White Paper

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Azimuth

Testing Drones—The Challenges & Smart Solutions

Table of Contents

1. Overview

This white paper talks about the emergence of (nonmilitary) drones, with a focus on some of the challenges associated with testing drones and proposed solutions.

2. Background

The market for drones is growing exponentially. According to *Business Insider*, **12% of an estimated $98 billion in cumulative global spending on aerial drones over the next decade will be for commercial purposes**. Drone sales have been driven by consumer-friendly pricing, and this is unlikely to change.

In a recent CNBC report, [*1] Mike Blades, senior industry analyst for aerospace and defense at Frost and Sullivan, offered numbers that indicate a robust US and international market for civilian drones. “The market is blossoming because drones are now affordable,” said Blades. He estimated that worldwide consumer sales for drones would top $720 million in 2014, or 200,000 units sold each month. He expects spending to double in 2015, growing to $4.5 billion by 2020.

Drones are being used for a variety of recreational and commercial purposes, in a wide range of industries, and for many uses, including real estate and construction (e.g., land survey, aerial photography); farming and agriculture; media (e.g., news capture, film production); and energy, utilities, and mining (e.g., mapping, documentation, field inspection).

Regardless of whether you manufacture drones or drone components (e.g., radio modem) or are just looking to use the technology for a new application, you need to test the drones before you deploy them.

*1: Barbara Booth, “Is It Time to Buy Your Kid a Drone for Christmas?” CNBC, December 22, 2014, http://www.cnbc.com/id/102280825.

Figure 1: Emerging Applications for Drones

3. Testing drones

Testing drones in the field is challenging for a variety of reasons, technical and nontechnical.

On the technical front, there are significant challenges with testing drones on the field:

(1) The environment is what it is and can't be controlled

(2) Environmental conditions are not repeatable

These technical challenges can't be underestimated. Take the cellular industry, for example: one of its biggest challenges is field testing before a device is released, given that many variables that affect performance cannot be controlled (e.g., weather, network load, etc.). Lack of repeatability in the field drives costs and time-to-market significantly.

Drone testing also involves nontechnical logistical challenges. Test engineers must identify and travel to a wide range of field environments. At the same time, they must follow local, state, and federal regulations that restrict when and where drones can be tested. These restrictions can limit the opportunities for exhaustive and broad-based testing.

3.1. What alternatives do we have? Testing drones in the lab?

Given all these challenges associated with testing drones in the field, is there an alternative? For example, can drones be tested effectively in a lab? Even if we can't move all our testing from the field to the lab, is there a way to reduce the dependency on field testing? Yes. This is where Azimuth's channel-emulation platforms and field-to-lab capabilities come into play.

Using a channel emulator, engineers can create a controllable RF environment that corresponds to the link between the radio controller and the device, as shown in the figure below. This controllable environment allows users to control every aspect of the RF environment, including multipath fading, drone velocity, mobility path, topography, and other environmental factors that influence a drone's performance.

Figure 2: Testing drones in the lab (Photo copyright © 2015 Parrot.com)

3.2. Testing in Characteristic Field Environments

This can be useful for testing the drone's (and an overriding application's) performance in characteristic RF environments (e.g., parking lots, enclosed spaces such as malls or stadiums, open fields) or for characteristic-use cases (e.g., flying drones tangentially away in a straight line or in circumnavigating circles, or maneuvering drones around natural or constructed obstacles).

An important thing to remember is that there are no channel models in the standards for drone deployments. In this instance, taking an ITU model and modifying it to account for that the drone is surrounded by relatively few/no scatterers would suffice. Watching the educational video on Azimuth's YouTube channel will help you understand the details and intricacies of creating channel models for testing drones.

3.3. Testing Actual Field Conditions—in the lab

Taking this a step further, you can use the concept of Field-to-Lab, and re-create actual field conditions in a controlled laboratory setting to simulate specific field conditions (e.g., Dallas Cowboys stadium, fully occupied, with no dome covering, light rain), much as it is being used in the cellular ecosystem today. Field-to-Lab powered drone testing can be used to test the performance of drones or components in the lab in environments "captured" from the field as shown in the figure below.

While this will not completely eliminate the need for field testing, it does provide a more repeatable and controllable environment that can help move more of the testing from the field to the lab; this leads to significant savings in cost, time, and effort. Field-to-Lab users have been able to realize almost 30% reduction in their field testing costs and significant improvements in time to market.

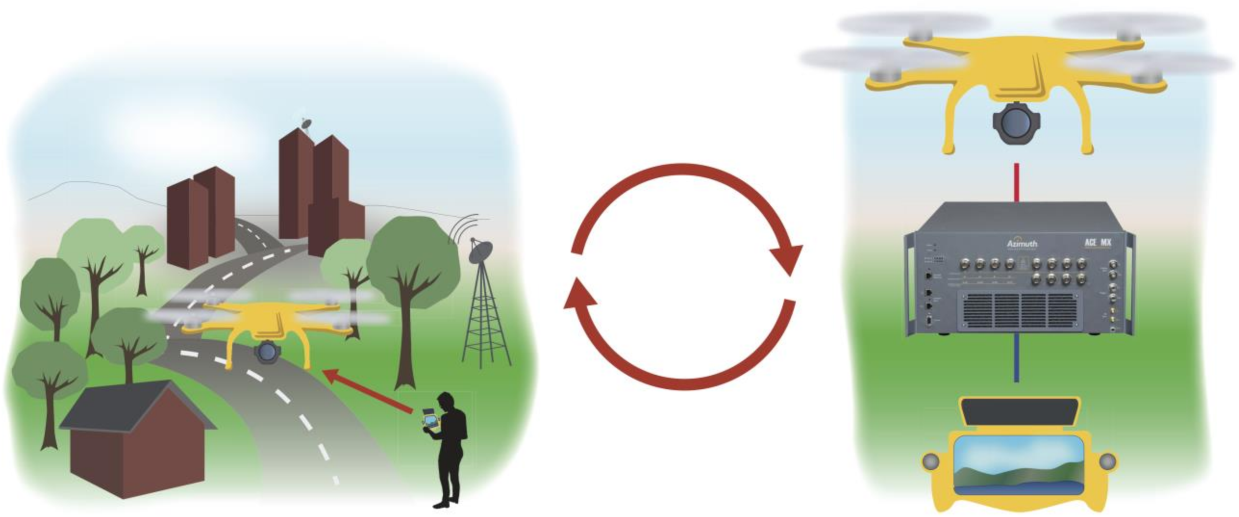

Figure 3: Testing drones in the lab by recreating field conditions captured from the field

Field-to-Lab can be used for pre- and post-launch testing. Pre-launch testing enables testing of drones (or components/overriding applications) before the launch in field environments. This gives users a better and more accurate understanding of how the drone will perform in the field. Field-to-Lab testing can catch the most critical and consequential issues in a controlled environment, where they are easier to re-create and address. That way, when users move on to field testing, they can focus on performance issues and refined testing.

Field-to-Lab can also be used for post-launch testing of drones such as to recreate specific issues. For instance, if users report issues flying drones in a particular topography, a replay of the capture of that environment capture in the lab can be used to debug the issue.

4. Applications

There are a variety of ways to use the testing solutions described above:

- Testing the performance of drones in typical user scenarios (e.g., flying a drone in circles around the operator)
- Testing the performance of drones in environments/scenarios that cause issues (e.g. a drone that's flying in such a pattern that one antenna shadows the other causing the drone to lose connectivity)
- Testing the performance of a drone in specific or typical field environments (e.g., in a specific stadium)
- Comparing the performance of different drones (standalone or with an overriding application)
- Comparing the performance of different radio modems or modem firmware within the drone

5. Summary

In this white paper, we learned about some nonmilitary uses for drones, some of the challenges associated with testing drones, and alternative solutions for testing drones in the lab. Drones can be tested in the lab using a channel emulator to re-create a controllable, repeatable RF environment, or in a Field-to-Lab environment, wherein you can test a drone under specific field conditions.

Specifications are subject to change without notice.

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Printed on Recycled Paper

Printed in Japan 公知 2017-10 MG No. AZCHEM-E-R-3-(1.00)