TESTING EMBEDDED CONNECTIVITY COMPONENTS
IN A MEDICAL REGULATED CONTEXT

Presented by Ron Jaegers
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About Me

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• Embedded Development Engineer @ Philips Innovation Services
• Father of three
• French car tinkerer
• Open-source enthusiast
PROJECT CONTEXT
Connectivity Platform

- Electronic Systems & IoT by Philips Innovation Services | Connectivity Center of Expertise
- Connectivity Platform
  - WiFi and BLE Connectivity Nodes
  - Mobile phone libraries
Connectivity Platform Triangle
Connectivity Platform Customers
Medical Context

- **Key values**: re-useable, traceable, automated
- No intended use...
- But not SOUP either...
COMPONENT LEVEL TESTS
Build and Test Setup

- **Key values**: scalable, fast, reproducible
- Dockerized Jenkins master and slave architecture
- All configuration under source control
- Supporting multiple configuration permutations
- CI build + micro tests + smoke tests on five embedded platforms: 6 minutes!
Component Test Pyramid

- **Flexibility declines** from base to top
- **Reliability declines** from base to top
- **Execution time increases** from base to top

- Strive to push down tests by refactoring where possible
Enabler: EmbeddedInfraLib

• C++, heap-less, STL-like, library for embedded devices

• Features:
  – Hardware Abstraction Layer (HAL)
  – Asynchronous event mechanism
  – Containers and streams
  – Network layer

• Published to GitHub: https://github.com/philips-software/embeddedinfralib
Micro Tests a.k.a. Unit Tests

- **Key values:** fast, isolated, deterministic
- C++ | CMake | Google Test
- 80k LOC | 3700 tests | 3 seconds
- Fast, faster, fastest... fast

1> 100% tests passed, 0 tests failed out of 29
1> Total Test time (real) = 2.94 sec

====== Build: 1 succeeded, 0 failed, 1 up-to-date, 0 skipped ======

1> Build- 0 succeeded, 0 failed, 1 up-to-date, 0 skipped
Enabler: Reference Product
Integration Tests

- C# | CMake | Gherkin (SpecFlow)
- 200 integration tests, testing on feature level; tracing to requirements
- Runtime up to several hours
Manual tests

- Part of release process
- Hard to automate and destructive tests
- 2 for WiFi | 4 for BLE
PLATFORM LEVEL TESTS
Platform Level Tests

- Compatibility & interoperability
  - Between platform components
  - Between platform & phones
- Pen-testing
RELEASING A PLATFORM
Releasing a Platform

• Requirements & test-cases in ALM tooling
• Evidence exported from CI environment towards ALM tooling
• Documentation is:
  – (Automatically) generated
  – Reviewed
  – Signed-off & Published