Testing in an Internet of Things World

INTRODUCTION
About Checkpoint Technologies

- Incorporated in January, 2003
- QA and QC in expertise focused on functional, performance and application security validation
- Atlassian – JIRA, Confluence, etc.
- HPE Software Gold Partner, HPE Software Support Partner, & HPE Certified Training Partner
- Mobile Labs Partner
- Zephyr Partner
- QAI Training Partner

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BRIEF OVERVIEW OF INTERNET OF THINGS
**IoT Defined**

- The interconnection of *uniquely identifiable* embedded computing devices within the existing Internet infrastructure

- Not just “person to and from machine” but “person to and from machine to and from machine” or just “machine to/from machine”

**Importance of IP**

- Yesterday: 32-bit IP address was used
- Today: IoT takes advantage of **IPv6**
  - 128-bit address allowing approximately $3.4 \times 10^{38}$ addresses

- We could assign an IPv6 address to every *atom* on the surface of the earth
- Can easily assign an IPv6 address to every “smart thing” on the planet!
Smart Thing Characteristics

• Four things needed:
  1. Unique identity (thus the importance of IPv6)
  2. Wireless communication
  3. Sensors
  4. Embedded electronics

Examples of THING

> Implanted medical devices that monitor metrics of a patient’s health or a wrist-worn fitness meter.

> Sensors in automobiles that monitor tire pressure and display a light on the dashboard when the tire pressures vary.

> Any natural or man-made object that can be assigned an IP address and provided with the ability to transfer data over a network.
IMPACT TO BUSINESS

On Business Itself

• Enables better prediction(s)
• Allows for stronger decision making
• Provides real-time correction/enhancements
• Maximizes ROI
• Legal concerns
On Economy & Landscape

With an economic impact of $2.7 trillion to $6.2 trillion annually by 2025!!

What’s Driving Growth?

• Goods, energy and systems of all kinds, are either safer, more efficient, less costly, or all of above when Internet connected than when off grid.

• Our private lives are more impacted (in a good way)

• V2V (vehicle to vehicle)
Who’s Developing IoT Apps?

- AT&T
- Bosch
- Cisco
- Dell
- GE
- Google,
- Hitachi Data Systems
- Huawei
- IBM
- Intel
- Microsoft
- Oracle
- PTC
- Salsforce.com
- Samsung
- Siemens
- Qualcomm

Network World 2016

Who’s Using IoT Apps?

- Agriculture
- Healthcare
- Retail
- Transportation
- Energy
- Manufacturing

Business Insider 2016
Emerging Applications

INFORMATION AND ANALYSIS
• Tracking behavior
• Enhanced situational awareness
• Sensor-driven decision analytics

AUTOMATION AND CONTROL
• Process optimization
• Optimized resource consumption
• Complex autonomous systems

McKinsey Global Institute Report
Authors: Michael Chui, Markus Löffler, and Roger Robert

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IMPACT ON QA & QC
Audience Survey

How involved are you with testing Internet of Things (Smart) applications?

Not involved at all and nothing planned in the near future. 36%

Not involved currently but there are planning discussions. 27%

I expect to be involved soon…within the next 12 months. 17%

I’m actively involved now! 18%

How the Internet of Things is Changing the Testing Process

Rethinking the testing process

Sensory monitoring

Simulating real life scenarios

“In the wild” testing, changes the normal testing conditions

Getting the UX right
QA & QC Challenges Increase

- Monitoring capabilities
- Course correction
- More abstract
- Big Data and Data Analytics
- Security
- Machine Learning

Top IoT Concerns

1. Network security
2. Data privacy
3. Delivering expected business value
4. Lack of expertise
5. Sufficient budget
Top Machine Learning Benefits

1. Increased security
2. Improved data-driven decision making
3. Better customer service
4. Reduction in restoration time
5. Increased grid visibility/control

Note:
Specific to Energy/Utilities industry

Source:
The Autonomous Grid: Machine Learning and IoT for Utilities
Whitepaper by ZPRYME and SAS Institute

How will test execution change?

RETHINK
How Will Test Execution Change?

- Sensory monitoring adds innumerable and minute variables
- Functional testing will become more real-time
- The “who” and “where” will even change!
- How do we simulate (or emulate) the real life scenarios that connected devices undergo?

Emulators vs. Simulators

**Emulators**
- More complex
- Emulates *real* device
- Emulates hardware and OS
- Written in machine-level languages
- Typically a full re-implementation of original software

**Simulators**
- Less complex
- Simulates device *behavior*
- Doesn’t emulate hardware nor work over real OS
- Written in high-level languages
- Partial re-implementation of original software
Test Automation

- Number of conditions and scenarios to validate increase significantly (esp. with machine learning)

- Even more emphasis on cost analysis
  - Do we realize an ROI with automation?

- Actual device vs. simulation vs. emulation
  - Is there a choice?
  - Which is cost effective?

- Ways to save/make money are direct and indirect
  - Time savings on labor
  - Greater test coverage – better quality leads to increased customer satisfaction and more sales
  - Risk avoidance

Self-driving Automobiles!
Multitude of Test Conditions

- Traffic
- Light
- Weather
- Road
- Construction
- Detours
- Police/Medical
- GPS
- Speed (limit)
- Connectivity
- Speed

Geographic
- Places of interest
- Mechanical
- Driver (skill, condition, etc.)

Smart Automobiles

Comm/GPS

Weather
Summary

- IoT Overview
  - Defined
  - Examples
- IoT and Business
  - Economic impact and Growth
  - Companies leading development
  - Industries actively using
  - Emerging IoT applications
- Impact on Testing
  - Concerns
  - Challenges
  - Emulation vs. Simulation
  - Automation
  - An IoT Test Case

Questions
Thank you!

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QUEST 2017!!!

I look forward to seeing you at QUEST 2017!
April 3rd – 7th, 2017
Chicago, IL
The Renaissance Chicago Downtown

Join me for:

The CSTE Certification Prep Course
Monday, April 3rd & Tuesday, April 4th

The Internet of Things’ Exciting Impact on Testing!
Thursday, April 6th, 10:00am – 11:00am