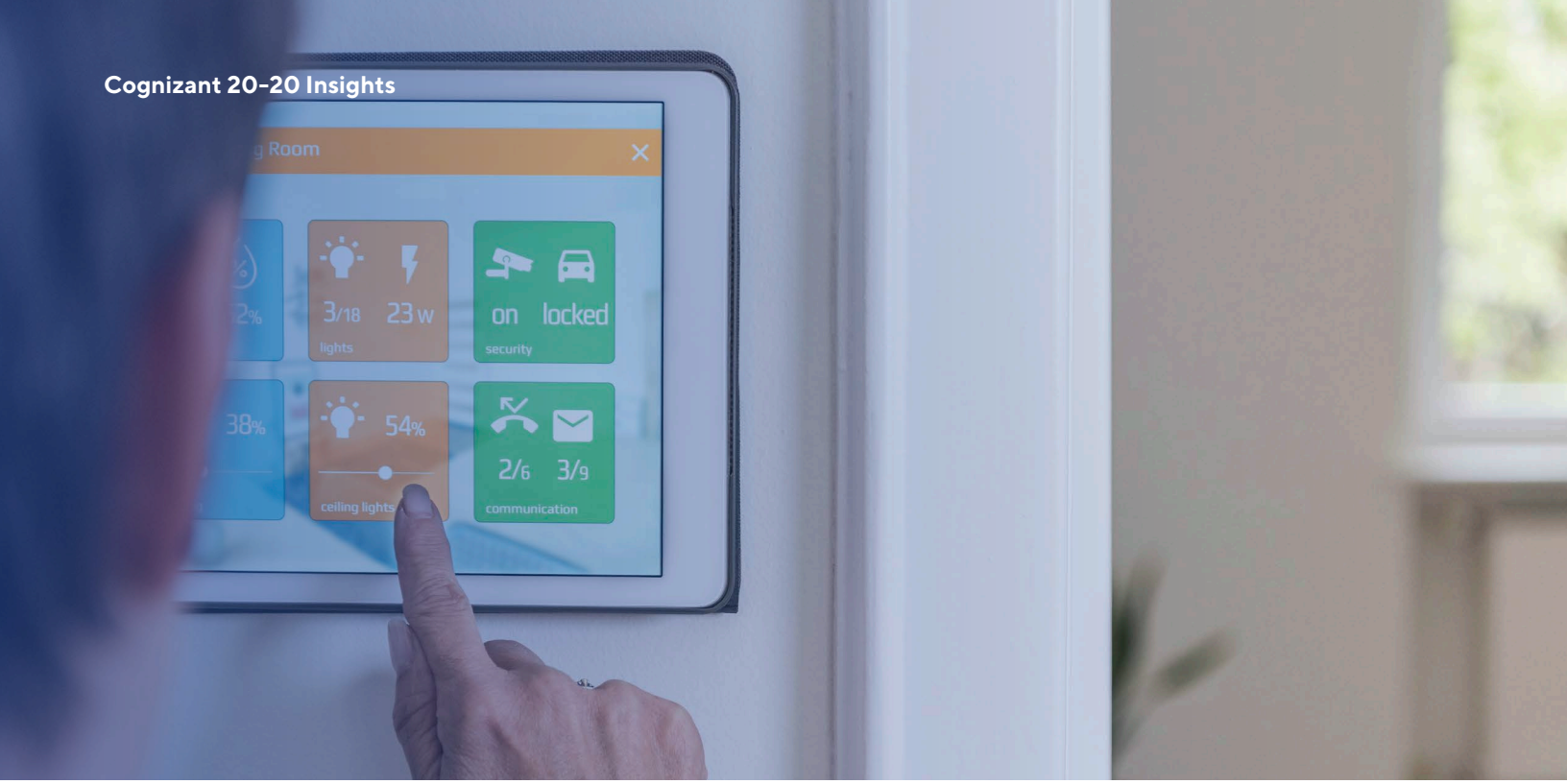

Digital Systems & Technology

Smarter QA for Smart IoT

By virtualizing components, simulating environments and using bots to automate human actions, enterprises can assure quality at speed for connected ecosystems such as the smart home.

Executive Summary

Digital pivots on the proliferation of smartphones and wireless technology, and the core function of a smart device is to sync applications through a network. Several such devices make up a connected ecosystem, such as a smart home, when they mutually communicate to transmit data and enable decisions based on digital footprints known as Code Halos™.[1] The technology powering these devices is collectively known as the Internet of Things (IoT) – a network of physical objects instrumented with sensors to interact with an internal or external IT environment to inform smarter business decisions.

To ensure that smart devices function as specified, enterprises need to validate not just the technology, but the entire process – starting from the trigger that activates the device, to its associated applications, network and environment, culminating in the desired result. A successful quality assurance (QA) strategy for such a diverse technological landscape must take into account interoperability – the ability of applications to mutually interact; the environment – the simulation of viable circumstances; and the elimination of human testing to drive quality at speed.

This white paper takes the smart home as the point of reference to elaborate on the concept of connected ecosystems, and addresses the challenges and opportunities inherent in the testing of such ecosystems.[2]

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Smart home elements

A smart home comprises smart devices that interact via a communications hub and which can be remotely controlled through a smartphone (see Figure 1). Built on the principles of IoT, smart homes allow information related to a household and its contents to be collected and disseminated, then put to use. For instance, in a smart home, the refrigerator keeps track of the expiration dates of its various contents. Every time the milk expires, the refrigerator app in the user's smartphone triggers a notification to buy milk, which triggers the navigation app to remind the user whenever he/she goes by the supermarket.

The connected ecosystem: A smart home

Figure 1

Another example of a smart-home device is the smart meter, which relays information about energy usage to end consumers and the utility company for better auditing and monitoring. In fact, the UK government has embarked on an ambitious plan to install smart meters in every household by 2020.[3]

Today's smart homes leverage smart devices ranging from simple stand-alone sensors that can detect changes in basements' water levels, to highly sophisticated appliances and devices equipped with self-learning and artificial intelligence (AI) capabilities.

Down to the basics: Complexities & challenges

Consider the situation of a fire outbreak. In a smart environment, the smoke detector sets off a fire alarm, which activates the water sprinklers and triggers a call to emergency services through the nearest smartphone.

This progression involves a situation (fire outbreak), devices that communicate (smartphone, smoke detector, sprinklers and fire alarm) and a network through which these devices communicate. To ensure the quality of smart devices, enterprises need to consider the following factors:

- **Interoperability:** The ability of different software to communicate in a given situation.
- **Myriad devices:** The ability of different devices to communicate with one another.
- **Environment:** A situation that acts as a stimulus to trigger smart devices into action.
- **Human intervention:** The necessity of a human action to trigger a response from a smart device.

Method to the madness

Adopting a smarter approach to QA can help enterprises simulate real-world conditions in a test lab through virtualization techniques. Deploying software-testing bots to automate human actions can eliminate the need for human intervention.

The following approaches can make QA for connected ecosystems smarter:

- **Automated testing for Zigbee:** Smart devices in a connected ecosystem communicate through a protocol known as Zigbee. To test these devices, QA teams communicate through code commands that exist in hexadecimal format (a combination of letters and numbers). Manually testing the devices using these commands can derail the release cycle. Using a Zigbee API from an automation framework through a Zigbee USB dongle can help QA teams test the device by applying scripts, thereby eliminating manual efforts and driving quality at speed (see Figure 2).
- **Replacing human activities with bots:** The physically repetitive tasks of certifying smart devices can be delegated to bots (see Figure 3, next page). For instance, bots can test thermostats by simulating the human action

Test automation: Achieving quality at speed

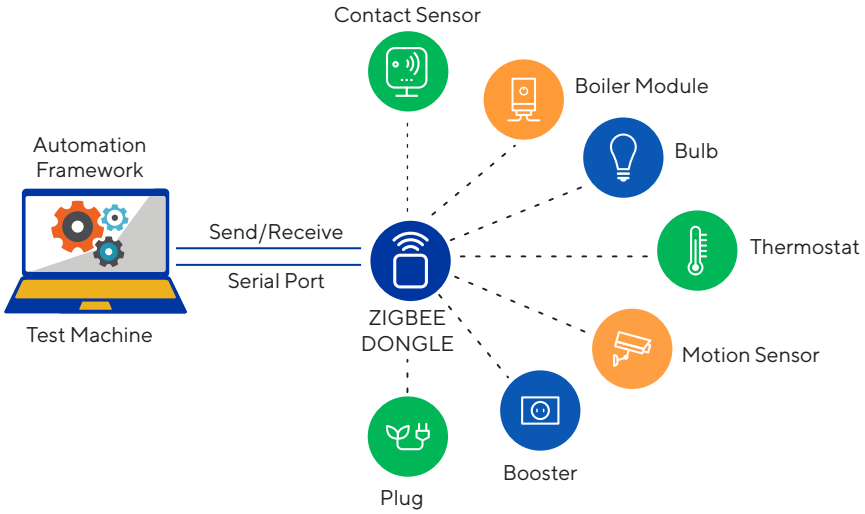

Figure 2

Adopting a smarter approach to QA can help enterprises simulate real-world conditions in a test lab through virtualization techniques. Deploying software-testing bots to automate human actions can eliminate the need for human intervention.

of rotating a knob. They can certify thermostat screens for foreign languages by capturing the screen through a camera and validating the value using optical character recognition (OCR). They can also help QA teams validate motion sensors by mimicking physical actions numerous times with high execution accuracy.

- **Quasi server for apps:** The development of front-end mobile applications and back-end server changes occur independently. Inevitably, there is a gap between completion of mobile application development and server changes, but this pain point can be addressed through test automation. Hence, the application can be independently tested by leveraging a stub-like implementation. A mock server can be deployed to send continuous data, such as a smart meter does. This helps identify functional defects in the mobile application much earlier and reduces time to delivery.
- **Pseudo apps:** Similarly, since the development of front-end apps occurs post hardware manufacturing, testing the hardware device and API integration without a user interface

Removing tedium from testing

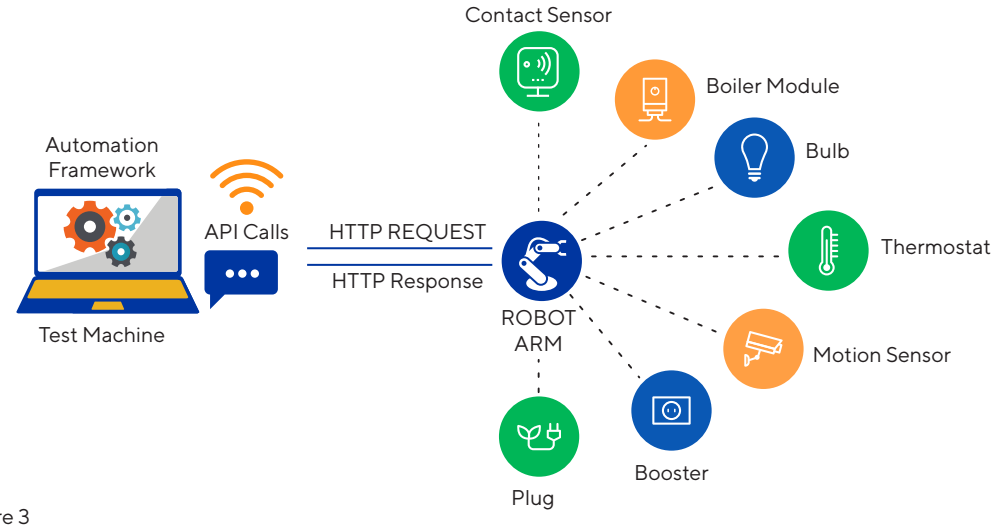

Figure 3

An app can be virtualized to test its geolocation functionality, which requires that the device be taken to a particular location from the hub to trigger a response.

(UI) is a challenge. To address this, a dynamic test app is created, with all the core (basic) functionalities required to test app integration with the hardware (see Figure 4, next page). This helps to secure an early sign-off from testers and developers, and can in some instances reduce testing efforts by up to 40%. Similarly, an app can be virtualized to test its geolocation functionality, which requires that the device be taken to a particular location from the hub to trigger a response.

- **Smart plug for smart meters:** Automating processes for smart devices that include a consumer access device and a communications hub is difficult. For instance, data on energy consumption should be authenticated by retrieving values from a smart meter and validating them on the consumer's application. For end-to-end coverage, a smart plug can be used with the automation framework. This can record data without the smart meter, and helps testers to validate the same in end-users' applications.
- **Voluminous execution:** Device testing usually employs a third-party, cloud-based mobile solution for test execution. However, as demand for a new build increases, multiple rounds of testing are required. In this scenario, the third-party solution can prove to be expensive. To address this, developing a mobile device farm as a replacement for third-party solutions can meet the frequent execution requirements at a minimal cost. Additionally, it can apply parallel Android and iOS execution with the Appium test automation framework.

Deploying an app to automate testing

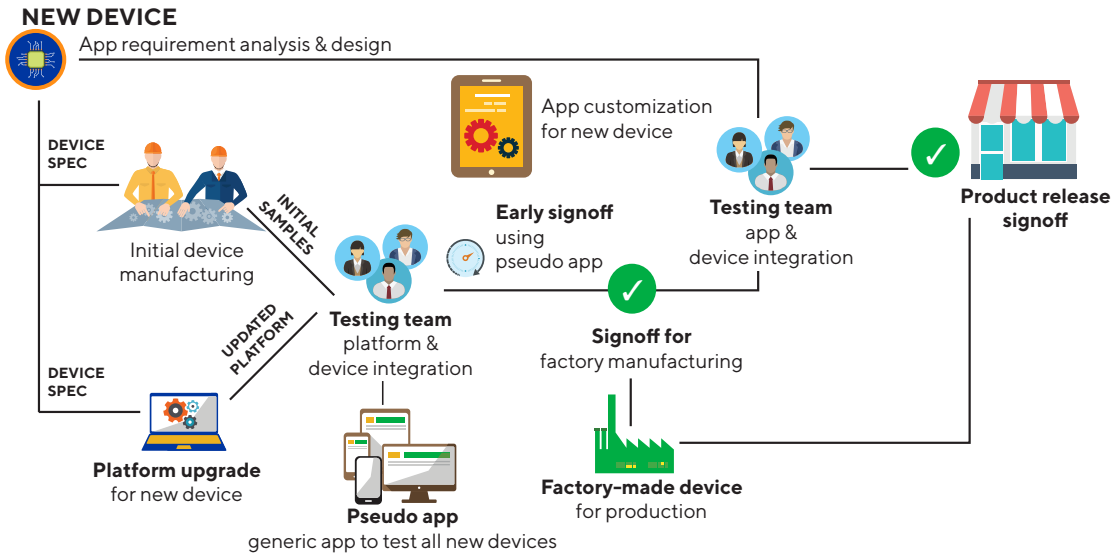

Figure 4

Quick Take

UK Energy Utility Speeds Testing Through Simulation

A leading UK energy supplier had entered the highly competitive, device-intensive smart home market. It wanted to assure seamless functioning of its connected devices and apps.

The interoperability of the connected system was assured by simulating the home automation ecosystem in a test lab. A robotic testing solution was deployed to mimic human-to-device interaction, which also eliminated human intervention and resulted in faster validation.

By taking this approach, the company achieved:

- 50% faster release time through end-to-end automation.
- 75% increase in its customer base.
- Significant CapEx reductions through service virtualization.

In today's digital age, the notion of quality has become closely linked to customer experience, business processes and technology. This is especially true for smart homes, where technology and business processes merge to drive a personalized customer experience.

The way forward

In today's digital age, the notion of quality has become closely linked to customer experience, business processes and technology. This is especially true for smart homes, where technology and business processes merge to drive a personalized customer experience.

Consequently, assuring quality for such connected ecosystems is a concerted effort, requiring testing of each smart device in relation to one another. As this white paper shows, high levels of automation and robotics can significantly improve smart-device QA.

However, to automate processes, most enterprises need a greater level of expertise in the QA domain, modern digital skills and more experience with the latest improved automated test technologies. They must be willing to turn away from traditional manual testing toward an ecosystem approach that rapidly orchestrates tools, technology and talent to drive quality at speed.

Endnotes

1 For more on Code Halos, read our book, *Code Halos: How the Digital Lives of People, Things, and Organizations Are Changing the Rules of Business*, by Malcolm Frank, Paul Roehrig and Ben Pring, John Wiley & Sons, 2014, http://www.wiley.com/WileyCDA/WileyTitle/productCd-1118862074.html.

2 Subbiah Muthiah, Ramakrishnan Venkatasubramanian, "The Internet of Things: QA Unleashed," Cognizant, April 2015, https://www.cognizant.com/whitepapers/the-internet-of-things-qa-unleashed-codex1233.pdf.

3 https://www.gov.uk/government/publications/smart-meter-roll-out-gb-cost-benefit-analysis.

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Pramod Nikhar is a Director within the Quality Engineering & Assurance (QE&A) Practice within Cognizant Digital Systems & Technology. As a quality practitioner, he is responsible for quality-as-a-service to energy and utility clients in the UK and Ireland. Pramod has over 15 years of industry experience across various QE&A segments. He holds a bachelor's degree in computer engineering and a post-graduate diploma in international business. Pramod can be reached at Pramod.Nikhar@cognizant.com.

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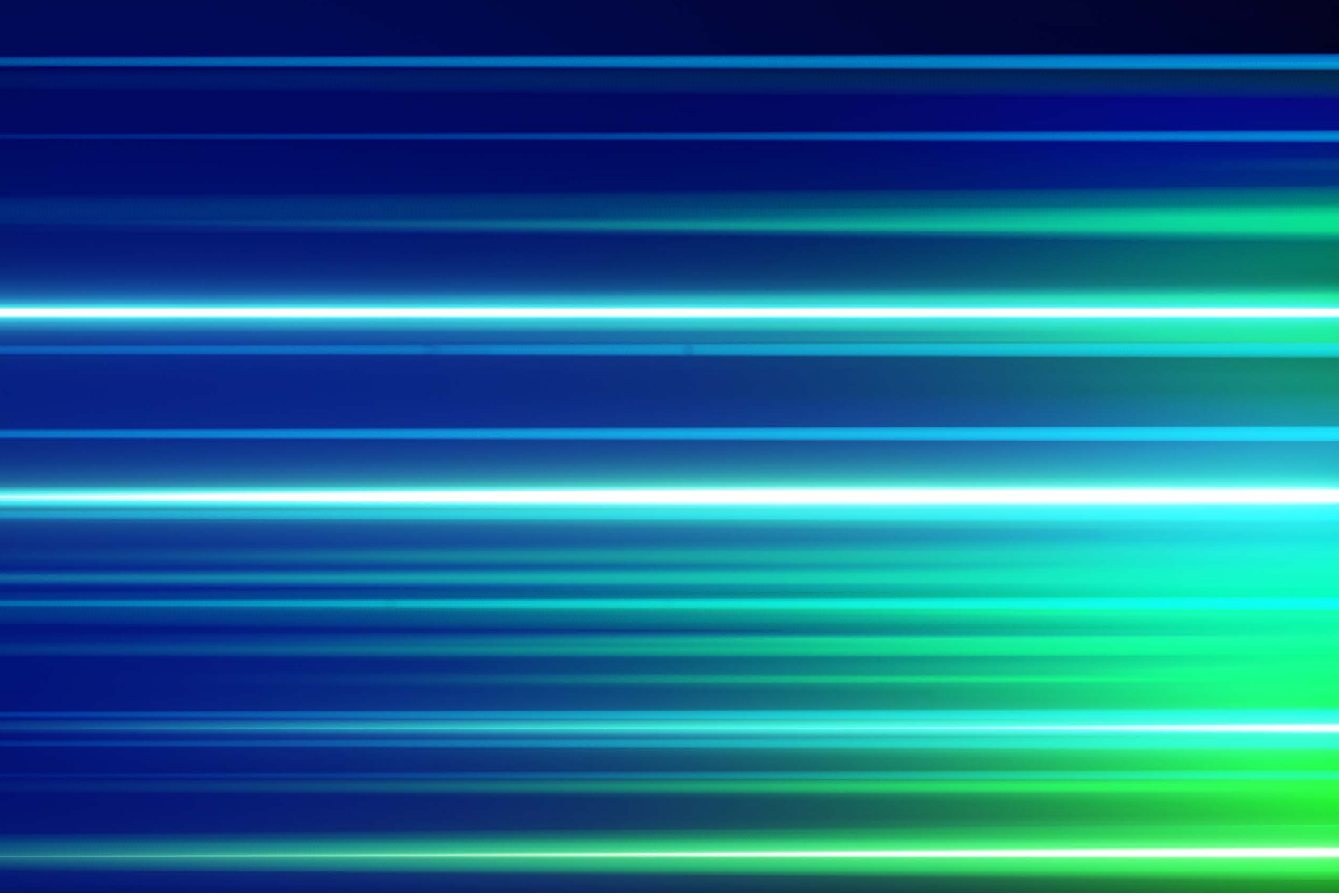
Karthikeyan Murugesan (Karthik) leads Cognizant's Quality Engineering & Assurance Practice for the UK and Ireland. He consulted for more than 20 years with companies across industries to drive quality outcomes. Karthik's vision is to drive quality seamlessly across the development cycle by leveraging leading automation technologies such as machine learning and other forms of AI. He can be reached at Karthikeyan.Murugesan@cognizant.com.



About Cognizant QE&A

Cognizant's Quality Engineering & Assurance (QE&A) is an independent business unit that addresses the end-to-end quality needs of today's digital enterprises. Cognizant's intelligent and automated approach to QA, driven by business-process-aligned test strategy and network-effect platforms, creates quality-led market differentiation. With more than 650 clients across industry verticals and a global footprint, Cognizant QE&A is a recognized thought leader in quality assurance.

About Cognizant

Cognizant (Nasdaq-100: CTSH) is one of the world's leading professional services companies, transforming clients' business, operating and technology models for the digital era. Our unique industry-based, consultative approach helps clients envision, build and run more innovative and efficient businesses. Headquartered in the U.S., Cognizant is ranked 193 on the Fortune 500 and is consistently listed among the most admired companies in the world. Learn how Cognizant helps clients lead with digital at www.cognizant.com or follow us @Cognizant.

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