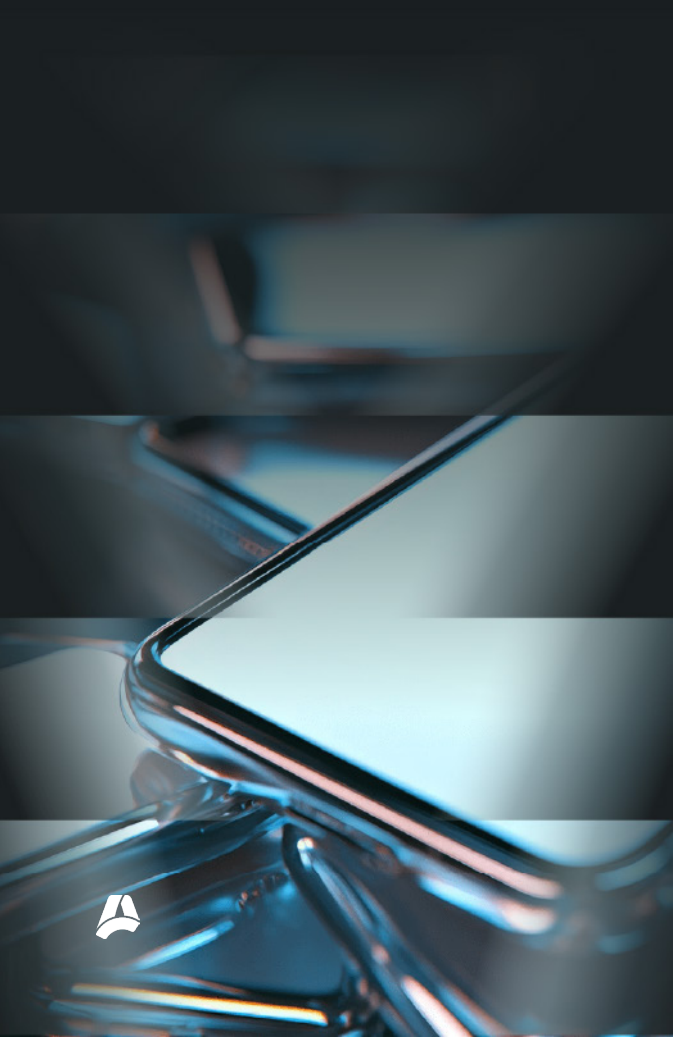
Beyond Pass-Fail: From Functional Testing to Revenue Generation

How detailed insights improve the quality of used smartphones

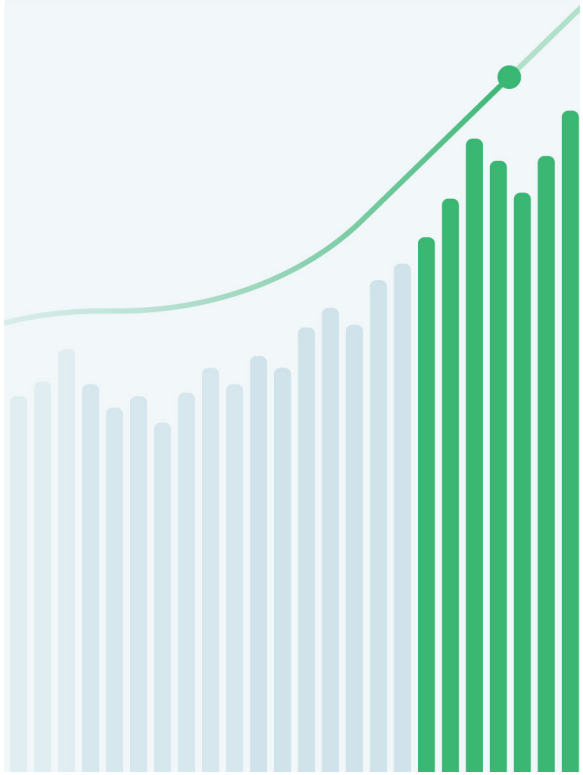
apkudo

The Global Secondary Smartphone Market is Booming



Executive Overview

With growth up 6% year-over-year in 2024, the global secondary market is growing faster than the primary market. From 2024 to 2032, it is expected to grow at a compound annual growth rate (CAGR) of 11.3% and reach $187.86 billion.



Consumer demand is driving this impressive market expansion. Consumers want cost-effective alternatives to expensive new smartphones. Many prioritize environmental impact, making purchasing choices to help reduce electronic waste in landfills—85% of consumers factor in sustainability when buying a device. In some regions, warranty assurance, certification, and after-sales services provide further incentives for consumers to choose used smartphones over new ones.

The supply of used smartphones is also increasing. More used smartphones are in circulation today thanks to the popularity of buy-back and trade-in programs—especially in North America. Advances in testing and refurbishment processes are improving the quality of these used phones.

Trust and Testing: A Critical Dependency

These favorable market dynamics create massive revenue generation opportunities for companies assessing, refurbishing, and reselling pre-owned smartphones.

But opportunity is not guaranteed.

The continued growth of the secondary smartphone market ultimately hinges on consumer trust, and trust starts with testing. **Much more than a check-the-box activity, testing is essential to the industry's ability to build and sustain consumer trust in used smartphones.** Testing ensures quality; quality drives trust; and trust fuels revenue generation.

This is why testing should be optimized to deliver the highest quality outcomes possible—in cosmetic grading and functional assessments. With detailed insights about the functionality of every phone and the *why* behind device passes and fails, companies can make strategic decisions about how to act on test results.

These decisions can advance their business interests and strengthen customer trust. The way to do it? Conduct functional testing that combines robotic precision with human insights. That is how to give consumers what they want: confidence that used phones do not simply pass assessment, but they perform.

Key Terms

A **defect** is any physical or functional imperfection affecting a device's performance, appearance, or usability. Defects are classified into various categories, such as:

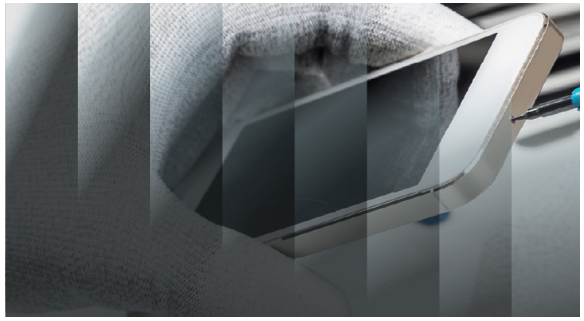
- **Cosmetic:** scratches, dents, discoloration, etc.
- **Functional:** touchscreen malfunctions, battery degradation, faulty buttons, etc.
- **Structural:** warped frame, cracked screens, etc.

Defect detection is the **process** of identifying and assessing these defects, often using automated or robotic systems.

Functionality testing Functional testing assesses the overall performance of essential device functions like touchscreen, display, camera, and battery health.

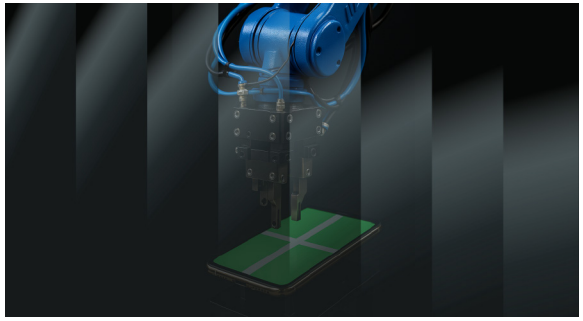
Cosmetic grading assesses a device's cosmetic condition, including scratches, cracks, and dents. Devices are typically assigned a grade on a scale from A to D, with Grade A being the best condition and Grade D being the worst. The fewer defects detected on a device, the higher the assigned grade.

Table of Contents



01 PAGE 04
Introduction

02 PAGE 06
Robotics is Supercharging the Assessment of Used Smartphones



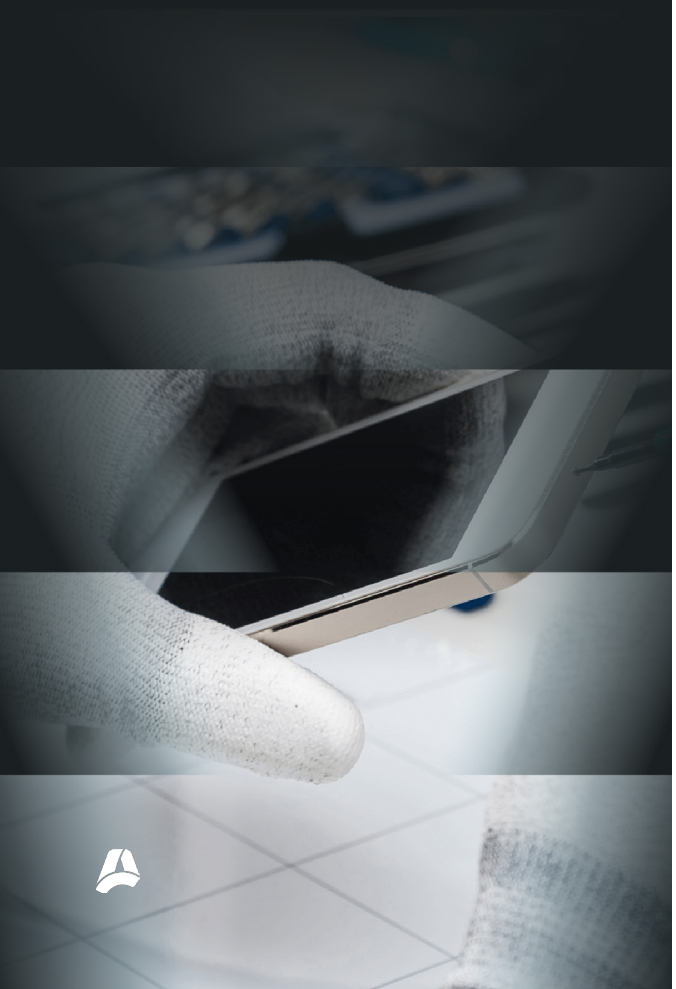
03 PAGE 08
Apkudo's Robotic Processing: More Quality, Less Subjectivity

04 PAGE 10
Functional Testing in Action: Manual Testing Versus Apkudo Robotics Testing

05 PAGE 11
Focusing on Quality Fuels Trust

01

Introduction

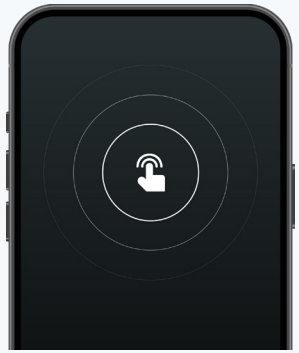


Functional Testing's Big Quality Problem: Human Subjectivity

Assessments of used smartphones involve functional testing and cosmetic grading. Because it includes both defect detection and grade assignment, cosmetic grading is typically the focus of discussions related to fair market value pricing and consumer trust and confidence. However, functional testing has a clear role in both of these areas.

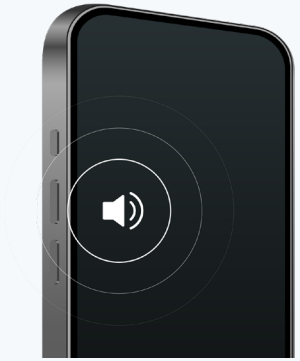
Functional testing assigns pass-fail determinations to the overall performance of essential smartphone device functions. While large volume scaled automation is common in North America, companies processing devices on a smaller scale primarily rely on human reviewers to conduct this testing. Their testing environments typically aren't controlled and standardized for temperature, lighting, humidity, background noise, and other external factors.

The binary nature of a pass-fail assessment suggests that functional testing is always straightforward. For some functions, it is. These include checks for stylus precision, Near Field Communication (NFC), wireless and wired charging current, and headset connection. These functions either work or they do not. Yet, making pass-fail determinations for other critical functional tests is much more nuanced—gray areas exist.



Display

Many defects are possible on the display—from non-working individual pixels to burn-in, a ghosting effect caused by displaying static images for too long. Tolerance for defects is not universal. What matters to one organization might not matter to another, and vice versa.



Audio

Testing smartphone speakers and microphones is not simply a matter of determining whether they work or not. The evaluation focuses on whether the sound quality is acceptable. This is very subjective, and determinations are heavily influenced by the sharpness and sensitivity of human testers' hearing.

Camera

Like displays, cameras can have many defects, and most smartphones have multiple cameras. Companies often test camera functionality based on the recognition of a QR code. This test effectively determines if the camera is working, but not how well it works.

Gray areas expose **how problematic human subjectivity is in functional testing.** Human-based assessment is highly variable, and different testers make different determinations. One tester's evaluation of the same phone can differ depending on the testing environment, their mood, and more.

This variability challenges the accepted notion that a functional testing pass is always synonymous with quality because not all passes are identical. Variability also raises the question of whether the pass will always meet consumers' expectations. This reality alone jeopardizes the quality of secondary devices—and the consumer trust that hinges on it.

02

Robotics is Supercharging the Assessment of Used Smartphones

Companies that have run manual functional testing for years assume they are catching all defects. But with so much subjectivity in play, this is not always the case. The stakes are too high for assumptions and guesswork in functional testing.

Overgrading devices—assigning them a higher grade than they merit—further erodes trust in the supply chain. Whether a wholesale buyer purchases a device lot from a processing company or a consumer buys a single device from a wholesaler, misplaced confidence in device quality damages buyer trust. As that trust declines, so does the overall revenue for sellers.

This is why Apkudo deploys robotics to offer functional testing unaffected by human subjectivity. **While manual testing is subjective for some functions, robotics make objective, precision-based pass-fail determinations for *every* function.** In addition, Apkudo's robotics include the determining factors for why failures occur. Companies get an extra layer of testing results and insights unavailable elsewhere.

Apkudo's robotic processing solution includes modular, integrated processing cells that automate every step of device induction and preparation. The functional testing cells include display, touchscreen, camera, and audio. Pass-fail determinations are based on thresholds specific to individual phone models. We set these thresholds using a comprehensive global device library cataloging every phone model, specifications, size, and color. Our New Product Introduction (NPI) process adds new models into the diagnostics and cosmetic testing library, enabling consistent and trusted outcomes.

Apkudo's functional testing is more insightful than manual testing for multiple reasons. It is conducted in a controlled testing environment, and detailed analytics enrich the results. Apkudo can avoid false fails by connecting functional testing and cosmetic grading results. For example, if cosmetic grading reveals a scratch on the display, we exclude this from the display test. So, if a defect is detected, it is truly a functional problem, not an artifact of a cosmetic defect.

Functional testing with robotic precision and human insights

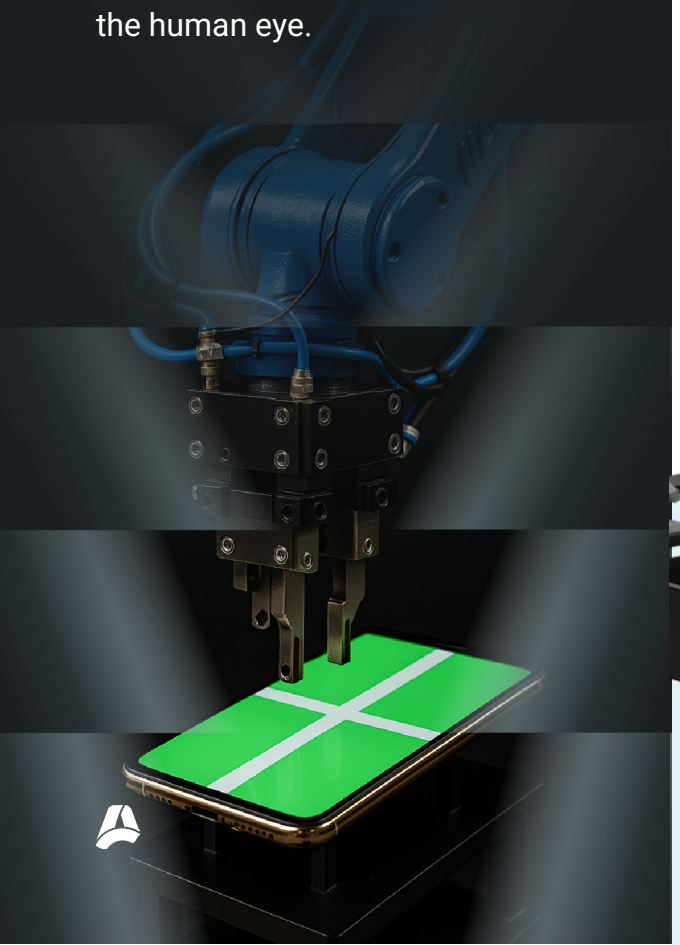
- Objective
- Accurate
- Repeatable

While platform-powered robotics perform fully automated device functional testing, human interaction still plays a key role. Humans monitor the processing line, handle exceptions, and make informed decisions about how to act on test results using more data than previously available. Apkudo customers get more than a pass or fail determination without context. Apkudo provides insights that show why the device failed, so the decision-makers can precisely and quickly determine what needs to be done to recover the device to a higher standard.

03

Apkudo’s Robotic Processing: More Quality, Less Subjectivity

At Apkudo, we focus on the quality of functional tests, not the quantity. Our testing is so precise that it identifies defects invisible to the human eye.



Display cell

Conducts pixel-by-pixel analysis of discoloration, convexity defects, pixelation, and burn-in using high-precision camera technology and Apkudo analytics software.

Camera cell

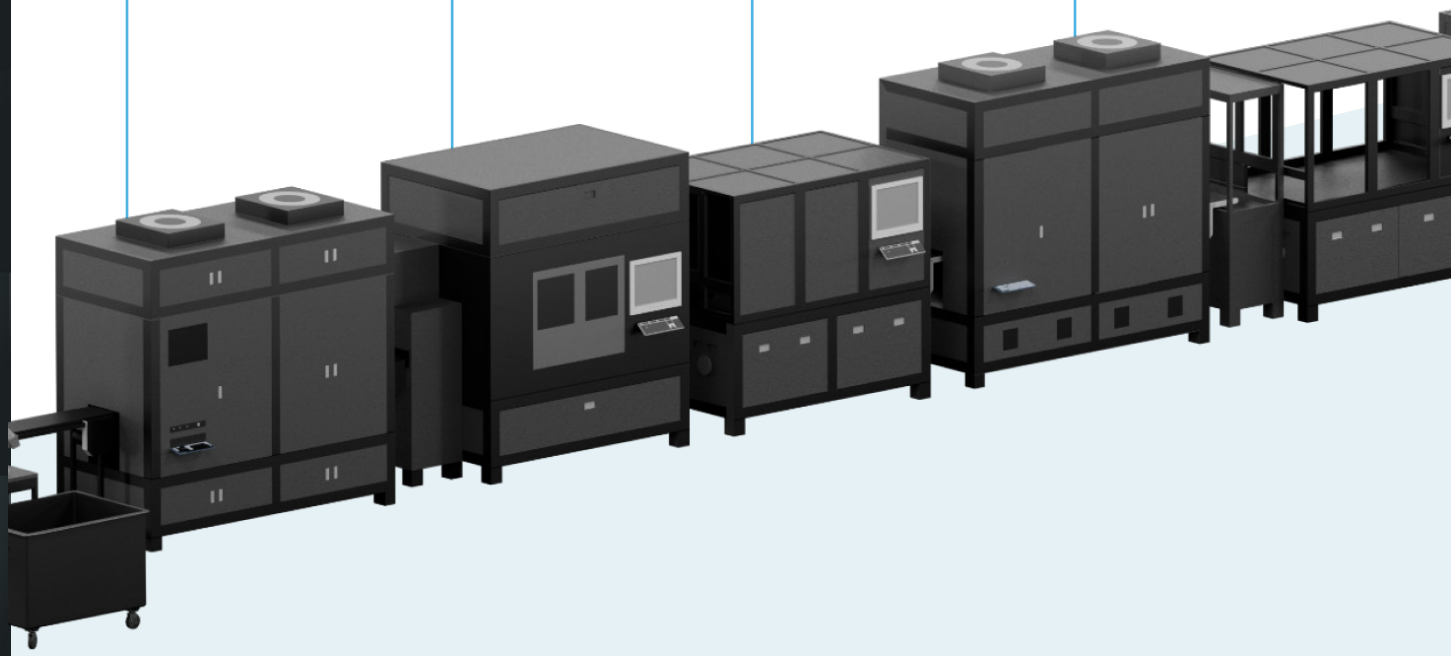
Takes pictures of defined test patterns using both front and rear cameras to test for focus, colors, brightness, and more.

Touch cell

Completes single- and multi-touch testing with robots, drawing touch test patterns and using Apkudo touch analytics software to analyze the recorded results.

Audio cell

Measures speaker and microphone audio levels and distortion in a highly controlled, audio-shielded test chamber.



An Industry Breakthrough

Functional Testing Gives Decisionmakers More Insight and Control

When robotics perform functional testing, a common misconception is that humans lose control of the process. In reality, they gain more.

Our functional testing offers nuanced pass-fail determinations that are objective and accurate. Decision-makers have more insight to make grading and pricing decisions based on test outcomes within the business rules they set. The testing offers insight. Decision-makers control what to do with it. They can ignore specific tests or have different grading scales based on customer channels. For example, particular functional fails may not be as relevant for B2B sales as for B2C sales.

More control through more insight is a business breakthrough—a turning point for this industry.

Getting meaningful, actionable insights from functional testing is an industry first. With insight into *fault detail,* not just *fault type,* companies can direct devices to the best channel to maximize value while minimizing bounce rates. At the same time, they can increase the value of used smartphones with more targeted repairs.

> With deep insights from our functional testing, companies can support device longevity in new ways, revisiting grading scale and pricing structures and opening the door to create new business value.

Imagine a device has an LCD fault. In today's pass-fail determinations, the company can sell this device with a failed LCD for a low cost or pay for an LCD replacement. However, with precise fault data from Apkudo, the company can sell the same device to a specific channel or customer that they know tolerates certain fault types. This eliminates the cost of uplift. The device brings more value because it can be sold as an *LCD pass with acceptable minor defects* rather than as *LCD fail.* The company isn't locked into selling the device at a lower price without investing in uplift or in repair to sell it at a higher price. They now have a third option: sell the device at a higher price with zero repair investment.

Having more selling options is a profound shift. Companies that recognize this and reinvent how their strategies for assessing device value, determining next steps, and enabling reuse can seize the business opportunities that come from having—and acting on—more detailed testing data.

04

Functional Testing in Action: Manual Testing Versus Apkudo Robotics Testing

	Display	Audio	Camera
Manual testing	Marco fails every phone he evaluates on his shift because they all have pink screens. He doesn't realize that the facility manager changed a fluorescent light bulb overnight to the wrong type with a pink hue.	Mary evaluates audio in a testing facility with background noise. She has trouble hearing the speaker sound, reports a defect, and fails the phone.	Jose evaluates the rear and front cameras of a smartphone and makes a pass determination.
Apkudo robotics testing	All display testing is conducted in a no-touch, automated cell in a highly controlled environment. The lightbulb change has no impact on testing results.	The phone plays a test tone inside an audio-shielded test chamber for a speaker test. No defects are detected, and the device passes.	Robotic testing identifies light orbs and records a defect. Jose never sees the orbs because the camera has to be facing a white wall for them to appear. Even then, they can be hard to spot with the human eye.

05

Focusing on Quality Fuels Trust

The notion that robotics must match human detection is fundamentally flawed. In reality, humans are wrong far too often, introducing variability that compromises quality and jeopardizes the growing secondary smartphone market. The more used devices meet consumers' quality expectations, the better business outcomes can be for circular device ecosystem players.

At Apkudo, we believe functional testing is a critical part of this equation, and our robotic processing system takes this testing to a new level. Our approach makes pass-fail determinations threshold-based, objective, and nuanced, offering companies more control. Combined with the Apkudo Platform, decision-makers get unprecedented, detailed insight into every device.

Human error should not define the quality of used devices. The availability of precision functional testing is a powerful opportunity for companies to change their businesses and promote device longevity and circularity in new ways. Precision testing offers the opportunity to pivot to precision management—a mindset and operational shift that will take this industry far.

To remain competitive, businesses must reshape device processes and fulfill the promise of quality that consumers deserve.

It begins with functional testing that delivers objective, accurate, and repeatable data.

About Apkudo

Apkudo helps customers optimize the management of connected devices, ensuring they extract maximum value, reduce costs, and minimize environmental impact. Its Circular Industry Platform offers comprehensive tools for enterprise asset recovery, automated testing and grading, lifecycle management, and seamless resale market integration. By streamlining processes and providing real-time decision support, Apkudo enables businesses to answer the critical question: “What should I do with this device, right now?” Whether assessing value, determining next steps, or facilitating reuse, Apkudo empowers customers to make smarter, more efficient, and sustainable decisions, transforming how they manage device lifecycles.

Copyright © 2025 Apkudo. All rights reserved.
Apkudo and its logo are registered trademarks of Apkudo.

AUTHORED BY:

Gary Landsberg
Chief Technology Officer
Apkudo

apkudo