EXTREME AUTOMATION OF TODAY'S TECHNOLOGICAL MARVEL - CONNECTED CARS

- Sandhya Jeevan Rao
Senior Project Manager

Abstract

Going by Gartner's findings which suggests that "25 billion connected 'Things' will be in use by 2020", it is important to think of the strategies that businesses will adopt, to uncover risks involved in implementing and delivering high-end IoT technologies. Lack of proper testing procedure leaves developers uncertain about the reliability of their software, and also affects how organizations determine the risks involved in the IoT technology.

Connected cars is the most widely used IoT implementation, with telematics playing a major role by making use of cutting edge technologies and solutions. While connected car is today's technological marvel, the great risk faced by all OEMs as they move further is that they have to bring new and innovative services to the market by keeping pace with technological innovations and by becoming more agile. In this article, we will be discussing about the extreme test automation methodology for IoT implementations, by using connected cars as an example and addressing the QA needs across diverse systems and multiple technology components, including hardware, software, and multiple releases that are delivered in agile mode.

Introduction

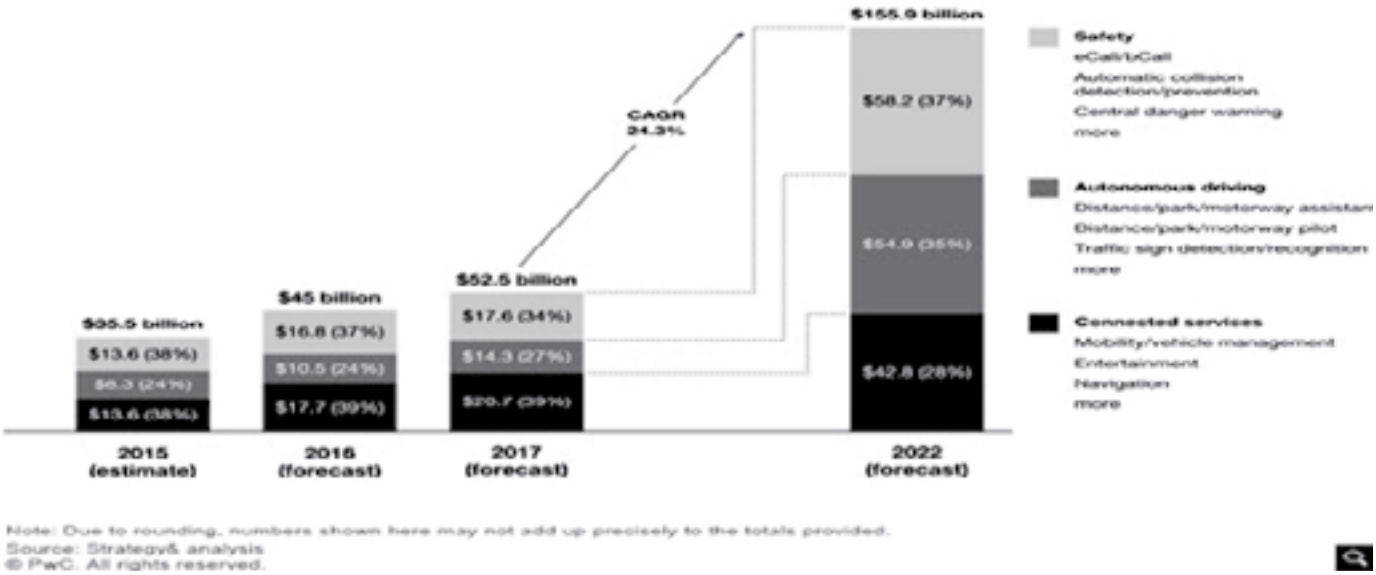
What makes IoT implementations a challenging endeavor is its diverse set of systems, technologies, variety of sensors, and network connections. These are unique characteristics that allow organizations to introduce cutting-edge, customer-centric services. The connected cars ecosystem is a typical IoT implementation delivered using a complex amalgamation of Cloud, Telecom Service Providers (TSP), Mobile Network Operators (MNOs), internal / external systems, and embedded software / hardware to the telematics unit. The complexity of the connected car ecosystems are attributed to factors such as manufacturer-specific requirements for HMI, web, and mobile applications, communication mechanisms (including V2I, V2V, V2X technologies), network latencies, and real-time performances. This ecosystem brings with it a set of challenges from an end-to-end QA perspective, implying that a successful test strategy is the key in understanding the needs of end users and thereby is crucial for delivering excellent customer experience.

The connected cars packages offered by OEMs:

OEMs today offer three primary connected package options:

- Safety (including driver assistance, lane management, etc.)
- Autonomous driving (including adaptive cruise control, self-parking, etc.)
- Connected car features and services (including vehicle management, vehicle diagnostics, consumer and commercial applications)

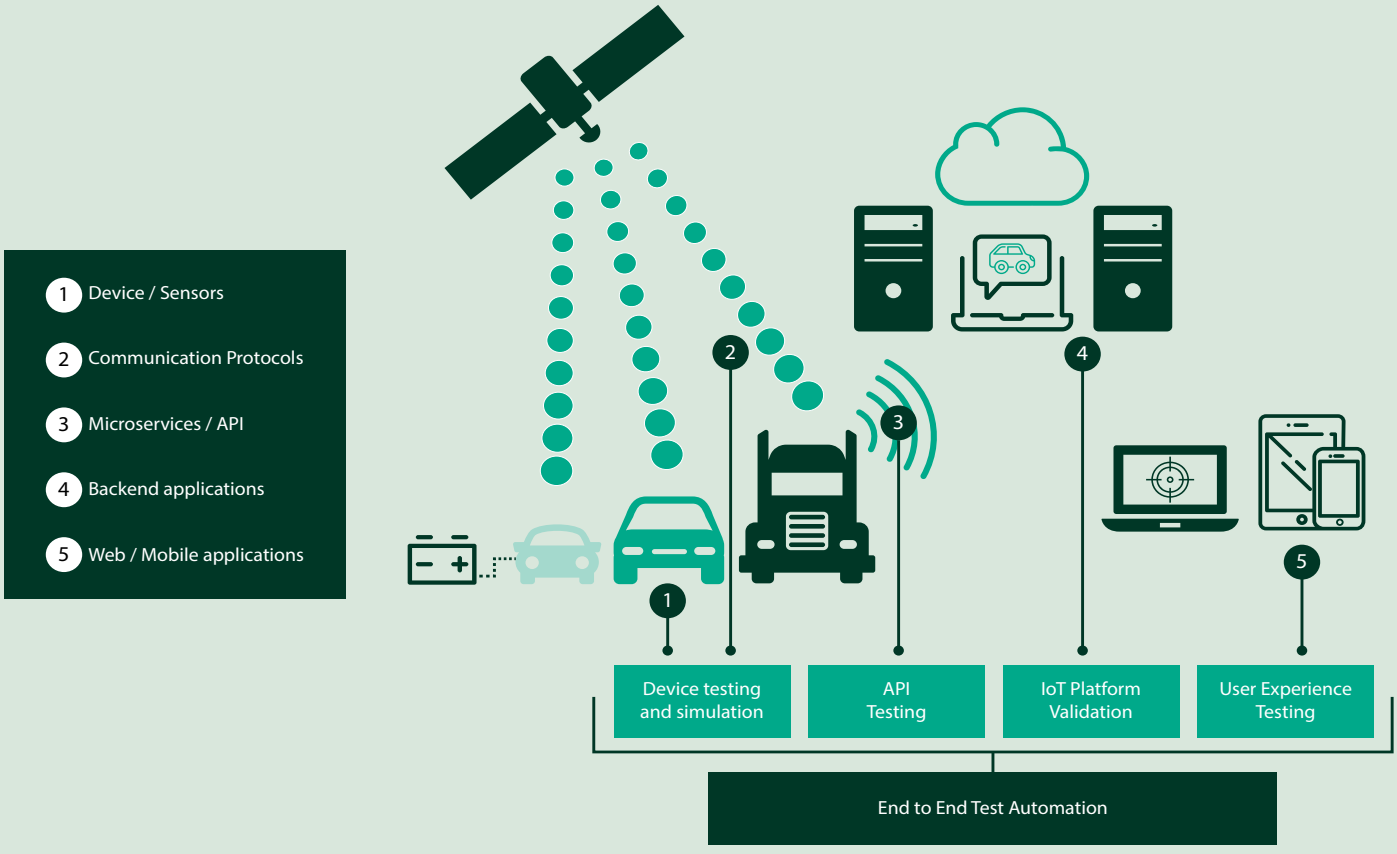
The picture below shows the estimated market share per connected car package from the period of 2015 to 2022, representing a steep increase after 2017, clearly indicating a need for OEMs to invest in identifying and addressing all risks associated with successful service delivery. While developing the software is only half the battle, remedying issues & risks requires that OEMs adopt a comprehensive test strategy with tests that provide measurable results, with regard to risk potential and confidence level that can be compared across different elements of the software.



Note: Due to rounding, numbers shown here may not add up precisely to the totals provided.
Source: Strategy& analysis

QA imperatives of the connected car packages

Validation of a connected car ecosystem involve handshakes between multiple QA touch points that span across device end validations, validation of web-based applications, mobile applications, and cloud -based telematics applications for analytics and data storage. Depicted below is a typical connected car ecosystem consisting of components that are of interest from a QA perspective across multiple layers: device layer, communication layer, and the application layer.



While traditional manual testing methodologies help reduce the risks associated with delivering a highly integrated software, extreme test automation of the connected cars ecosystem is imperative to an agile mode of delivery that is adopted for achieving a faster time-to-market, which is an important objective of OEMs implementing telematics applications. Listed below are a set of challenges associated with test automation of connected cars ecosystem.

Intelligent Devices	Connectivity	IoT Platform	Enterprise Systems	Applications
Dependencies	**Multiple protocols**	**Complexity**	**Coverage**	**Multiple configurations**
• Dependency on vehicles and devices • Need for a human interface, especially for in-car HMI, physical buttons (like e-call), etc.	• Support for different network simulations for all type of IoT protocols • Infrastructure to simulate geographical spread and high load conditions	• Complex architecture with multiple integration points • The distributed and independent development methodology followed for hardware device and application software	• Ability to cover all possible events and errors • Large amounts of test data required • Dependency on third party software integration	• Multiple desktop/ laptop OS • Multiple mobile phones and OSs • Multiple browsers

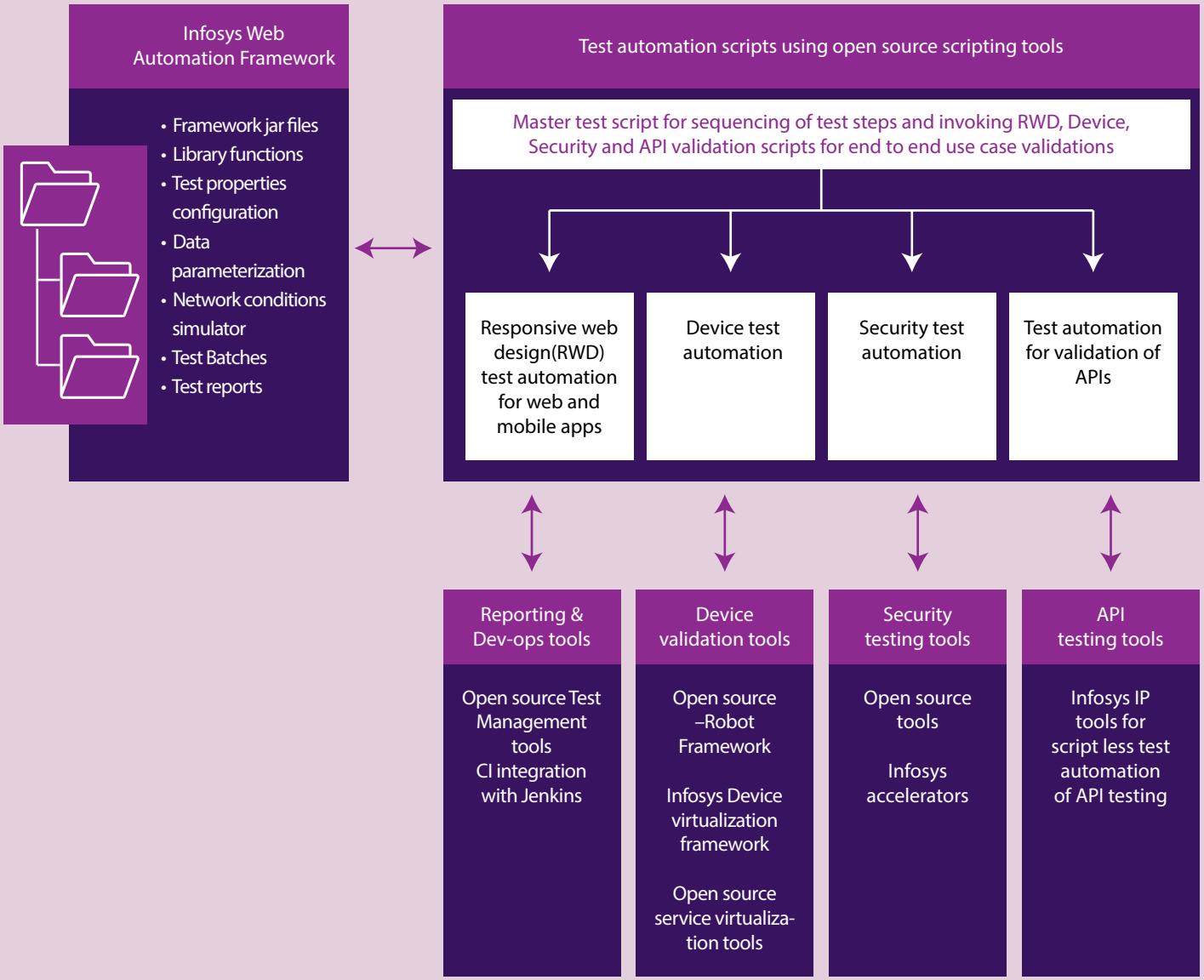
Infosys Extreme Test Automation framework for IoT Implementations

The Infosys Extreme Test Automation methodology is a holistic QA approach that addresses unique challenges in IoT implementations such as connected cars, smart asset management, smart farms, smart factory, smart home, smart energy, connected health, and connected store solutions. Using a hybrid automation framework – which is a unique combination of open source tools and Infosys IP tools – the framework supports validation of devices, web, and mobile applications and backend server integration using microservices / APIs, ensuring a faster return on investment for client organizations.

Details of the framework components and features supported are listed below

 Framework component	 Features supported	 Benefits
iWAF – Infosys web automation framework	• Customized framework with 80+ wrappers based on Selenium web driver • Supports web and mobile app automation with exhaustive OSs, browsers, mobile device versions, and combinations • Structured, scalable, and reusable framework with clear reporting and easy integration capabilities	• **Reduced cost of ownership** using open source tools • **40% Faster time to market** with accelerated test automation • **Complete coverage** of test requirements • **Modular, extensible framework** that reduce maintenance efforts
iFAST- Infosys framework for API and services testing	• Excel-based codeless automation script development • Pre-built templates for common API/Service validation patterns	• Ease of use and reduced testing cycle time by 40% due to **early automation** using pre-built templates
Infosys device virtualization and device test framework	• Simulation of IoT devices and sensors • Extensible adaptors for IoT-specific protocols – MQTT, Kafka, etc. • Extensible cloud connectivity adaptors for data ingestion using REST APIs • Simulation of real life conditions such as adverse weather, extreme temperatures, disastrous events and accidents, etc. • Device specific test automation using open source Robot framework	• Reduced cycle time due to reduced dependency on specific sensors and devices • **Enhanced customer experience** with the ability to address automated testing of end user safety features by simulating real life scenarios • **Niche technical skill sets** combined with test automation capability for testing device status/condition involved in IoT end-to-end use cases
Infosys security testing framework	• Pre-assessment tool to determine security index of the application • KI-based Threat Analyzer tool to strengthen security test design • SCA automation with continuous build using tools Fortify/AppScan/-Checkmarx	• **Ensuring data privacy and security** with the ability to test vulnerabilities across applications, backend systems, integration layers, and device layers.

High-level architectural view of the Infosys Extreme Test Automation framework for IoT implementations:



Conclusion:

While connected cars is today's technological marvel, there is an increased focus on the capability of solutions that can scale up and address the technological needs of the future. The fast pace of technological innovations, agile mode of delivering software, and importance of providing end users a cost effective, reliable service will drive organizations to choose the right strategy: A strategy that can address risks and issues posed by software development of IoT implementations such as connected cars, smart asset management, smart farms, smart factory, smart home, smart energy, connected health, connected store solutions, and many more that are yet to happen by 2020. A robust test strategy that is modular, extensible, and which can evolve with addition of newer communication protocols, connected devices and sensors, and technologies for middleware, data storage, and analytics is the need of the hour. Mature testing practices with best-in-class QA practitioners, that are skilled in operating multiple cutting-edge technologies combined with deep domain knowledge providing innovative, cost-effective test automation solutions will help organizations accelerate their journey towards a successful implementation of software services for the connected 'Things' of the future.

References

http://www.strategyand.pwc.com/reports/connected-car-2016-study

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