Assuring Mobility for the Internet of Everything

Abstract

Born of the convergence of wireless technologies, micro-electromechanical systems (MEMS), and the Internet, the Internet of Things (IoT) promises a future where objects will be connected to the Internet and each other. The real-time communication between these devices will make the devices smart, and drive many business and consumer use cases, not just improving business agility and operations, but also customer experience and the overall quality of life. In the context of such a connected future, we need to assure the systems, sensors, devices, all in the realm of IoT—since much could go wrong if any one of those connected articles were to malfunction. This calls for an all-encompassing testing strategy for IoT, with testing approaches that ensure maximum test coverage and returns from IoT testing.

Communication of Everything with Anything

To be useful, IoT devices need to talk to each other. This requires mobile applications and connectivity. The future world will interact with 'things' through digital modes, driven by smart phones and wearable devices. Mobility will play a key role as the bridge between the IoT and users.

With sensors for acceleration, temperature, proximity, light, sound, altitude, and magnetic fields, the smart phone is an ideal device for monitoring health, driving speed, personal habits, and even the magnitude of earthquakes. Simply put, when integrated with mobile, the IoT promises to positively impact our homes, health, city, industry and social environment.

The convergence of mobile and the IoT, with other emerging technologies such as artificial intelligence (AI), augmented reality (AR), Big Data and analytics, and social technologies will have an even greater impact not just on our lives, but the next generation too.

The Testing of All Things

While the sensors and actuators in our smart phones lend intelligence, connectivity and access to equipment spread across networks, they also introduce data privacy and security risks that need urgent attention. Made up of devices, networks, back-ends, protocols, and machine-to- machine communication, a small change in one device can impact not just the device, but all connected systems downstream.

The ever-growing number of things (sensors, equipment) and mobility channels (smart phones, wearable devices), require new and innovative testing approaches and infrastructure. Lack of universal IoT testing standards, coupled with tight schedules, further aggravate the testing challenge. Testers must also account for changing market conditions, and diverse product specifications. Together, these challenges make IoT testing time consuming and complex.

However, in addition to these challenges, IoT testing poses potentially newer challenges such as the need for:

- Defining device functionality to meet business requirements
- Ensuring sensor performance through wear and tear over a period of time and in varied weather conditions
- Enabling uninterrupted, always-on, high-speed network communication
- Providing security from threats such as backdoor trojans, viruses, malware and denial of service attacks
- Offering a high level of usability through the Device User Interface (UI) and smart-ness
- Complying with device hardware and sensor development and deployment specifications
- Ensuring smooth integration with third party APIs to perform complex tasks
- Setting up comprehensive test environments accounting for different conditions

The Strategy for All Testing

While the challenges present a difficult testing terrain, an all-encompassing strategy, comprising multiple approaches, provides the ability to take the challenges head on, and ensure maximum coverage and return from IoT testing:

Get a Holistic View for Continuous Improvement

To assure functionality, we need to focus on hardware controllers, sensors, mobile device interaction, and access controls, while continuing to discover exceptions. We must also set access controls, monitor sensor behavior, keep a watch on notifications and alerts, and validate and verify data. Moving towards a radical shift in application testing, we need to continuously discover new test scenarios under different test environments.

Use a Different Approach for Different Device Channels

Wearable devices such as smart watches need a design-specific testing approach, as these are produced by multiple manufacturers for specific purposes including burning calories, monitoring heart rate, and facilitating surveillance.

Perform Usability Testing

Human Computer Interaction (HCI), combined with pattern judgments and heat maps, helps develop consistent and intuitive user interfaces that improve user productivity and device acceptability. In addition to usability, we also need to test all physical things, sensory reactions including sight, sound, touch, size, and shape, and verify, validate, and correlate user demographic information with test results.

Ensure Security

Despite fast-emerging smart homes and businesses, device manufacturers do not always adhere to basic security requirements, which could lead to security vulnerabilities. We need to adhere to guidelines specified by the Open Web Application Security Project (OWASP), whose top 10 security considerations for IoT[1] could form the initial basis for testing.

Assure Range and Frequency

As range is a major issue in mobility, we need to test 3G and 4G devices under various signal strengths, including zero signal. This testing needs to be done for Wi-Fi, Bluetooth, NFC, and other communication technologies and protocols.

Ensure Performance through Soak Testing*

The rising number of connected things will increase the load on individual devices, and will call for discovery and considerations of new types of load, stress, failover, spike, and other performance tests. Most IoT devices are planned for extended usage, without being stopped, restarted, or re-booted. Given this reality, soak testing is imperative for IoT device success.

Simulate Usage Scenarios

Testing sensor interaction with mobile devices needs to take into account usage scenarios, environment, and climatic conditions. However, it may not always be possible to test for certain non-reproducible scenarios such as extreme temperatures. Sensor simulators could be leveraged to simulate sensor actions under certain conditions.

Gartner, Inc. forecasts that the number of connected things in use will reach 25 billion by 2020[2].

Use Real Devices

To ensure 100% accuracy of test results, assurance for IoT, especially the testing of equipment that rely on sensors, should be done using real mobile devices, not simulated virtualized appliances.

Ensure Uninterrupted Data Transmission and Collection

Communication failure between devices and things could result in functionality failure. It is therefore important to ensure uninterrupted data transmission and collection.

Deploy Network Simulation Tools

Testing of things over a network requires setting up the entire test environment, comprising multiple networked computers, routers, smart devices, network emulation tools, real network mediums and data links.

Conclusion

We have miles to go when it comes to testing IoT devices and their interaction with the real world. The complexity of varied devices continuously talking to each other and exchanging data over networks and bandwidth, stresses the importance of mobility testing. Traditional testing procedures, paradigms and approaches are of limited use for testing emerging IoT technologies and devices. Generally, no two devices follow an identical testing procedure, hence IoT testing requires a personalized approach for each unique device.

The existing major players in mobility assurance are working extensively towards providing better testing platforms for quality assurance of IoT devices and apps. We need to prioritize the testing approach as well because it forms the foundation of smooth communication between smart devices of the future.

References

[1] OWASP, OWASP Internet of Things Top 10, 2014, accessed Dec 2014, https://www.owasp.org/index.php/OWASP_Internet_of_Things_Top_Ten_Project

[2] Gartner, Gartner Says 4.9 Billion Connected "Things" Will Be in Use in 2015, November 11, 2014, accessed Dec 21, 2014, http://www.gartner.com/newsroom/id/2905717

[*] Soak testing is a non-functional test to examine if a system can withstand a huge load for long periods of time, and to measure its reaction parameters.

About The Authors

Manikanddan GC

Manikanddan GC is a part of the Mobility Assurance CoE at TCS, and handles mobile test and automation solutions for various customers across verticals. He focuses on innovating new mobile test services and models, app monitoring, and continuous Q-Ops.

Vignesh Viswanathan

Vignesh Viswanathan works on consulting and solution strategies for mobile app testing and automation across the Retail, Travel, and Hospitality and BFS industries for TCS. He assists customers to deploy Mobile Test Solutions and discover futuristic test services with IoT.

About TCS' Assurance Services Unit

With one of the most comprehensive testing portfolios on offer, TCS addresses business, quality, and risk management challenges for its global clients. We empower organizations across domains to ensure first-time-right releases, reduce cost of quality, and accelerate superior customer experience.

TCS offers assurance services across the testing value cycle, including test consulting and advisory, test services implementation, and managed services for test environment and test data management. We continually redefine testing and QA paradigms to help our clients stay ahead of the curve. Our library of domain-based reusable business functions and proven engagement model founded on the twin pillars of product and process quality enable us to deliver certainty to our clients.

Over 30,000 testing consultants, strategic alliances and partnerships with key product vendors, more than 65 dedicated test centers of excellence and our innovation labs power our tailor-made solutions, testing assets and accelerators. TCS has the unique distinction of being the only global IT services organization to have been recognized consistently as a 'Leader' in the Quality Assurance space by leading analyst firms – Gartner, Ovum, Everest, IDC, NelsonHall and HfS - over the last few years. With specialized test environments and labs, TCS drives the delivery of assurance in a non-disruptive, agile, and automated manner, making the entire development lifecycle more efficient.

Contact

Visit TCS' Assurance Services unit page for more information

Email: global.assurance@tcs.com

Blog: #ThinkAssurance

Subscribe to TCS White Papers

TCS.com RSS: http://www.tcs.com/rss_feeds/Pages/feed.aspx?f=w
Feedburner: http://feeds2.feedburner.com/tcswhitepapers

About Tata Consultancy Services Ltd (TCS)

Tata Consultancy Services is an IT services, consulting and business solutions organization that delivers real results to global business, ensuring a level of certainty no other firm can match. TCS offers a consulting-led, integrated portfolio of IT and IT-enabled, infrastructure, engineering and assurance services. This is delivered through its unique Global Network Delivery Model™, recognized as the benchmark of excellence in software development. A part of the Tata Group, India's largest industrial conglomerate, TCS has a global footprint and is listed on the National Stock Exchange and Bombay Stock Exchange in India.

For more information, visit us at www.tcs.com

Experience certainty. IT Services
Business Solutions
Consulting

TCS Design Services I M I 11116