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3G MOBILE TEST ASSET DEVELOPMENT

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ABSTRACT

As mobile services and applications are becoming more pervasive with the increasing adoption of 3G networks and devices, verifying the different quality attributes in all parts of the system is important. This describes a testing platform for 3G User Equipment (UE) that allows effective testing of UE devices and applications in a laboratory environment. By simulating parts of the network, the platform provides a realistic yet controlled environment for testing. Using this platform, we have executed a number of tests on 3G UEs and applications. Based on our experiences we describe the specific challenges encountered in testing in a 3G network in contrast to testing in a more traditional environment.

As the worldwide3G network deployment is scheduled for next upcoming years, mobile testing industry strives to supply test equipment with sufficiently good features to meet the needs .The biggest challenge is not only in customizing the new features quickly but also in making sure of the stability and robustness of the product. The test applications covered in this includes protocol conformance testing. Through practical experience, 3GPP has decided that the most efficient and cost-effective way to reach this goal is to create a certification system for mobile terminals.

A certified mobile is tested to an agreed and continuously updated set of test cases. All test cases are developed, maintained and delivered by 3GPPand validated by a certification agreement group, such as the Global Certification Forum (GCF) or the Personal Communication System Type Certification Review Board (PTCRB)… The agreement group has the responsibility to ensure that each test case is performed on a range of commercially available test equipment, providing compatibility between test facilities. This paper describes an Automated Test-Bench Application for Mobile phones.

Keywords: *3G (Third Generation), GCF Global (Certification Forum), PTCRB (Personal Communication System Type Certification Review Board), 3GPP (3rd Generation Partnership Project)*

1. INTRODUCTION

3G refers to the third generation of mobile telephony (that is, cellular) technology. However, to get from 2G to 3G, operators had to make "evolutionary" upgrades to existing networks while simultaneously planning their "revolutionary" new mobile broad-band networks. This led to the establishment of two distinct 3G families: 3GPP and 3GPP2. Within 3G, the services have also been continuously evolving with the different software releases and more functionalities like Release 99, Release4, Release 5, Release 6, and Release 7etc.

Automated testing is a process whereby the entire testing is automated using the certain programming language (such as C++,Java ,Perl, or Ruby). The major advantage of automated testing is that tests can be executed continuously without the need for a human intervention. Such an automated test environment isused to realize conformance testing where the different implementations run meet the actual specifications proposed by the standard bodies.

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2. CT-AUTOMATED TEST BENCH ARCHITECTURE

The test bench has the System Simulator

(SS) with the network environment simulated in it. The system simulators available are Anritsu, Anite and Rohde & Schwarz. The Device under test (DUT) here is the UE (User Equipment). UE is connected to SS through RF cables.

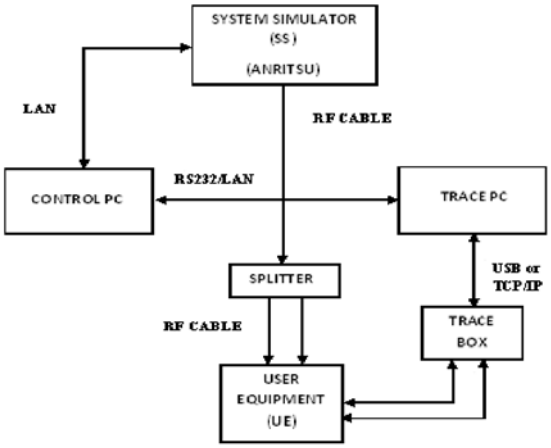

Fig1: Test bench architecture

Usage of Splitter is to accommodate the bands both low and high, though its use could be optional. Test scenarios are defined in the SS (System Simulator) in TTCN format. Control PC is connected through LAN to the SS, thus getting access to all the test cases. PCT (protocol conformance test suite) is run in Control PC in order to invoke the testing. On the other hand, UE (User Equipment) has protocols defined in it. UE is connected to Trace PC through Trace box. Trace PC is used to keep track of the UE logs. Trace tool is the tool used for recording the trace messages. ATE (Automated Test Environment) is run on the Trace PC to exchange AT commands (as SS communicates with UE in the form of AT Commands) between UE and SS.

2.1 Test Bench Application

The Test Bench Application resides as a process in the UE. The test cases are inputs to this application. These test cases are converted into a set of commands and fed into to a scenario file. These commands are read by the application, and the tests are executed automatically.

This process is responsible for generating various types of logs specified in the scenario. It could be profiling information, like time taken to capture and save a message or time to read or send a message, etc. It could be logged to track the execution flow of the scenario.

2.2 Scenario File

The scenario file contains the automated test scenarios to be executed by the test bench application on the mobile. The XML based scenario file has its own command list and tag syntax using which the designer or integrator writes the automated test scenarios to test the target application.

2.3 Testing Process

The test cases are standardized and specified by 3GPP.These test cases are run using TTCN scripts on the tester. Prior to the execution, various parameters are set in both the UE and the SS (PICS and PIXITS) which are explained in the later sections. Once the parameters are set the test bench is checked for its stability w.r.t power levels. Once the test bench is stabilized, test cases are run and the behavior of both SS and UE are analyzed in real time. After the testing is completed the result is generated, and it is reported. We are in a process of upgrading the automated test bench.

3. CONFORMANCE TESTING

3.1 Importance of Conformance Testing

Conformance testing is the use of standard methods, based on approved test suites developed for each standard protocol, and on testing procedures, lead to the comparability of results produced by different testers, and thereby to the mutual recognition of test reports. This will minimize the need for repeated conformance testing, and minimize the associated costs

3.2 Conformance assessment process

The method used to conduct the test is called the conformance assessment process. It is standardized to achieve some degree of comparability of test results on similar products tested by different test laboratories.

3.3 Test laboratory

The test laboratory is responsible for conducting the test and can be

1) The organization which implements or

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supplies the product.

2) The organization which will be using the product, and which is willing to test it.
3) An independent organization whose business is the testing of products.

3.4 Test components

Simulated Network Environment:

Simulated Network Environment is created, and the test bench is set up. Different test scenarios are run on the test bench to analyze the behavior of various entities.

Tools Required

1 Flashing tool

2 Trace tool
3 ATE(Automated Test Environment)
4 Protocol conformance tool (PCT)
5 Log Analysis tool

Trace tool is used to collect the MS message logs. It uses Product Message Descriptors (PMDs) for this purpose. Flashing tools are used for flashing the MS. Log analysis tool is used to analyze the Logs of both the tester and MS to find out the failure reasons and analyze the behavior of MS and SS.

3.5 Test Preparation

The initial step, called Test Preparation, verifies the way to conduct it. The product, the tested protocol, the testing method, the test environment are agreed upon.

Two types are important for this stage:

3.5.1 Protocol Information Conformance Statement (PICS)

The PICS is a statement made by the network vendor.
It's a standard protocol.

3.5.2 Protocol Implementation extra Information for Testing (PIXIT)

PIXIT supplied by the test suite, specified and refined by the test laboratory. It provides additional information necessary for the test laboratory to conduct the test. This includes: addressing information, test method information, specific values to complement the range of values stated in the PICS, etc.

3.6 Test Operations

The second step, called Test Operations, is where test campaigns are carried out. This step requires the preparation of the test tool, the test suite and the test environment. Starting from a standardized collection of test cases, which is capable of testing a standard protocol in its generality, one builds a collection of test cases executable in the test environment of a specific implementation.

3.7 Conformance test reports

The third step of the conformance assessment process is the production by the test laboratory of two types of the test report: a System Conformance Test Report (SCTR) and a Protocol Conformance Test Report (PCTR), for each protocol tested.

3.7.1 System Conformance Test Report (SCTR)

The SCTR documents the results of the conformance testing. It contains an identification summary of the different elements (test laboratory, nature of the conformance testing), a system report summary per protocol indicating the reference to the different standard components (protocol, PICS, PIXIT,) and the test results (number of test cases runs, passed, failed, inconclusive).

3.7.2 Protocol Conformance Test Report (PCTR)

A PCTR records the results of the conformance testing process of one protocol implemented and submitted to test using a specific standard. The PCTR contains the necessary identifiers (Protocol, PICS, PIXIT) and the detailed results of the tests. In addition, the report of the test campaign indicates for every test case of the standard, and in the order of this standard, if the test case was selected, was run to completion, and its execution result (also called verdict).

4. CONFORMANCE TESTING ARCHITECTURE

4.1 Test methods

A test method defines a model for the accessibility to the tester and is a definitive procedure that produces a test result.

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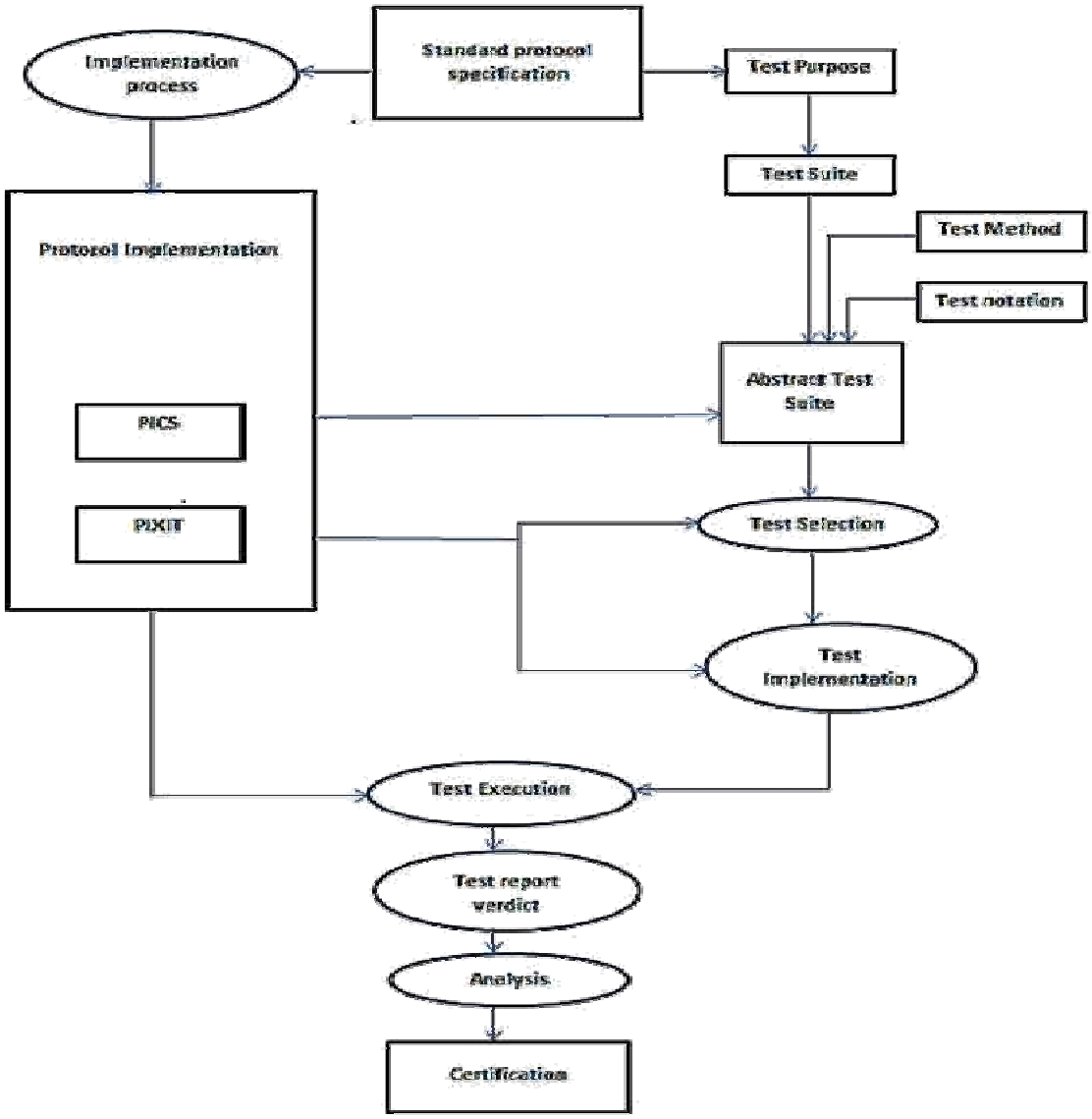

Fig.2 flow of conformance testing

4.2 Abstract Test suites

An abstract test suite is a standard, applicable to the test of a protocol standard according to a given abstract test method. There can be as many ATS as there are Abstract Test Methods chosen to test a protocol.

4.3 Test Suite

It is a collection of test cases that are used to test a specified behavior. A test suite contains

detailed instructions or goals for each collection of test cases

4.4 Test Notation: TTCN

A TTCN test suite consists of many test cases written in the TTCN programming language. The language was written in tables and called Tree and Tabular Combined Notation. It is also called as Testing and Test Control Notation.

4.5 Test Case Selection and Implementation

The test cases are standardized and specified by 3GPP.These test cases are run using TTCN scripts

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on the tester. The test sequences are created and executed based on the feature.

4.6 Test execution

This step is performed using test equipment or a test tool and test procedures. For each test case, a verdict is assigned. The verdict is either pass, fail, or inconclusive. Pass indicates that the test was executed successfully, and that the goal expressed in the corresponding test purpose was achieved. Fail indicates that the implementation does not conform to the specification. Inconclusive indicates that no evidence of non-conformance was found, but that the test purpose was not achieved.

4.7 Test Report &Result analysis

After testing is completed the result is checked for three verdicts namely Pass, Fail or Inconclusive for each test case are consolidated into an overall summary. If the verdict is FAIL, then the logs are analyzed to find out the bug. The bug could be either from SS, UE (or)the test environment. This is fixed after a brief analysis, and the result is reported.

4.8 Final conformance review

All the test results help to form the conclusion as to whether the implementation was found or not.

4.9 Test coverage

The orderly construction technique of a test, suite and of its test purposes aims at optimizing the coverage and minimizing test duplication.

5. EXISTING WORK

Real problems come up when testing alot of test cases on the real system and network. There are lot many test cases need to be executed per feature. The features get tested on defects may get identified at later stages resulting in already tested features. Furthermore, running an exhaustive test case for each release becomes very difficult and time consuming with more and more features developed. This approach proved too time consuming and expensive. We came up with the solution called the automated test bench. The current work described in this paper addresses the shortcomings in manual testing and aims to speed up the testing activity.

6. CURRENT WORK

The current solution "Automated Test Bench for Mobile Application" has been designed and developed to address the above-mentioned challenges with very minimal human interventions.

7. OVERALL SYSTEM

The basic concept of the Test-Bench Application is to embed the test execution application within the mobile thus replacing the external user who would otherwise manually perform the testing.

For the application which is tested this will act as an external agent who will trigger and validate it. The command for the trigger and the data corresponding to it will be stored in the scenario file.

The Test-Bench application and the scenario will thus replace the external user performing the mobile testing and automate completely the testing cycle of a mobile phone.

8. CONFIGURABILITY

The target application to be tested can be configured via the scenario file. By this way, the test bench application can send commands to any configured application/process with absolutely no code changes. The log file name, type of logs and their details can also be configured via the scenario file. The scenario file is stored on the file system. This is a huge advantage as scenarios can be added on the fly.

9. RESULTS

Our release has a set of n regression test cases to be run. The cycle takes 2 man days. Sum this up for 3 products; the total effort comes to 6 man days. With automated test bench deployed, this complete activity can be done in 2 man days for all 3 products with very minimal human intervention for testing. This has helped us reduce time and cost.The ability of the test bench to track and log the execution flow has in addition helped us to track and fix problems quickly. and integration the test suites from product point of view. The target is to automate at least 60% of tests where human intervention and constant monitoring is not required.

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10. CONCLUSION

As stated in the result, automating 100% of testing using the automated test bench application has greatly reduced our delivery time and effort. Multiple product testing can now be done simultaneously with very minimal human intervention.

The activities currently ongoing on the automated test bench are automation of test cases

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