# Test Automation for Embedded Devices

Originally Created for:

*5th International Conference on QA & Testing for Embedded Systems*

*October 18-20, Bilbao, Spain*

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# Introduction

Using Automation to Test Internet-Based Applications on Embedded Devices

Based on: "*Automated Testing for Embedded Devices*", Scott Barber & Chris Walters, 2002 and "*Testing Embedded Devices*", presented at MIT as a guest instructor in 2002

# Who Am I?

My name is Scott Barber and I’m a test-aholic…

- Chief Technologist of PerfTestPlus, Inc.
- Executive Director for the Association for Software Testing
- Co-Founder of the Workshop On Performance and Reliability (WOPR)
- Member of the Context-Driven School of Software Testing
- Signatory of the Agile Manifesto for Software Development
- Prolific author, speaker and columnist
- Internet-based, embedded application testing specialist

…Oh yeah, I almost forgot, I’ve been involved with over 100 separate software testing projects.

# Internet-Based, Embedded Applications

Software that requires Internet connectivity to make use of the entire feature-set.

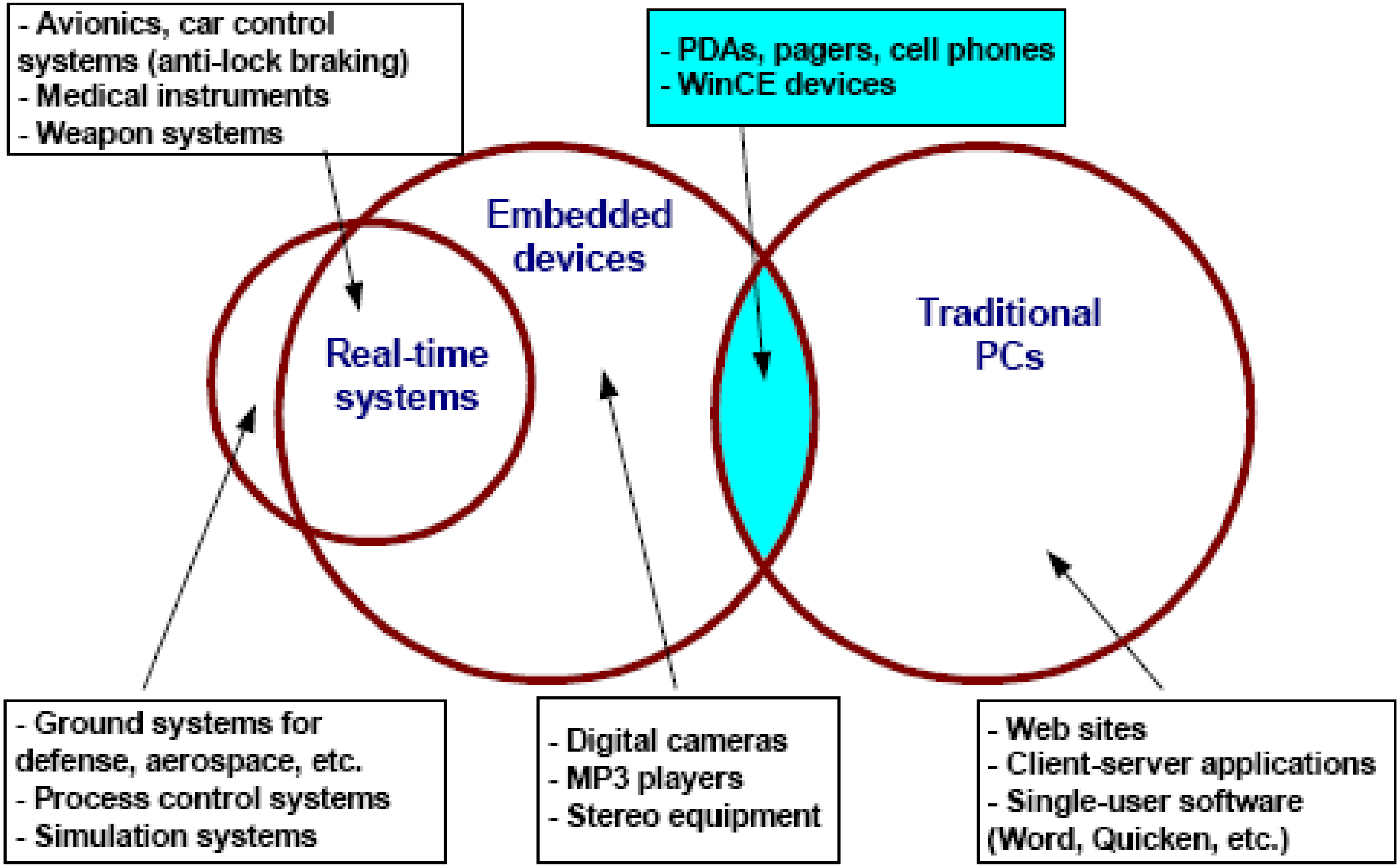
Software that resides on (typically hand held) embedded systems.

Systems cannot (effectively) be instrumented by test by loading or installing test software directly onto the device.

Examples typically include:

- Cell Phones
- PDA's
- Set Top Boxes
- Cameras

# Internet-Based, Embedded Applications



- Avionics, car control systems (anti-lock braking)
- Medical instruments
- Weapon systems

- PDAs, pagers, cell phones
- WinCE devices

- Ground systems for defense, aerospace, etc.
- Process control systems
- Simulation systems

- Digital cameras
- MP3 players
- Stereo equipment

- Web sites
- Client-server applications
- Single-user software (Word, Quicken, etc.)

# Internet-Based, Embedded Applications

Significant, non-obvious testing challenges:

Real-time, embedded and PC-based software testing industries each have their own techniques, tools, approaches and terminology... and they rarely overlap.

Real-time and embedded software testers are typically the most senior engineers & developers on the project.

PC-based software testers are predominantly have little to no electrical engineering or development experience.

The majority of Internet-based, embedded applications are being tested by PC-based software testers.

# Five Basic Approaches

Unit testing in testing in the IDE (Manual or Automated)

Human testers using actual devices (Manual)

Externally driven test automation via connection to a PC

Testing against simulators or emulators (Manual or Automated)

Back end testing via Internet (Manual or Automated)

# Unit Testing in the IDE

Pros:

- No special hardware or software required
- Relatively easy to accomplish
- Can ensure that software units function as designed when accessed independently from one another

Cons:

- No indication of how units work in combination
- No indication of how software will interact with system hardware
- No ability to test realistic usage scenarios

# Human Testers on Actual Device

Pros:

- No special hardware or software required
- Relatively easy to accomplish
- Only way to effectively test usability and performance
- Typically very important in addition to other forms of testing

Cons:

- Can be extremely time consuming
- Prone to human error
- Typically limits total number of test cases, scenarios and variations tested

# External Driven Automation

Pros:

- Can enable test automation
- Can increase test coverage
- Can enable scenario based testing

Cons:

- Often challenging to impossible to implement
- Typically fragile
- Frequently has unexpected effects on device hardware and state
- Rarely enables detailed or accurate test verification

# Testing Against Simulators or Emulators

## Simulators:

Generally allow users to experience what a thing will look and feel like but which doesn't use the same code base.

PC-based flight simulators are a good example.

## Emulators:

Are pieces of software that allow an application written for one platform or operating system to be executed on another platform or operating system.

Unix emulators running on a windows platform to enable the execution of unix-based programs in a windows-based environment are good examples.

# Testing Against Simulators or Emulators

Simulator Testing Pros:

- Enable testing prior to devices being ready
- Very good for early testing of user experience or paradigm testing
- Can provide all of the benefits of software prototyping, including generation of test ideas

Simulator Testing Cons:

- Not a valid test of actual software to be used in production
- Can give a false sense of security
- Usability and paradigm testing results may be invalid if executed on a significantly different platform

# Testing Against Simulators or Emulators

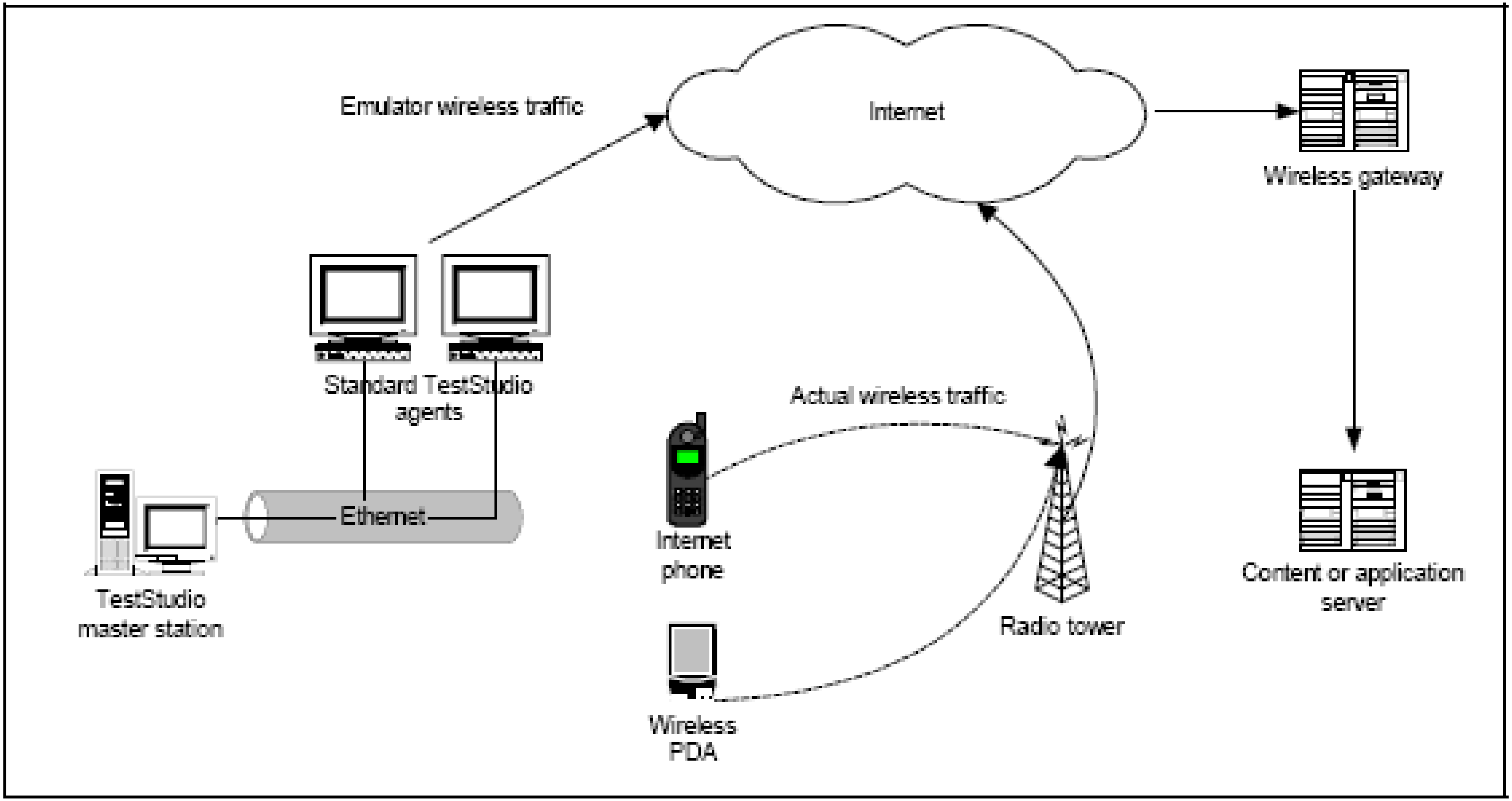
## Emulator Testing Pros:

- Test actual production code
- Typically reveal many of the same defects as testing on the actual device
- Frequently enable test automation, increase test coverage and enable scenario based testing

## Emulator Testing Cons:

- Not a valid test for performance
- Will not reveal defects specific to device hardware or configuration
- Usability and paradigm testing results may be invalid if executed on a significantly different platform

# Back-End Testing via Internet


Emulator wireless traffic
Internet
Wireless gateway
Standard TestStudio agents
Actual wireless traffic
Ethernet
TestStudio master station
Internet phone
Radio tower
Content or application server
Wireless PDA

# Back-End Testing via Internet

Pros:

- Indistinguishable from actual device testing from back-end components (when done correctly)
- Generally easy to automate via emulator
- Good for performance testing
- Does not require cellular/satellite networks to be operational

Cons:

- Does not test the actual device or how software will perform on the device
- Not good for usability, paradigm or non-internet based features.

# First Hand Experiences (Case Studies)

Testing the Inet API on the RIM Blackberry

Testing the ESPN Mobile Phone

Testing Microsoft's IPTV solution

# Questions

# Contact Info

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