CTS – The Android™ Compatibility Test Suite

Android is a rapidly growing open-source platform and ecosystem for mobile phones and other consumer and embedded devices. With its rock-solid Linux foundation, a very business-friendly open-source license and an easy-to-use Java programming model, it provides a perfect basis for mobile applications.

The liberal licensing and openness of the platform bears a potential danger, though: fragmentation. A device manufacturer may – intentionally or by oversight – change the platform in a way that makes it incompatible with the rest of the Android world. This poses a problem for the Android ecosystem: In particular application developers and end users need to rely on an application for a certain Android version running properly on all devices based on that same verson. For this purpose, the Google-led Open Handset Alliance developed the Android Compatibility Test Suite (CTS). Noser Engineering was approached by Google to provide most of this test suite.

«The CTS is a collection of more than 20,000 test cases that check Android device implementations for known issues. Device makers run the CTS on their devices throughout the development process, and use it to identify and fix bugs early. This helps ensure that the builds they finally ship are as bug-free as possible.»

Dan Morrill
Google Open Source and Compatibility Program Manager, Official Android Blog Entry 5/31/2010

The Project

The CTS is similar in spirit to what a Technology Compatibility Kit (TCK) is in the traditional Java world: It consists of a platform specification and a large number of tests that make sure an implementation conforms to that specification. Since the Android platform evolves over time, there is a version of the CTS for each Android release. For the initial CTS release, Noser Engineering provided the specification and the tests for the complete Android runtime-environment.

The Benefit

The CTS is used mainly by device manufacturers and operators. While the general licensing of Android is not tied to passing CTS, Google grants access to the Google applications and the official Android Market only to compatible devices. Hence each device manufacturer has a strong interest in passing CTS and makes it part of their quality assurance and acceptance.

The Implementation

The implementation consists of three bigger deliverables, developed by a team of 15 engineers over the course of 9 months:

- About 5000 tests were written for the Dalvik VM. These exercise each and every of the 200+ byte code instructions of the VM. Both functional and security aspects are being tested.
- About 20000 tests were written for the Android Core Java Libraries, that is, for all the packages in the java.* and javax.* namespaces. Each test covers multiple aspects of a single Java method.
- The specification of the Android Core Java Libraries (the JavaDoc) was completely reworked to provide a basis both comprehensive and precise enough for deriving tests. It is now on par with the quality of the original Sun specification.

The Technology

The CTS relies on JUnit 3 as a framework for writing and running unit tests. A couple of interesting new tools were written specifically for the project:

- A byte code assembler for the Dalvik VM as well as more low-level tools that allow to modify Dalvik Executable (DEX) files on a structural level.
- A new JUnit test runner that is able to filter individual tests based on annotations. It also deals with regressions and timeouts, and is able to isolate tests if necessary.
- Doclet-based tools for measuring the progress of the specification and test implementation of the Android Core Java Libraries. These served as a vehicle for project management.

The Result

The CTS is now part of the open-source code of Android. It is being used by device manufacturers worldwide during quality assurance and acceptance. Thanks to the CTS – operators, developers, and end users can rely on the compatibility of Android devices and applications.