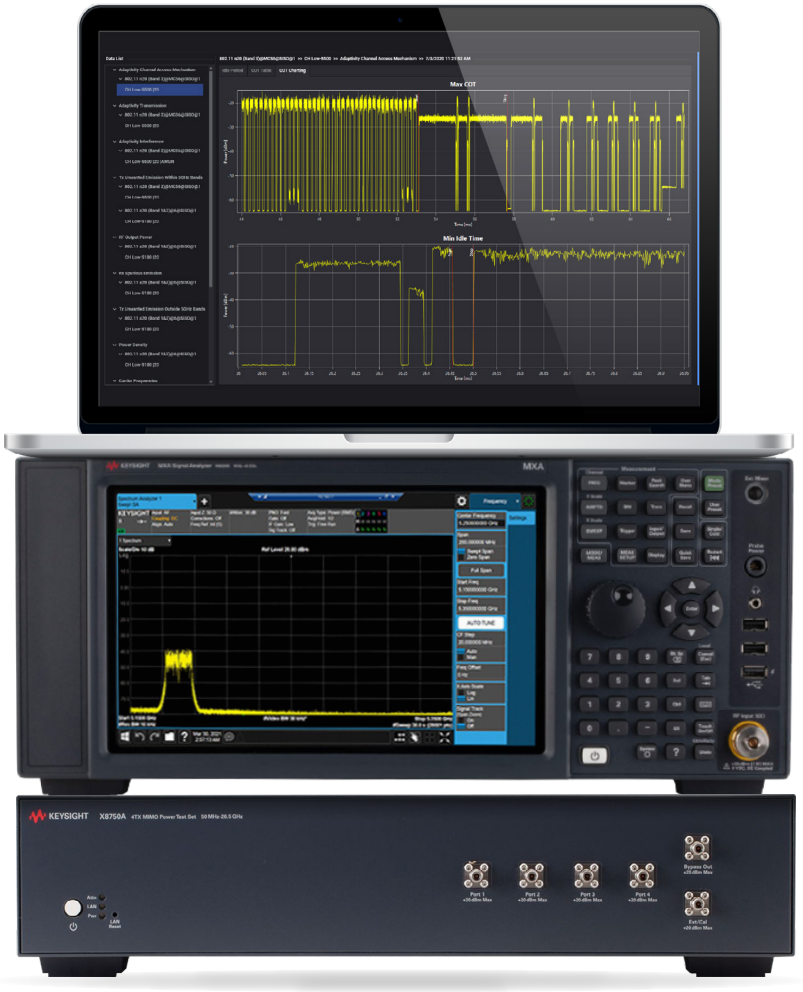
This test station addresses ETSI test cases at 2.4 GHz, 5 GHz, and beyond 6 GHz.

Required solution

Hardware: Keysight signal analyzer and the X8750A MIMO test set.

Software:

- XA5004A ETSI regulatory test software for non-signaling parameters.
- Use for power, bandwidth, spurious, frequency, and timing specific tests.



Signaling adaptivity / receiver blocking test station

This test station covers ETSI test cases at 2.4 GHz, 5 GHz, and beyond 6 GHz.

Required solution

Hardware: Keysight signal analyzer and signal generators (analog and vector) and X8749A test set.

Software:

- XA5005A ETSI regulatory test software for signaling test cases.
- Use for adaptivity and receiver blocking specific tests.

Dynamic frequency selection test station

This dedicated, dynamic frequency selection (DFS) test station supports test cases for ETSI EN301 893 V2.1.1, EN302 502 V1.2.1, FCC-06-96, FCC-13-22, Japan MIC 2019-07, Korea, and China. It significantly reduces test time by simplifying and automating DFS testing, data collection and calculation, and allows for easy report generation.

Required solution

Hardware: Keysight signal analyzer and vector signal generator and the X8749A test set.

Software:

- XA5003A DFS test software.

CHAPTER 8

Build a Robust and Resilient IoT Ecosystem

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Build a Robust and Resilient IoT Ecosystem

As wireless standards continue to evolve, regulatory compliance tests have significantly increased in complexity, directly impacting the test process. New tests such as DFS are complex, and the adaptivity and CBP tests in Wi-Fi 6E now require the collection of large volumes of data at high speed.

A test system must be capable not only of collecting data, which is a time-consuming process, but it must also be able to process and analyze the data sets.

For information on how Keysight's solutions can help you address the regulatory compliance challenges, please check out this link:

www.keysight.com/find/IOT0047A

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