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TEXAS
Evaluate, elect and implement a platform independent test framework for automated testing

Master of Science Thesis in the Master Degree Programme
Integrated Electronic System Design

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Evaluate, elect and implement a platform independent test framework for automated testing

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Sammanfattning

Under utvecklingen av moduler för mobilt bredband på Ericsson utförs ett omfattande integrering- och verifieringsarbete, för att säkerställa hög kvalitet på produkter som släpps. Fram tills idag sköts majoriteten av verifieringen manuellt. Till följd av en ökad mängd produkter och konfigurationer har arbetsbördan för verifiering ökat. Man har identifierat att många tester är lämpliga att automatisera.

Huvuduppgiften för det här projekte har bestått i att utvärderar befintliga testautomatiserings-verktyg, och i slutfasen implementera ett lämligt test-automatiserings-verktyg. För att uppfylla de krav som fanns utvecklades en egen lösning, kallad TEXAS. Med en server-klient-arkitektur OCH plugin-hantering har lösningen visat sig vara användbar för att automatisera delar av de testar som utförs på Ericsson.

Abstract

During the development of mobile broadband modules, Ericsson deals with a number of integration and verification work to ensure high quality is kept when releasing the products. Up until today a large amount of the verification activity is performed by manual testing. Due to an increasing number of products and configurations the workload for the verification team has increased. However, it has been identified that many tests are suitable for automation.

The main task of this master thesis work has consisted of evaluating existing test automation tools, and in the end implement a suitable test automation tool. To fulfil the requirements it was decided develop a new test automation tool, called TEXAS. Implemented in a server-client model combined with a plug-in architecture it has proven to be useful to automate a selection of the current tests performed at Ericsson.

PREFACE

This report is the result of a 20 week master thesis project carried out at Ericsson AB, Gothenburg.

We would like to thank the employees at the Mobile Broadband Modules department for their support during the project. It has been a great experience to do this work.

Our thanks also to our examiner at Chalmers University of Technology, Arne Linde, for reviewing the master thesis report.

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1 INTRODUCTION

This chapter intends to familiarize the reader with the background of this master thesis. Furthermore it will describe the objectives and goal for the work.

1.1 Background

The market for Internet access via 3G technologies has increased rapidly during recent years. Starting in 2007, Ericsson Mobile Broadband Modules (Ericsson MBM), has expanded massively up until today. They are developing a family of mobile broadband modems with HSPA, WCDMA, EDGE/GPRS capabilities in various configurations [1]. Opposed to other popular 3G modems, connected to the computer as external USB dongles, the Ericsson modules have a mini PCI interface, suited to be fitted inside notebooks, netbooks and MIDs (Mobile Internet Device). Ericsson targets the notebook vendors directly, who integrates the module and the software into their notebooks.

The bundle delivered to notebook vendors consists of:

- Module hardware
- Firmware software
- Device drivers (Windows and Linux)
- Connection Manager software (Wireless Manager, Windows only)

Figure 1.1: *Ericsson F3507g Module [1].*

Before the product is delivered to notebook vendors it is put under several tests to make sure the module is compliant to various standards and that the software is of satisfying quality. The MBM Integration and Verification Functional team is responsible of performing functional verification for instance verifying that device drivers load properly and that a connection can be established and much more.

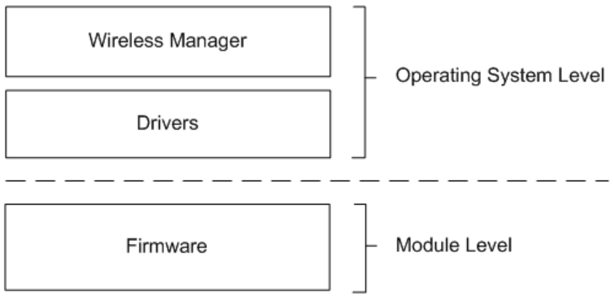


Figure 1.2: *Relations of Ericsson hardware and software.*

So, the verification is not solely dedicated to verifying that one piece of software is functioning as intended. It is critical to ensure that the interaction between firmware, drivers and connection manager software is functioning as intended.

1.2 Problem description

The functional testing is up until today to a large extent carried out manually be a group of testers. The current work-flow for a member of the verification team when verifying a new release of software is to:

- Prepare SUT (System Under Test) with correct test setup

- Fetch test specification for the current product
- Step-by-step follow a test instruction list.
- Note if a test is pass/fail.
- If fail, file trouble report

The flow above is normally described as scripted testing [3]. As a consequence of an increasing number of customers, releases and supported platforms the workload of the functional verification team has become too large. It has become untenable to continue to perform all functional verification tests manually, both from a cost perspective and a time perspective.

It has been identified that the current test flow can be improved in several areas. An internal study proposes that as much as 58% of the manual tests are suitable for automation [11]. Overall, the test flow is in need for better handling of test specifications and result storing.

1.3 Purpose and Goal

The objective of this thesis is to propose and implement an automated test environment that solves the above problems. The expected outcome is to

- Reduce manual testing
- Increase test coverage
- Provide a better overview of test results
- As a consequence of the above, release products of higher quality

In parallel with this master thesis, another master thesis project, TEA-TIME [5], is developing an inventory and tracking database to keep track of test equipment to attend to the above problems at a higher level. It is a wish from Ericsson to be able to connect these systems to be able to book and schedule test execution from one place. With this proposal, TEA-TIME would act as a higher-level test coordination system, where as the result of this master thesis would be the test execution engine performing the actual tests. This implies that a way of communicating between those two systems will have to be agreed on.

1.4 Limitations and Delimitations

The current functional testing also involves verifying correct behavior of a GUI-based connection manager software. Due to the problems connected to verifying the correctness of graphical elements [3], this will be outside the scope of this master thesis.

The platforms supported will only be Microsoft Windows XP, Microsoft Windows Vista and Ubuntu Linux 8.10 but with a possibility to adapt to new platforms.

The aim of this master thesis will be to implement a framework which makes it possible to execute functional tests in an automatic manner, but implementing and verifying individual test cases will be outside the scope of this project.

1.5 Related work

Prior to this master thesis work, a tool for Windows called PCSWTestSuite has been developed internally at Ericsson MBM. The basic purpose of this tool is to address some of the issues described above. It has the possibility to create Test Suites which defines a sub-set of Test Cases. Each Test Case is built with Sub Tests, where a Sub Test performs a basic functionality, such as verifying internet connectivity or verifying the presence of loaded drivers in the system. Although proven to be quite useful, it has not been fully developed. Written in C# .NET it is only compatible with Microsoft Windows.

In a more general view, a lot of research has been done in the area of automated testing. Mark Fester and Dorothy Graham discuss general ways of implementing and utilizing software testing [9]. Others propose that almost all test can be automated, such as M.M. Siteur MBA in his book Automate Your Testing [10]. A master thesis by Johansson and Wallinder covers the work of implementing a testing framework for testing telecom platforms [12].

However, most published research covers the art of testing software as a stand-alone component. In the MBM domain, it needs to be verified that the interaction between many components is functional. Both hardware and software aspects needs to be considered, which is why it is important to study how a more general test tool can be beneficial.

2 THEORY

This chapter describes some terms and technologies that were used in the project, which will give the reader background information on different testing theories that are relevant for this thesis.

2.1 Software Testing

Software testing is the process of executing a program or a system with the intent of finding defects and is often used to determine the quality of the software. Historically, testing was carried out by the programmer after the development phase. As the complexity of software has increased rapidly, software testing as evolved to its own separate profession. Today, software testing is continuously carried out and has become an integrated part of the development process.

Testing can be divided into two major concepts, black-box testing and white box testing [3]. In black box testing, the testing is carried out without knowledge of the internal workings of the test subject. Based on input, the output is analyzed for correctness. This type of testing is usually applied to test functional requirements.

White box testing, also known as glass box testing, is the opposite of black box testing. The structure and flow of the software is visible to the tester. The test cases are derived from the program structure.

2.1.1 Test methods

There are two ways of testing software - manual or automated. Refer to below sections for brief explanations of the terms.

Manual testing

In manual testing a tester takes on the role of an intended end user of the software under test. Either the tester uses *scripted testing* or has a more relaxed approach and utilizes *exploratory testing.* In both cases, the manual tester is responsible of setting up the test environment before testing.

In scripted testing, the tester follows a pre-made test plan. The test plan consists of a set of test cases. The tester perform each test described and marks the test case as pass of fail depending on the outcome.

Exploratory testing is a form of manual testing where the tester does not follow a test plan, or very high level descriptions. It is utilized to think outside the box and discover bugs that are not generally catched in the scripted test plan. The tester *explores* the software in his own way to discover new defects not generally covered by scripted testing. The success of this type of testing is highly dependent on the skills of the tester and his knowledge of the software. This type of testing has always been applied in some kind of way, but the term was coined by Cem Kane [3] in 1983 and he has contributed to making it more scientific.

Automated testing

The other side of the coin is automated testing. In this case, software is used to control the execution of test cases. An action is performed automatically and the outcome is compared to the expected result and the success is determined by this. The testing is generally carried out by some sort of testing tool or testing framework, some of which are described in section 3.

Benefits

It is easy to understand that automating testing has several benefits. Some of them are:

- **Run more tests more often**
  With an automated environment it is most likely possible to run the same tests in less time compared to manual testing. Hence, it is possible to run the same tests over and over again with little human interaction. This leads to greater confidence in the system.

- **Run tests (close to) impossible for a human**
  Some testing would be very hard for a human tester to perform. Those

include things such as stress-testing a system, long time tests with repetitive tasks to ensure long time stability.

- **Utilize resources more efficiently**
  By removing tedious and boring tasks from the manual testers work tasks, those resources can be used to improve test cases or debug other faults found and perform exploratory testing instead.

- **Reuse of tests**
  If the test cases implemented are carefully considered, the chance that they can be reused without to much effort is great. The is a highly desirable as many projects that are of the same character tends to run in parallel or overlap each other.

So, the main reason for automating test is of course to save money and time, and to increase the test coverage.

Test automation is not always suitable

A common mistake is however to assume that test automation will solve all testing problems. It will not [3]. It is important to understand when to apply automation of test cases. Some tests are impossible to automate, and some are not preferable.

- Tests that are run rarely is probably to expensive to automate compared to the benefits.

- Some tests are easily verified by a human, but requires great efforts to be verified by a computer. For instance, GUI verification can be placed into this category. To verify that the look and feel is correct and that correct graphics is loaded is one of those.

- Tests that require physical interaction. To relate to the domain of MBM testing, such things would be to change the HW module, remove the battery, remove the AC adapter and so forth.

As touched upon above, there is an initial high cost of automating a test case. An engineer has to put time an effort into developing and testing the test case. However, if the test case is run continuously the cost associated with the test case will decrease by time. The relationships are illustrated in below figure by Mark Fewster and Dorothy Graham [9]. It also describes the "goodness" of a test case. It also shows that a test case is the most effective of finding faults when introduced. Over time, the defects covered by the test case are corrected and the test is unlikely to find more defects. It is still a good regression check, however.

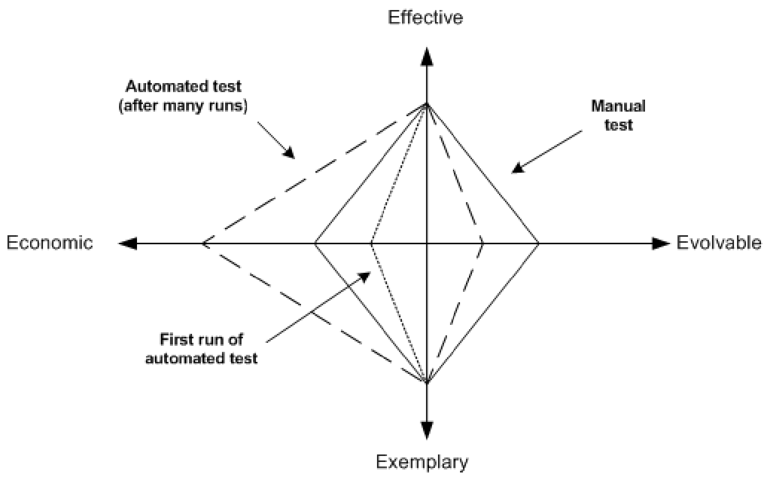


Figure 2.1: *"Goodness" of test case. [9]*

Even though an automated test case passes without finding any defects, it does not imply that there exists no faults. If test cases are not tested properly, it may not function as intended hence causing the tester to believe the software tested is flawless. But how can a test case be tested? Should the test tool be tested by another automated test tool? It is easy to see that this is not manageable. The best approach is to review the testing code and simulate failures to make sure they are catched.

Flow of automated test development

The process of automating tests does not only involve writing good test cases. Equally important is:

1. Test planning phase
2. Test case design
3. Test execution
4. Result handling

For this master thesis work, all those topics will be taken into consideration. It is important that results, logging and test case scripts are made available in formats that are structured and interchangeable to fit with other tools in the organization.

2.1.2 Types of test

Acceptance testing

Acceptance testing can have many meanings depending on the stake holders involved. In the Ericsson MBM domain it means a small scope test performed after a new software build before accepting to perform a full scope test.

Regression testing

Regression testing is the term used for testing software to make sure old features is still working and that no new faults has been introduced due to code changes. When a bug is fixed it can cause other parts of the software to behave differently. It is important to run these test before releasing software to ensure high quality.

2.2 Data Interchange Formats

As a preparation for choosing data formats used internally and for communcations protocols, some formats were inspected.

2.2.1 XML

XML (Extensible Markup Language) [17], is a widespread general-purpose data-interchange format derived from the standard SGML (ISO 8879). It is promoted by the W3C (World Wide Web Consortium). It is very verbose text based format, which makes it human readable. Furthermore, many languages have built-in support for parsing and serialization of XML.

2.2.2 Bencode

Bencode is a text-based encoding used by the peer-to-peer protocol Bittorrent [18]. It is very lightweight, and because of the fact that it is not binary it is often used for cross-platform applications where things such endianness could be a problem. It is very flexible, but is not yet standardized by any organization.

2.2.3 JavaScript Object Notation (JSON)

JSON is a very widely used protocol for encoding simple data, the messages are both human readable and easy for machines to parse [7]. JSON is implemented in almost 40 programming languages which comes with ready to use libraries and API's. It supports five different data types, each encoded differently:

- Values: A value can be a string in double quotes, or a number, or true or false or null, or an object or an array. These structures can be nested.
- Strings: A string is a collection of zero or more Unicode characters, wrapped in double quotes, using backslash escapes. A character is represented as a single character string.
- Numbers: A number is very much like a C or Java number, except that the octal and hexadecimal formats are not used.
- Arrays: An array is an ordered collection of values. An array begins with [(left bracket) and ends with] (right bracket). Values are separated by , (comma).
- Objects: An object is an unordered set of name/value pairs. An object begins with (left brace) and ends with (right brace). Each name is followed by : (colon) and the name/value pairs are separated by , (comma).

The most simple type is constructed as key-value pairs. a typical (key,value) message is represented in the following way:

```
{"Key1","Value1","Key2","Value2" ,..., "KeyN","ValueN"}
```

Practical examples

When using JSON, the available libraries provides rich functions to manipulate the data. The following two pseudo code examples shows how to encode and decode a JSON Message.

Listing 2.1: *Example of how to decode a JSON message*

```
public void decodeExample() {

    // Set raw JSON string
    String inputStr = "{"name":"John","age":"25"}";

    // Instanciate new JSON object
    // The constructor creates an object from
    // the input string.
    JSONObject jsonObject = new JSONObject(inputStr);

    // Get the name from the JSON object
    String type = jsonObject.get("name");

    // Get the age
    Int id = jsonObject.get("age");
}
```

Listing 2.2: *Example of how to encode a JSON message*

```
public void encodeExample() {

    // Instanciate new object
    JSONObject jsonObject = new JSONObject(inputStr);

    // Put data into object
    jsonObject.add("name", "John");
    jsonObject.add("age", "25");

    // Encode into message string.
    String encodedMsg = jsonObject.encode();

    // encodedMsg now contains the example string used
    // in the decode example above:
    // {"name":"John", "age":"25"}
}
```

2.3 TEATIME

TEATIME is the name of the system implemented in parallel with this master thesis. It is consists of two parts - TEA (Test Execution Automation) and TIME (Tracking Inventory Manager for Ericsson) [5]. This section intends to give a brief overview of this system.

2.3.1 TIME

TIME is a system to keep track of test assets within the Ericsson MBM unit. These includes test computers, module samples and more. The main parts is the underlying database, TEATIMEDB, and its web-based user interface. It also features a physical check-in station equipped with a bar code scanner to easily register assets.

The part relevant for this master thesis is the built-in capabilities of scheduling of automated tests. After booking a test computer, SUT, it will be possible to choose a pre-defined test suite to queue for execution on the selected computer. The information about scheduled tests is stored in TEATIMEDB.

2.3.2 TEA

The TEA part, Test Execution Automation, is responsible of distributing the scheduled test jobs in TEATIMEDB, booked by TIME. This is realized by an application called TEA-Coordinator. It continuously monitors the TEATIMEDB for upcoming scheduled test bookings. When found it will interact with a test executor found on the client to start the test execution. The test executor will be the result of this master thesis. Other responsibilities includes gathering information about the ongoing test, and store the results in the TEATIMEDB. When test execution is complete, it will inform the user of the result by SMS or e-mail.

2.4 Network Communication

2.4.1 TCP/IP

TCP/IP is a well-known communication protocol used in many applications. As the name tells, it is seperated into two parts, TCP which is short for Transmission Control Protocol and IP, for Internet Protocol.

1. TCP is a connection-oriented, reliable transport-layer. The main task for TCP is to handle package flow between different systems.

2. IP on the other hand handles the routing of packages.

Together they form a reliable (no packet loss) and robust communication protocol, used for instance by the Internet and many other network based applications.

3 MARKET ANALYSIS

Prior to the actual work in the master thesis a market analysis was carried out to gain knowledge regarding existing testing tools and frameworks. This section will describe different views on a number of existing frameworks and an analysis on how well suited they are for the purpose of this masters thesis.

Tools for test automation are not a new area, there are a lot of tools and frameworks available. Therefore, it is wise to take a look at some of the existing tools on the market.

A thorough analysis of such tools gives great overview of how a system may look like and reduces the chance of inventing the wheel again. Because, this type of application will always inevitable lead to a point were a decision has to be made - either an own developed application is the best way or an already existing tool is the best alternative.

The described frameworks/tools has been chosen because they are interesting in their own way. The first framework describes an open source application which is quite generic and resource efficient. Second up is a framework, TPTP - which is a little bit more resource demanding and have a large use base. Lastly, an analyze of a complete test environment is provided. They all originates from IBM, but there exists of course other test environments as well.

At the end, a result analysis is carried out to describe how well the different applications would suit in a project like this.

3.1 Frameworks

Before reading about the different frameworks, presented below, it is important to know what a test framework is. A framework is a set of libraries, code or tools that can be used to build up a test environment. One could say that a framework is like a toolbox and the user is the builder who select the tools needed for the environment.

3.1.1 S.T.A.F.

S.T.A.F stands for "Software Testing Automation Framework" and is an open source automation framework, originally designed by IBM for internal automation testing purposes. The purpose of STAF is to aid automation and make it easier to create and manage automated testcases and test environments.

The basic idea of STAF is to use re-useable components with different functionality to built up tests. STAF was created with a few points in mind [2].

- Minimum machine requirements - This is both a hardware and a software statement.
- Easily useable from a variety of languages, such as Java, C/C++, Rexx, Perl, and Tcl, or from a shell (command) prompt.
- Easily extendable - This means that it should be easy to create other services to plug into STAF.

The services are executed by a background process called the STAF daemon. The daemon is responsible for serving STAF requests, both receiving and sending. When a new request is present, it is placed in an internal queue and is executed by the daemon. STAF allows for components to be run inside of STAF or externally (for example a JAVA routine.)

STAF operates in a peer-to-peer environment, enabling other computers to send requests to the STAF daemon for remote network testing.

The features described above makes STAF a flexible and powerful framework, that can be used when building an automation tool.

3.1.2 Eclipse TPTP (Test and Performance Tools Platform)

Eclipse is an open source community initiated by IBM, now controlled by the Eclipse Foundation in which many companies are part of. The idea is to provide a general environment for developing new tools for the Eclipse platform. On of its sub projects is the Eclipse TPTP (Test and Performance Tools Platform). TPTP provides an open platform with frameworks for building new multi-purpose open source developed IDE (Integrated Development Environment).

TPTP aims to support verification and test of the product from an early stage throughout the application life cycle. The initiators of TPTP designed the framework with the following quote in mind: Şto build a generic, extensible, standards-based tool platform upon which software developers can create specialized, differentiated, and interoperable offerings for world class test and performance tools [4].

Some of the benefits from using TPTP [4]:

1. Save time and increase stability by automating tests and running tests more often
2. Save aggravation by finding problems in your application faster and with less difficulty
3. Find performance bottlenecks and other metrics easily

To achieve the statements above, TPTP comes with a rich set of functionality. The platform provides tools for testing, tracing, profiling and logging. All available in a common infrastructure. Support for testing frameworks as JUnit and other Eclipse environmental tools.

3.2 Test Environments

3.2.1 IBM Rational Functional Tester

Rational functional tester is a test environment that provides tools for automated testing capabilities such as functional testing, regression testing, GUI testing and data-driven testing. Functional Tester is a product within the Rational software platform [8].

The tool supports various script languages and development environments. For example, Java can be integrated using the Eclipse framework or .NET using Microsoft Visual Studio. This means that the tool can be adjusted to fulfill the needs of different projects and applications.

Some of the benefits from using IBM Rational Functional Tester [13]:

1. Support for manual testing
2. Support for custom coding of test scripts
3. A platform for test management

Of course, Rational Functional Tester can be integrated with other Rational applications, making it powerful if there already exist a Rational platform in the project [8].

3.3 Result of analysis

One of the purposes of having this analysis was to see if there are any existing tools available that could be used in this project, either directly or partly. Another purpose was to see how other tools are implemented and to get a glimpse on the features available in these types of applications, which is of great use when creating a new application.

When looking at the available tools a distinct observation is easy to see. It is not easy to create a generic framework/tool that directly (or even partly) can be used according to various requirements, expectations and features from different stake holders. From the three tools analyzed, only STAF can be considered useful for this project.

For instance, both IBM Rational Functional Tester and TPTP lacks network support and are both quite large applications. TPTP seems to be a better fitted with testing code (unit testing, regression etc) rather than functional verification.

IBM Rational Functional Tester has a lot of features that could be useful for this project, a downside however is that the tool is proprietary, costs money and it is uncertain if any modifications can be made in a nice way for this project.

As mentioned, STAF on the other hand, seems to be quite well fitted for this project. But, when analyzing a bit deeper a lot of challenges unfolds and it becomes clear that a lot of modifications needs to be done in order to match the requirements.

Basically, the things that this project would benefit from using STAF would be the network support, logging and the re-useable component architecture and the fact that the program is under maintenance from IBM.

Due to the tight time schedule and because of the sparse benefits, the thoughts of using STAF was discarded in order to focus on the architecture of an own developed solution.

4 METHOD

The success of an implementation, task or project is often closely tied to the preparation phase. A single decision can have severe impact on the end result and must therefore be considered thoughtfully. In this chapter some of the steps and decisions in this masters project will be described.

According to Sommerville [14], the process of choosing a tool for an organization often starts by browsing the market for an existing suitable solution for the problem. Sometimes, an off-the-shelf system can be used out of the box or with with a slight modification, sometimes a complete custom system is required.

The first month of this project was spend on analyzing the market situation vs. a custom system implementation. When the decision was made to implement a custom system, to avoid pitfalls and issues regarding the planning, a project plan was initated.

4.1 Development process

The process used is called spiral development, the process is iterated a number of times. The process used included these steps:

1. Planning
2. Risk analysis
3. Development plan
4. Validation

5. Prototype
6. Feedback

This process starts with a planning phase to revise the time plan, resource allocation and see what features the concluding prototype will have.

The risk analysis is needed to ensure that no requirements where unrealistic and in need of revision.

The development and validation phase aims to fulfill the result from the planning and risk analysis phase.

The closing phase of this development process is to wrap everything into a prototype.

After the delivery to the customer, the planning phase starts over again based on feedback from the customer and things that were excluded in the previous iteration.

In the developing phase of this masters project three iterations where used:

1. Prototype I
2. Prototype II
3. Final Delivery

4.2 Requirements

Prior to the implementation phase some requirements were gathered.

Functional requirements

- Possibility to create and edit test suites graphically
- Solution which is possible to control remotely, and interact with higher-level coordination software, such as TEA-TIME.
- Tests should be able to be executed without LAN connectivity to ensure that WWAN connection is the only connection operational.
- Use naming scheme of test suites compatible with current set-up.

- If possible, provide a mechanism to re-use test code from already developed PCSWTestSuite.

Non-functional requirements

- Easy interface for configuring and creating test suites
- Small footprint
- Run on Microsoft Windows XP, Microsoft Windows Vista and Ubuntu Linux 8.10.

5 DESIGN & IMPLEMENTATION

This chapter will describe how TEXAS, the result of the preceding analysis, is implemented. TEXAS is an acronym which stands for *Test EXecution Automation System*. This chapter intends to give a technical overview of the different sub components of the system.

5.1 Systems description

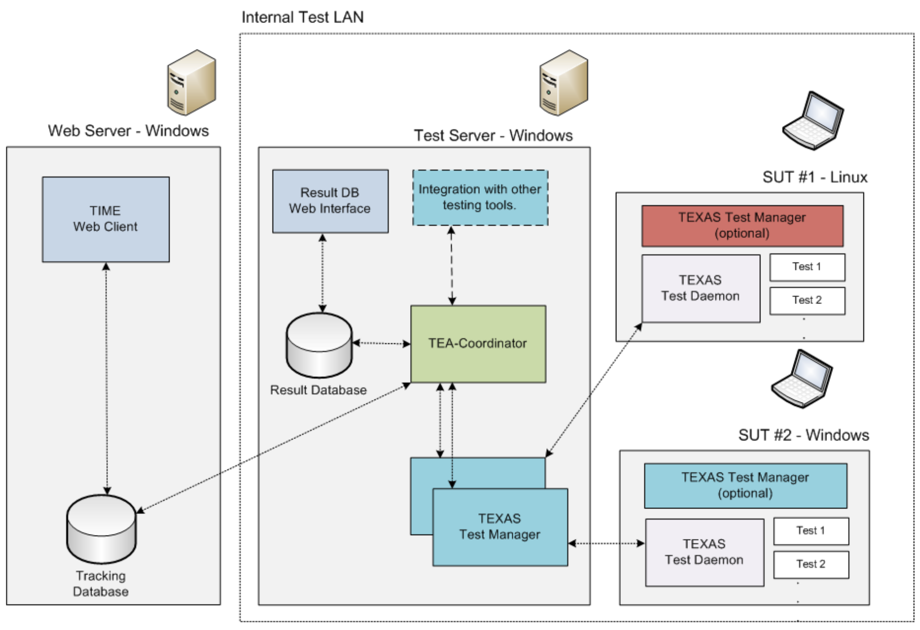


Figure 5.1: *System overview*

Figure 5.1 shows an overview of the complete test environment. The parts included in this master thesis work are prefixed with TEXAS. It can interact with TEATIME, which in short is a system used to book and schedule test equipment for test execution. Refer to section 2.3.

TEXAS is implemented in a server-client model, where the server part, called TEXAS Daemon, is deployed on the SUT (System Under Test) computer and is responsible of the actual execution of test suites.

A client application, called TEXAS Manager, connects to TEXAS Daemon and manages the setup of the test execution.

Two scenarios of usage are possible:

Stand-alone test execution TEXAS Manager and TEXAS Daemon are both installed on a SUT without any LAN (Local Area Network) connection. Test execution is started from TEXAS Manager locally.

Remote test execution Tests are started on a SUT connected to a internal test LAN, either from a GUI component called TEXAS Manager or from a non-GUI TEXAS Manager controlled by the TEATIME sub-component TEA-Coordinator.

5.2 SUT configuration

As described above, the SUT can be utilized in a LAN environment. In this scenario, several SUTs would be connected to an internal test LAN dedicated to be used for automated tests.

Each SUT will be configured with two partitions, one intended for the operating system and one partition for backup purposes. The backup partition will house files such as a clean system image, and TEXAS configuration files, and a TEXAS installation package.

The system image will be prepared with Java Run-Time and a setting to auto-install TEXAS from the backup partition the first time it is started.

5.3 TEXAS Daemon

TEXAS Daemon is a Java-based TCP/IP server application, which makes it runnable on both Windows and GNU/Linux platforms, as well as a range of other platforms. It is deployed on the SUT, and will show as a small icon in the tray bar in Windows/Linux, if available.

The outstanding parts of TEXAS Daemon is shown in figure 5.2.

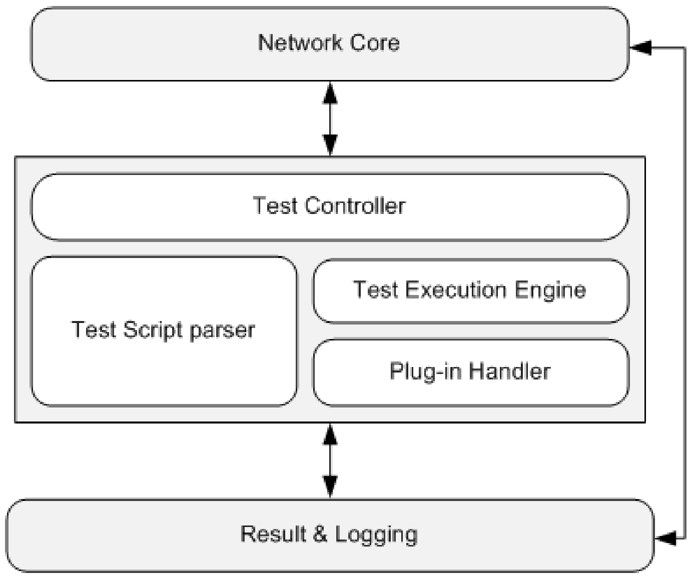


Figure 5.2: *TEXAS Daemon overview.*

The main purposes of TEXAS Daemon is to:

1. Provide network communication access
2. Parse pre-defined test script
3. Execute tests described in test script
4. Provide result and log feedback

As discussed in the theory section, it is important to be able to rely on the automated test system. Hence, the architecture of the daemon was made as simple as possible to reduce the possibility of errors. The intention was to separate the test execution part from the actual test code. To resolve this, TEXAS Daemon features a parameterized plug-in system, where each plug-in provides test functionality. When combined, these plug-ins builds test cases and test suites. As a result of this design choice, test functionality is removed from the test execution system which makes the process of debugging a lot easier as well as developing new test functionality.

The communication interface is described in section 5.5.The inner workings of TEXAS Daemon will be described in the following sections.

5.3.1 Test file structure

To comply to the wish from Ericsson to have a similar naming scheme to existing tools, it was decided to categorize the test execution in an hierarchal tree-manner consisting of the following entities:

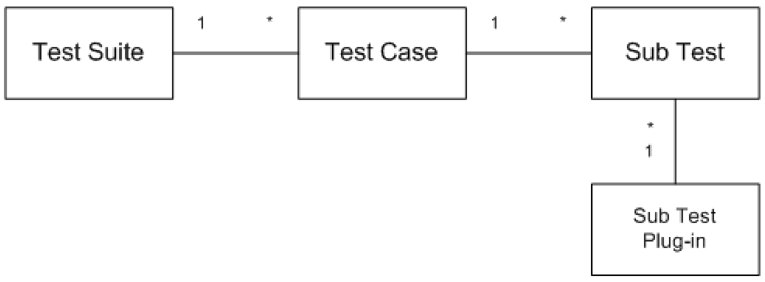


Figure 5.3: *Test structure relationship.*

Test Suite Top structure, contains an arbitrary number of Test Cases.

Test Case Holds an arbitrary number of Sub Tests.

Sub Test This is the lowest entity. A Sub Test refers to a named plug-in which actually executes test code. The higher levels entities are containers for structural reasons only.

As discussed in the theory chapter, it is important to have a good test script structure. It was decided to go for an XML-based implementation, due to its simplicity and compatibility advantages. The test script files specifies the flow of the test execution, namely in what order Sub Tests should be executed, what parameters to be passed and a few other execution control parameters.

Each of the test entities contains a number of general attributes to describe and control the execution of the test.

Name	Description
Name	Name of the test entity.
Iterations	How many iterations will be run.
AllowNetwork	Specify if a local network connection is allowed during test.
SkipOnLastSuccessful	If true and several iterations is specified, skip.
AbortOnError	Abort if the entity run fails.
Enabled	Specify if test entity should be included in test.

Table 5.1: *Test entity attributes*

Refer to below table for a brief example on how the implementation of the XML test suite is structured:

Listing 5.1: *Example of the test order in XML*

```xml
<TestDocument>
 <TestSuite Name="Template Test Suite">
    <Iterations>10</Iterations>
    <TestCase Name="Sample Test Case">
      <SubTest PluginID="Plugin Name">
        <InputParameters>
          <Parameter Name="Test">Value</Parameter>
        </InputParameters>
      </SubTest>
    </TestCase>
  </TestSuite>
</TestDocument>
```

5.3.2 Configuration files

When TEXAS Daemon has received and parsed the script files it sets up a number of configuration files. The main reason is to keep track of the execution, in terms of current test, current iteration and number of other parameters. These files are stored, if available, on a second backup partition. If only one partition is configured on the SUT, it will be stored in the application folder.

The most outstanding configuration file is the **lastsession.xml** file. For each change of the execution cycle, the current status is written to this file. This is achieved by serializing an internal data structure to XML by using the XStream library [16]. By writing this information to the filesystem, it is possible to resume an ongoing test session if TEXAS Daemon, or the operating system itself should crash. It is also useful if power tests, such as reboot is to be performed. In this case, TEXAS Daemon will set a flag that the shutdown is expected. The default behavior is to scan the configuration directories for this file on start-up, and if found load and resume the last known good state. If the shutdown was not expected, this will be written to the log file.

The purpose of having a text file configuration file is also useful for another, but equally important feature. The current manual test procedure includes preparation steps where the computer is to be *ghosted* with a clean system image before continuing. This means that the tester applies a pre-made file system image with the Norton Ghost software [15]. This has to be done by booting into a DOS-based GUI before the operating system is started. It is desirable that this procedure is automated. The solution to this is to

1. Prepare computer with two partitions, one intended for the operating system, and one for backup purposes.

2. Prepare second partition with a DOS-based operating system, such as FreeDOS where ghost software can be run and system image files can be stored.

3. Create TEXAS Daemon plug-in with the functionality to manipulate configuration files on backup partition to select system image file.

4. Set second partition as bootable, reboot system. FreeDOS will load and automatically start Ghost software to apply clean system image to first partition. When done, reset first partition as bootable and reboot computer.

5. On first run of clean system image, auto-install TEXAS Daemon from backup partition. TEXAS Daemon will read the lastsession.xml configuration file and resume execution after the preparation steps.

5.3.3 Sub Test Plug-in system

As described in previous section, TEXAS Daemon itself is just a testing framework. The testing functionality is handled by plug-ins, which provides sub test functionality. A sub test plug-in contributes with functionality for a specific task.

Examples of plug-in usage:

- Install drivers
- Check drivers loaded
- Check Internet connectivity
- Put computer in different power state (sleep/hibernate/reboot)
- Measure transfer rates
- And more.

The basic idea is that each plug-in takes an arbitrary amount of input parameters and implements a predefined interface containing a run() method. This method executes the test code and returns a test result based on the input parameters and test code.

Architecture Overview

As the base of TEXAS Daemon is Java, the natural programming language for the plug-in development is also Java. Java class files can easily be loaded in runtime. However, measures were taken to provide the possibility to interact with plug-ins written in other programming languages. For this master thesis, support for Java and C# .NET was implemented.

The plug-in architecture itself is 3-tiered;

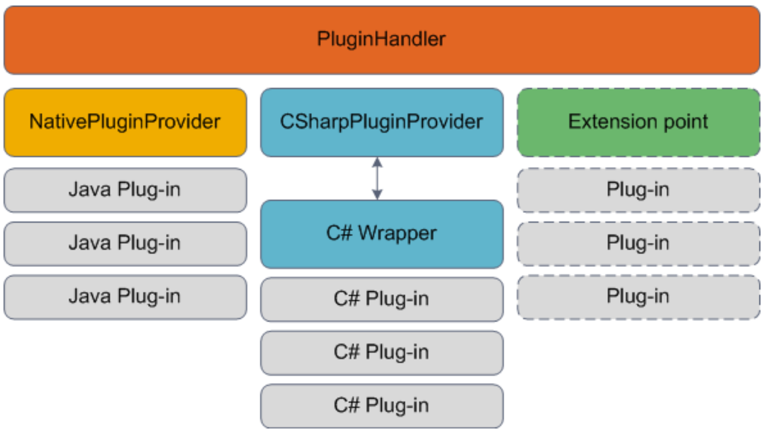


Figure 5.4: *Plug-in system overview.*

PluginHandler

All plug-in execution is handled through this interface, it keeps track of all available plug-ins and their attributes.

PluginProvider

The PluginProvider interface was introduced to address the issue of interacting with non-Java plug-ins. The interface provides the PluginProvider with a list of available plug-ins and their parameters, and an execution function to call for a plug-in to be executed.

In the Java case, the PluginProvider scans a directory for pre-packaged JAR files and loads the plug-ins into runtime. With this generic interface, it is possible to add new PluginProviders that executes plug-ins written in various script languages such as Perl, Python, Tcl/Tk and/or programming languages such as C#. The methods of communicating with the actual plug-in will be implemented differently depending on plug-in language.

Plug-ins

The plug-ins is where the test code is defined.The plug-ins are implemented are dependent on which PluginProvider they correspond to. However, each plug-in needs to contain a run() function or similar that can be called for when the test is to be executed. It also needs to be able expose what input parameters are available and what the default values are. Below table 5.2 shows a list of the expected attributes.

Name	Description
Name	Identifies the plug-in, must be unique.
Description	Describes the usage and purpose.
Version	Identify version.
Group	Provides a mean to categorize plug-ins, i.e Power Test, Driver test
InputParameters	Provides an array of expected input parameters, and their default values.

Table 5.2: *Plug-in attributes*

Again, how the PluginProvider communicate with the plug-ins is up to the implementation of the PluginProvider.

As mentioned, support for C# is supported. This is provided by a separate Windows Service called TEXAS C# Wrapper. Refer to below section 5.3.5 for description of TEXAS C# Wrapper.

Refer to appendix 8 for ways of implementing a Sub Test in code.

Result

Each plug-in run() method returns a result object, that contains information of the outcome.

Name	Description
Message	Created from within the test, message describing what went wrong/ok inside test.
Result	Describing fail/pass

Table 5.3: *Result structure*

The information is passed up to higher layers for further processing.

5.3.4 Logging

To provide traceability two different logging mechanisms are implemented, one for TEXAS Daemon itself and one log connected to the test execution. The program log for TEXAS Daemon uses a third-party library called log4j, which is an open-source logging framework developed by the Apache Foundation [6].

Logs from inside the plug-ins are saved are saved to a separate log file, which contains only logging that are related to the test cases. It was decided to go for an XML based format for the test logging. This makes it easy to export the results to other software, such as the TEATIME system.

5.3.5 TEXAS C# Wrapper

The C# Wrapper is a service running along-side with TEXAS Daemon to enable the use of C# Plug-ins. Another important aspect of the implementation of this application was to support the the legacy code (Sub Tests) from MBM's PCSWTestSuite program.

Since C# has superior support for Windows interaction compared to Java, it is in some cases necessary to have a service like this to be able to do certain Windows specific tasks in an easy matter.

Basic flow of TEXAS C# Wrapper

As described in 5.3.3, a plug-in provider has been implemented to carry out tests written in C#. This plug-in provider contains methods for communicating with the service and to convert logs, test results and plug-in lists received from the C# Wrapper to the Daemon. The data sent from the C# Wrapper is a XML-string that is de-serialized and interpreted by the TEXAS Daemon.

When TEXAS Daemon is started, it asks the C# wrapper for its available plug-ins. The plug-in list is then sent on the channel and stored at the plug-in handler. The plug-ins are now available to be used in a test execution. When a Sub Test written in C# is about to be started, the plug-in handler fetches the plug-in information and tells the plug-in provider to execute the test. This works in the same way as a sub test written in Java, the only difference is the TCP/IP connection.

5.4 TEXAS Manager

TEXAS Manager is a tool designed to manage the test execution by communicating with TEXAS Daemon.

It has two purposes:

1. Create and manage test suite
2. Start and monitor execution, analyze results

The design of the manager is divided into three main blocks, the GUI block, the event manager block and the network core part.

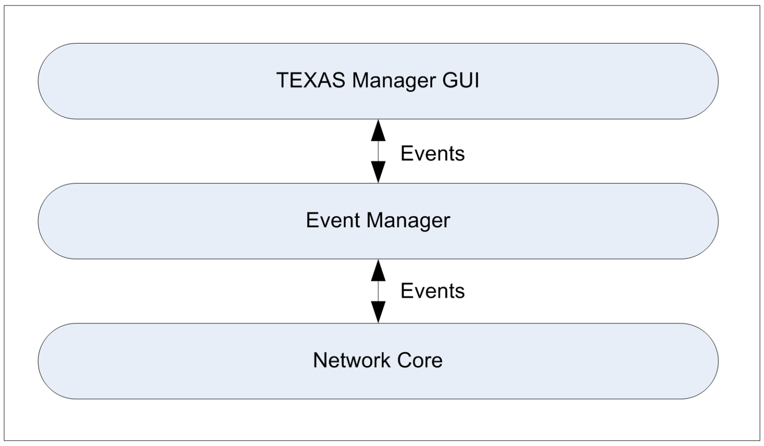
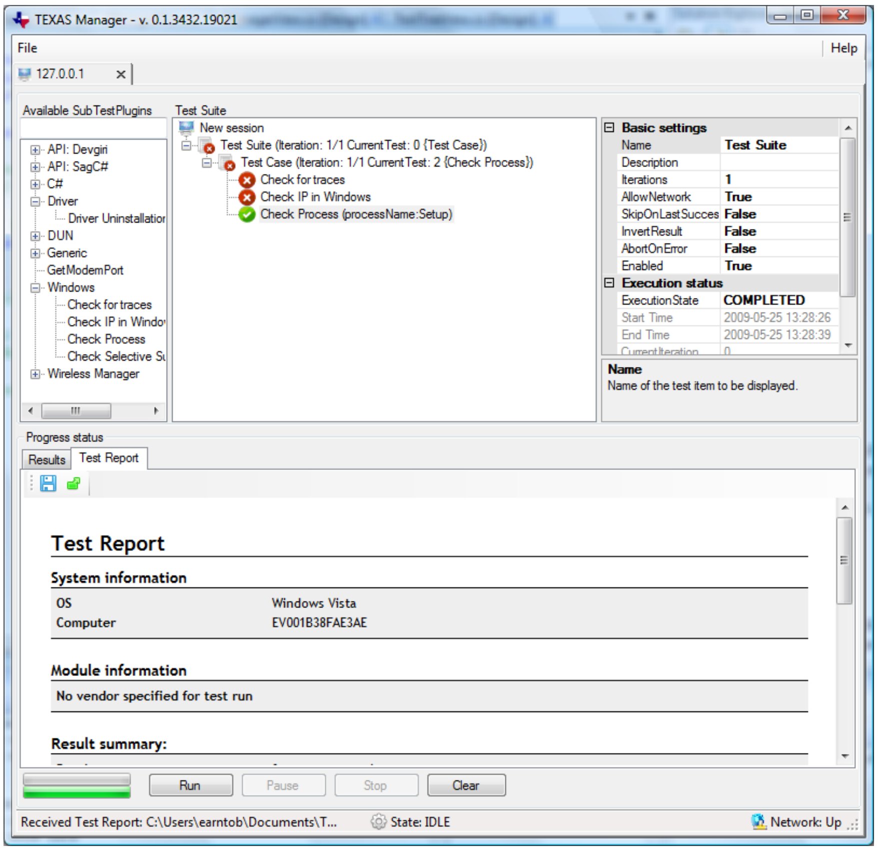


Figure 5.5: *TEXAS Manager overview.*

5.4.1 GUI

The GUI, shown in figure 5.6, features a multi-tab interface to be able to manage several TEXAS Daemon connections. Each tab presents a workspace where the user can create and modify test suites by simple drag-n-drop techniques. The Sub Test plug-ins available on the host system is listed in a list box. Once a test suite is created properties of each test entity can be set individually, and input parameters to Sub Tests can be set through the GUI. When the user is satisfied with the structure of the Test Suite, the test can be sent to TEXAS Daemon for execution. TEXAS Manager will serialize the test structure to XML and send it. TEXAS Manager receives updates continuously of the test process. To conform to the requirement that it should be able to execute tests with no LAN activated, the user can specify whether or not TEXAS Daemon should send status updates. When



New session
Test Suite (Iteration: 1/1 CurrentTest: 0 {Test Case})
Test Case (Iteration: 1/1 CurrentTest: 2 {Check Process})
Check for traces
Check IP in Windows
Check Process (processName:Setup)

Basic settings	
Name	**Test Suite**
Description	
Iterations	**1**
AllowNetwork	**True**
SkipOnLastSucces	**False**
InvertResult	**False**
AbortOnError	**False**
Enabled	**True**
Execution status	
ExecutionState	**COMPLETED**
Start Time	2009-05-25 13:28:26
End Time	2009-05-25 13:28:39
CurrentIteration	0

Name
Name of the test item to be displayed.

Test Report

System information

OS	Windows Vista
Computer	EV001B38FAE3AE

Module information

No vendor specified for test run

Result summary:

Received Test Report: C:\Users\earntob\Documents\T... State: IDLE Network: Up

Figure 5.6: *TEXAS Manager screenshot.*

a test is in execution, the user has two more control options to consider; stop and pause. If the test is stopped, the test execution is deemed to be aborted. If the test is paused, the daemon will wait for the user to resume the test. Both the stop and pause action is only available if the TEXAS Manager is connected to the daemon and triggers when the next sub test is about to be executed.

The result from the test session is displayed to the user in a HTML report, visible when the daemon has confirmed that the test execution has stopped. The HTML report is generated from the result log, written by the TEXAS daemon during the test execution and is dynamically divided into new pages if the result log contains too many sub tests.

5.4.2 Event Manager

The event manager serves as the bridge between the GUI and the Network Core. The role of the event manager is to receive events from the GUI and the Core and take action depending on which type of event that was received. A typical event sent from the GUI through the event manager is when there is some sort of user interaction, for example, the run button is pressed. When this event is triggered, several events will be sent down to the network core and forwarded to the daemon to start the test execution.

On the other hand, when something has been received from the network core, there are several types of events sent from the event manager to the GUI, for example, the plug-in list, status updates from the execution and other events that the TEXAS daemon broadcasts on the network.

A big advantage of this event handler is that it can easily be tailored to fit another purpose than a GUI application. Since, the designer can decide on which events to subscribe to from the network core and built a new application based on these events.

5.4.3 Network Core

The network core in TEXAS Manager handles all the methods and functionality regarding the network communication. The purpose of this part is to send and receive data on the network connection between the manager and TEXAS Daemon. The communication to and from the event manager is event driven, which means that the core sends up an event to the event manager when something has been received on the network connection. Of course, the network core also receives events from the event manager.

The core consists of three major layers:

1. Socket layer - Is responsible to set up or maintain an active socket connection. Sends data on the socket, receives data, connects to clients and listens for clients to connect.

2. Message layer - In this layer, the received data (or the data which is about to be send) is considered and manipulated depending on the direction of the data (receive/send)

3. Event layer - The last layer in the core handles sends events based on the event from the message layer or the layer above (event manager).

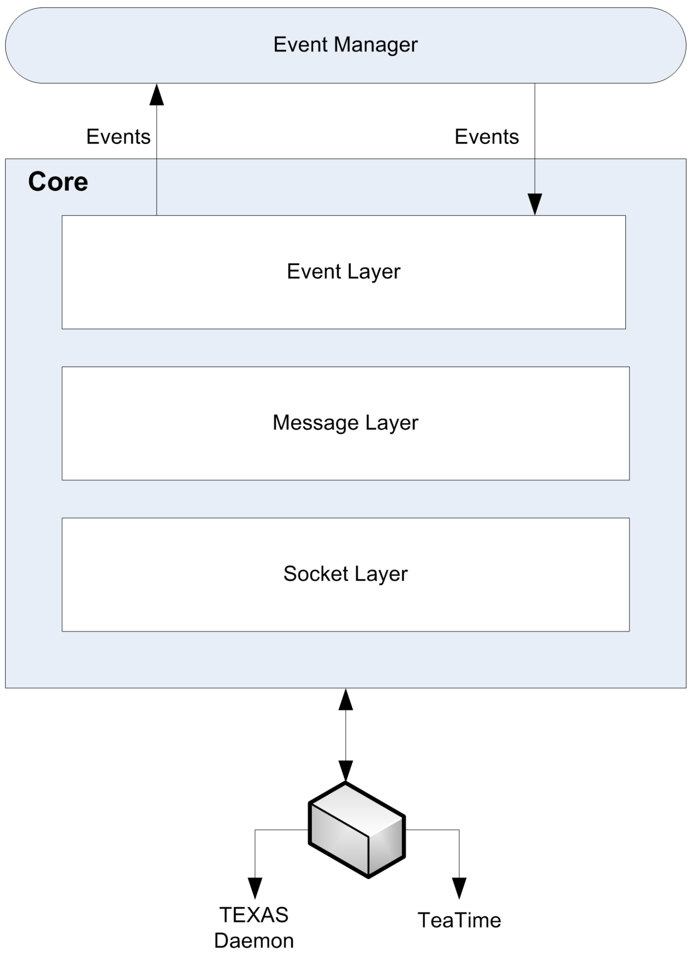


Figure 5.7: *Shows the basic concept for the core.*

5.4.4 Non-GUI implementation

A scaled down version without GUI was developed to provide a mean to communicate with TEATIME. As described in 2.3, TEATIME is used to schedule tests on dedicated test computers connected to a LAN. When a test is to be started, TEA-Coordinator launches a TEXAS Manager process and tells it to start a test on a certain computer. The TEXAS Manager without GUI uses the network core and a tailored event manager to interact with TEATIME instead of the GUI. When the application is launched by TEATIME, a network core is instantiated for both TEATIME and TEXAS daemon.

The events received from the daemon are propagated up to the event manager and then forwarded to TEATIME if that message is of interest to TEATIME (based on the agreement in the communication protocol described in appendix 9). If the event is of no use for TEATIME (i.e events that the GUI is interested in), the event is simply discarded. Refer to appendix 7 for a complete users guide.

5.5 Communication

As mentioned before, all communication between the different parts in the TEXAS system is made possible through the TCP/IP protocol. The decision to go with TCP/IP came natural in order to support remote execution of tests and also because it is a well-used, easy to implement and a reliable protocol.

A number of message formats were investigated before deciding which format that would work well for the data transmission. For example; Bencode, XML-RPC and Java Object Notation (JSON) were analyzed.

Together with the TEATIME project, it was decided that JSON was best suited.

5.5.1 JSON in TEXAS

The protocol used for communication between the different parts of the system make use of the simple but powerful protocol of JSON.

One of the main reason for choosing JSON to serve as communication protocol was because of the fact that it is widely adopted and suites well for network communication. Another reason was that the system needed an easy protocol that allowed for interaction with other applications in a non-complex way.

In TEXAS, all communication between TEXAS Daemon, TEXAS Manager and TEXAS C# Wrapper is done by JSON interchangeable messages. For example, the TEXAS manager without GUI uses JSON to communicate with the TEATIME system. The message protocol used in TEXAS is the same as in TEATIME but with some extensions.

The message syntax used in TEXAS is represented in the simplest way, using (key,value) pairs. As mentioned, JSON can be compiled into more advanced messages representing arrays and complete objects. However, in TEXAS, there is no need for such advance message syntax.

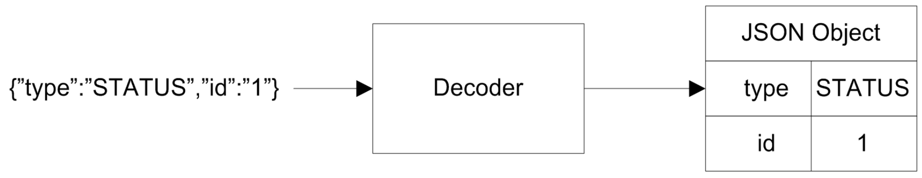


Figure 5.8: *Data conversion in TEXAS*

The data flow is shown in the figure above, the incoming data from the network layer is decoded into a JSON object. The JSON object then holds the data in a dictionary data structure.

When sending a message to the network layer, the JSON object is converted to a string. The encoding procedure is similar to the decoding.

The protocol make use of three message classes:

1. Control messages (CONTROL) Used to control Texas Daemon, for example: Start, Stop, Pause a test session.

2. Status messages (STATUS) Used to update the GUI with information regarding the current test execution.

3. Info messages(INFO) Used to set and get information.

5.5.2 Message Events

In TEXAS Daemon there is a class responsible for the messages, the MessageHandler. It contains methods for decoding all incoming messages sent to the network layer, also methods for sending encoded data is included in this class.

When TEXAS Daemon is executing a test, the executor thread walks through different stages depending on the current item. All test entities (TestSuite, TestCase and SubTest) have their own notification event tied to them. The notification event is the way TEXAS Daemon notifies the listeners on the network about the current execution.

For example, when a test starts the first test entity the executor thread will run into is a TestSuite, it will then notify the listeners that the Test Suite will start and when the test is over an event will be sent to notify all listeners. This works in the same way for Test Cases, Sub Tests - notification events is sent before and after each test instance.

6 DISCUSSION

6.1 Conclusion

The objective of this master thesis was to investigate and choose a test automation tool to aid the functional testing performed at Ericsson Mobile Broadband Modules. One of the key decisions made for the thesis work was to create a solution nearly from scratch. Although some of the existing solutions were found to be very powerful, it was concluded they were not suitable for the demands at hand. This set the course for the project, and with the work done it can be concluded this proposal proved to be successful.

One of the key requirements was to have a platform independent solution which would allow for future expansion to new operating systems. This was achieved by using Java as the basis for the server execution part.

Another crucial part was flexibility. The main concept of having different parameterized plug-ins in a tool box for use as building blocks for new test cases, has proven to be very useful as TEXAS has been evaluated by Ericsson employees. It also makes it manageable to extend the test functionality without having to re-build the entire test environment. By adding support for C# plug-ins, it is possible to re-use old test code developed internally with minimal effort. Also, the possibility to extend TEXAS for use with other programming and scripting languages will be beneficial.

A functional GUI to monitor and manage test suites was developed, based on the old PCSWTestSuite software look. This makes it easy for inexperienced testers to create and execute new test suites.

As test suites are saved in standardized XML format, the integration with higher-level software is made possible.

Initial efforts to support interaction with TEA-TIME, created by Sternersson and Weber [5], was carried out successfully and the integration steps set out in the time plan was kept.

Overall, the requirements and expectations set up in the planning phase were fulfilled.

6.2 Future work

Although the work carried out within the scope of this master thesis came a long way, future efforts are needed before TEXAS is put into production usage.

TEA-TIME integration More integration work with the TEA-TIME system needs to be done. Although stand-alone testing can be performed, the real strength lies in the ability to book and schedule tests on dedicated computers without directly interacting with the SUTs. It is crucial to test the stability of the interaction with TEA-TIME as well as adding new features for configuration purposes.

Plug-in development Some conceptual basic plug-ins were developed during the master thesis work. Further investigation and review of current test specifications is needed to identify which functionality is wanted. Already existing sub tests developed in C# needs to be converted to the plug-in format used for TEXAS.

Stability and debugging It is extremely important to be able to rely on a test execution tool to be stable. If the tool keeps crashing it is hard to trust the results from the tool, and to know when there is an error in the tool or error in the test subject. Even though stess testing has been performed to some degree, more work needs to be done in this area.

Windows 7 integration The test tool was to support the specified platforms in section 4.2, but as Windows 7 is about to be released, it must be ensured that TEXAS will function also on this platform.

GUI testing More research is needed in this field, to understand if it is possible to combine GUI testing with TEXAS.

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Glossary

EDGE	Enhanced Data rates for GSM Evolution
GPRS	General Packet Radio Services
GUI	Graphical User Interface
HSPA	High Speed Packet Access
LAN	Local Area Network
MBM	Mobile Broadband Modules
MID	Mobile Internet Device
PCI	Peripheral Component Interconnect
S.T.A.F	Software Testing Automation Framework
SUT	System Under Test
TEA	Test Execution Automation
TeaTime	Inventory and tracking system
TEXAS	Test EXecution Automation System
TIME	Tracking Inventory Manager
TPTP	Test and Performance Tools Platform
USB	Universal Serial Bus
WCDMA	Wideband Code Division Multiple Access

WWAN	Wireless Wide Area Network
XML	eXtensible Markup Language

7 TEXAS USER MANUAL

TEXAS User's Manual

Abstract

This document includes manuals for how to use TEXAS Manager and TEXAS Daemon.

1 Introduction

Test EXecution Automation System (TEXAS) is a tool for automated testing primarily implemented for MBM to aid functional verification. With TEXAS, you can easily set up test suites based on the provided sub tests to ease the daily verification work. The system consists of two parts, TEXAS Manager (TM) and TEXAS Daemon (TD).

1.1 System basics

The heart and soul of TEXAS is the TD. TEXAS Daemon is where the actual sub tests are executed. The sub tests are integrated into the framework as stand alone plugins. Since TD is mainly working as a backend program and does not support a lot of user interactions, its counter program is the TEXAS Manager. The Manager works as a front end to TD and represents it through a GUI.

In TM, you establish a connection to a Daemon and you will receive a list of available sub tests. Then, a test suite can be built and executed on the Daemon. TM and TD communicate through a socket interface and TD updates the GUI by sending status messages, which are processed and displayed by TM.

A test session is divided into three blocks, and the following terminology will be used throughout this document:

- Test Suite
    - Test Case
        - Sub Test

A test suite is the container of the test. A test suite can contain several test cases. A test case is a building block inside the test suite making it possible to group several sub tests into different blocks to give a nice structural representation of the test session. As mentioned above, a sub test is the lowest level in the session and represents the actual test.

Because of the socket based communication interface, the Daemon can be isolated on a remote host and enables for remote testing.

The Daemon is implemented in JAVA™ to support different platforms as the JAVA™ runtime application is platform independent.

1.2 System Overview

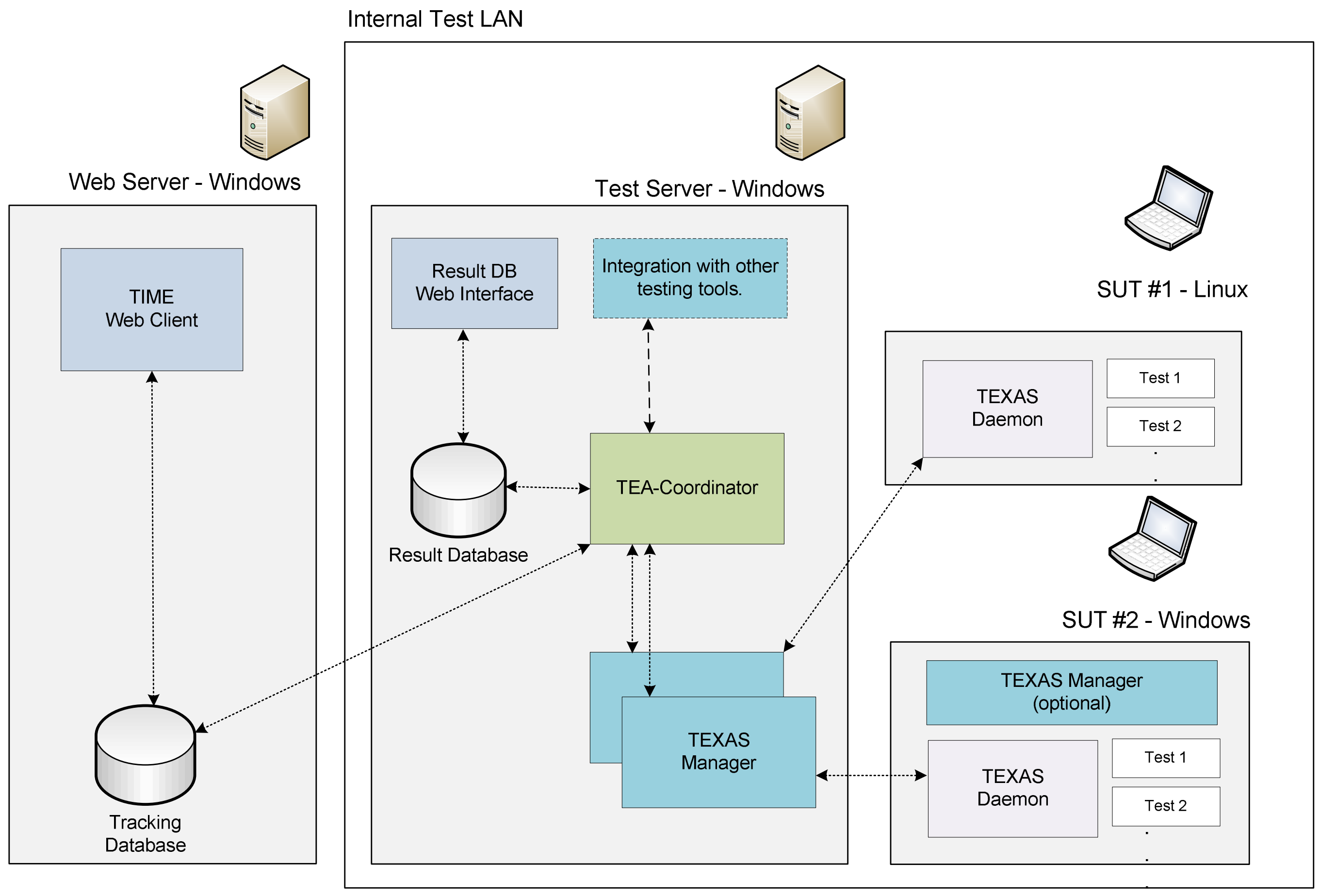


Figure 1: System Overview

The above figure describes the interaction with TeaTime [ref].

1.3 Features overview

- Generic test framework
- A great number of useful sub tests
- Platform independent execution engine
- Supports remote or stand alone testing

1.4 Supported host operating systems

Currently, TEXAS is available and has been verified for the following operating systems:

- **Windows**

- **Windows XP (32 and 64 bit)**
- **Windows Vista (32 and 64 bit)**
- **Windows 7 RC1**

- **GNU/Linux**
  - **Ubuntu 8.04 (“Hardy heron”)**
  - **Ubuntu 8.10 (“Intrepid Ibex”)**

2 Installation

Since TEXAS can be installed on different operating systems, this manual will cover instructions for both Windows and Linux, respectively.

2.1 Installing on Windows hosts

2.1.1 Prerequisites

2.1.1.1 TEXAS Daemon

Java™ 6 Runtime

2.1.1.2 TEXAS Manager

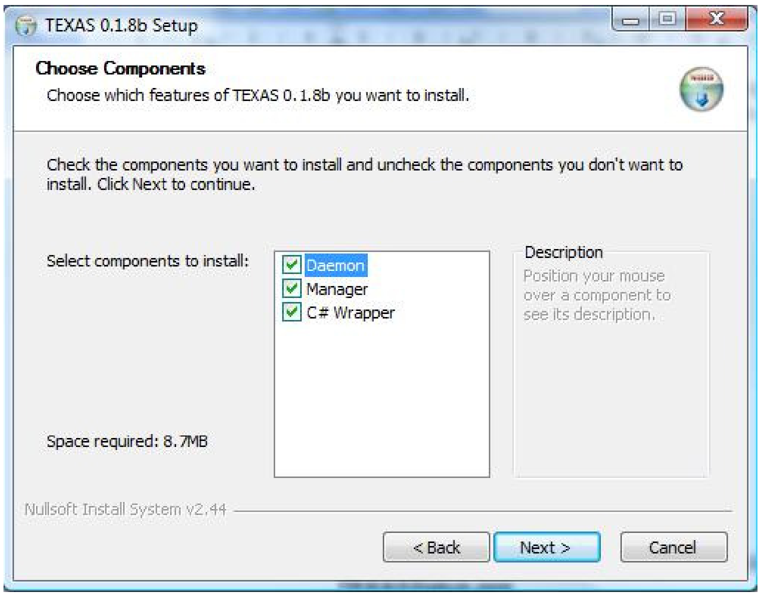
.NET Framework 2.0

2.1.2 Performing the installation

1. Install TEXAS on your system by double-clicking on its installer file, ***TEXASSetup.exe***

2. Press “I Agree” when the window has been initialized

3. Choose components to install (see 3.1.2.1) and click “Next”


TEXAS 0.1.8b Setup
Choose Components
Choose which features of TEXAS 0.1.8b you want to install.
Check the components you want to install and uncheck the components you don't want to install. Click Next to continue.
Select components to install:
Daemon
Manager
C# Wrapper
Description
Position your mouse over a component to see its description.
Space required: 8.7MB
Nullsoft Install System v2.44
< Back
Next >
Cancel

4. Specify the destination folder of the TEXAS system.

5. Press **Install** and let the installation finish.

Please note that the installation can take some time to finish. Before the installation program finishes, it starts TEXAS Daemon and runs some helper scripts to set up the environment.

2.1.2.1 Note about the different components

Most often, you want to install all three components. However, here are some descriptions of the different components' functions.

Daemon – TEXAS Daemon: Without TD you will not be able to run any tests on the system. TD is required for test execution.

Manager – TEXAS Manager: Without TM you will not be able to create or modify existing Test suites and test cases. However, if you only need to run a specific test suite file and is not interested in the graphical representation of the test execution – it's possible to skip the installation of TM (see 5.x.x for more info).

C# Wrapper – Some specific Windows sub tests requires that the C# wrapper is installed. The C# wrapper is an additional component that executes sub tests and is a helper program for the Daemon when interacting with Windows.

2.2 Installing on Linux systems

2.2.1 Prerequisites

2.2.1.1 Texas Daemon

Java 6 Runtime edition.

2.2.2 Performing the installation

From the TEXAS installation folder (make sure you are the super user):

- Either double-click the Install.sh
- or type ./Install.sh

Texas will now be located in /opt/TEXAS

Done!

3 Starting out with TEXAS

This section will describe initial instructions on how to run the TEXAS system on different operating systems. Please note that there exists no GUI for GNU/Linux, yet. Please go to section 4.3 “Setting up the system for remote testing” if you want to use TEXAS Manager and a Daemon running on GNU/Linux.

3.1 Verify that TEXAS Daemon is running

TEXAS Daemon is supposed to be started from the installer. When TEXAS Daemon is active and running, it’s located in the tray area like this:

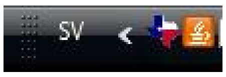
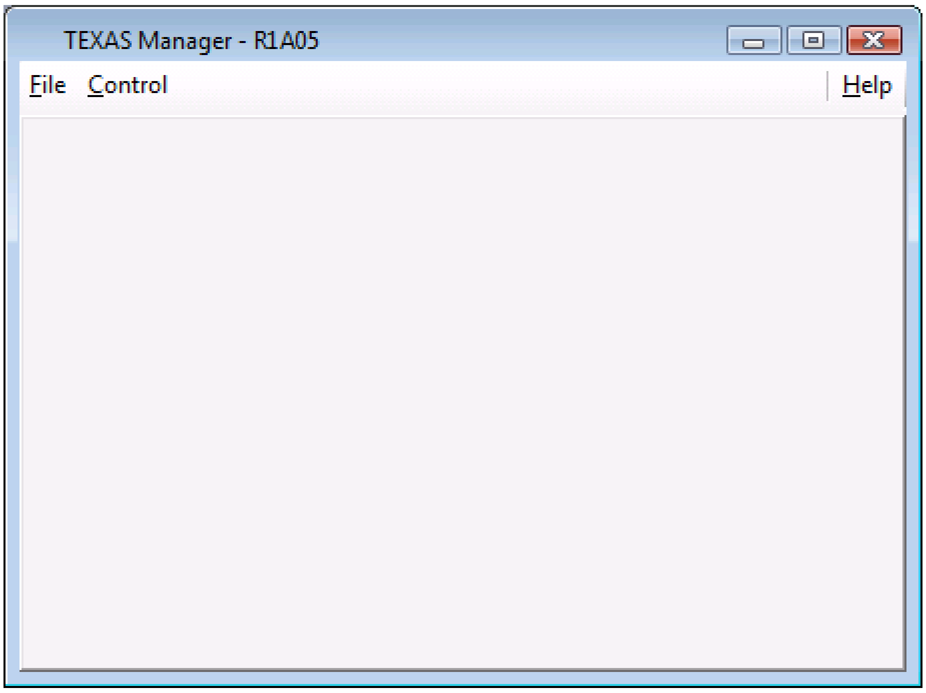


Figure x: Texas daemon is up and running

3.2 Starting the graphical user interface

- On windows, either double-click the desktop icon labeled “TEXAS **Manager**” or browse to Program->Ericsson->TEXAS->Manager

A window like the following should come up:



3.3 Setting up the system for remote testing

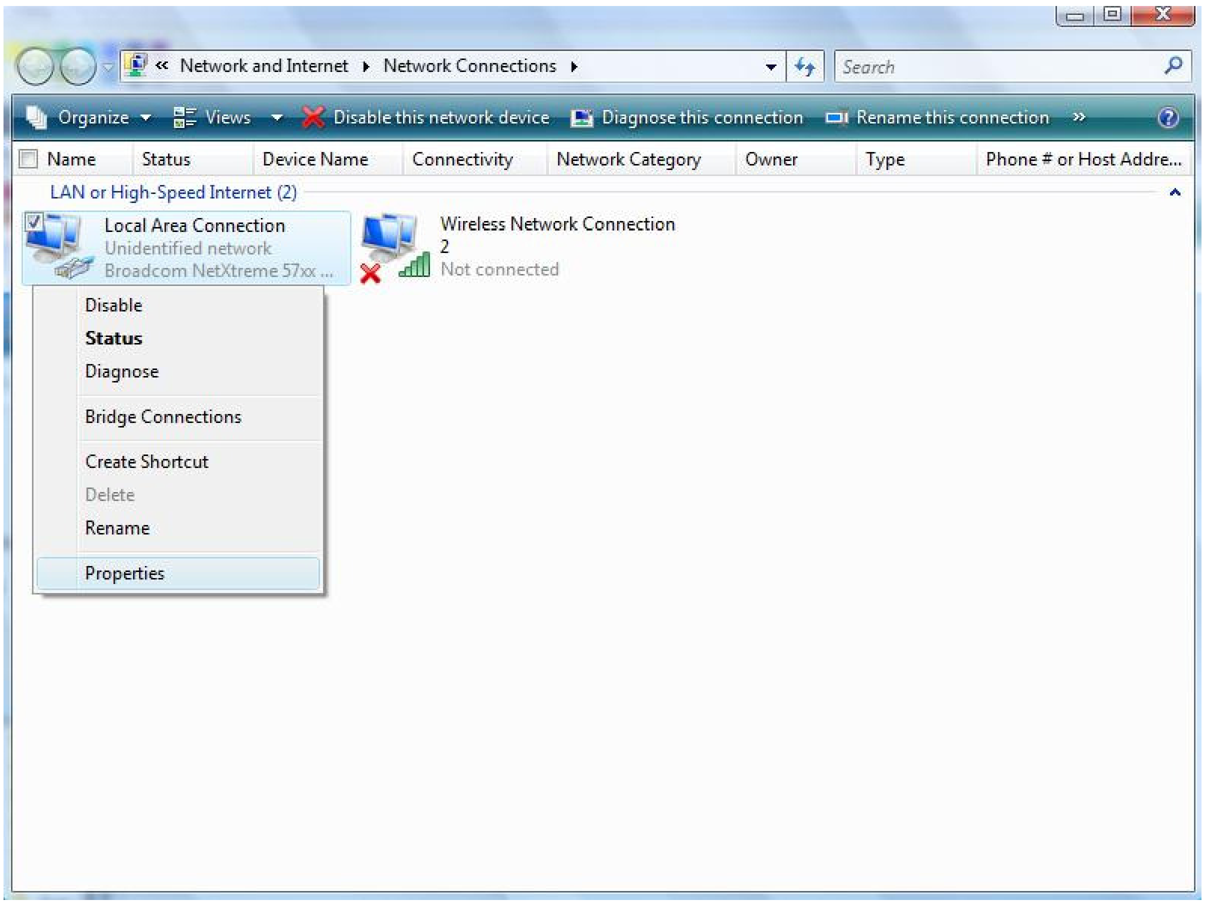
This section will describe how to set up a network to make remote testing available. Follow the instructions for the corresponding OS.

First: follow the installation guidelines in section 3 to deploy the TEXAS system correctly on the target system.

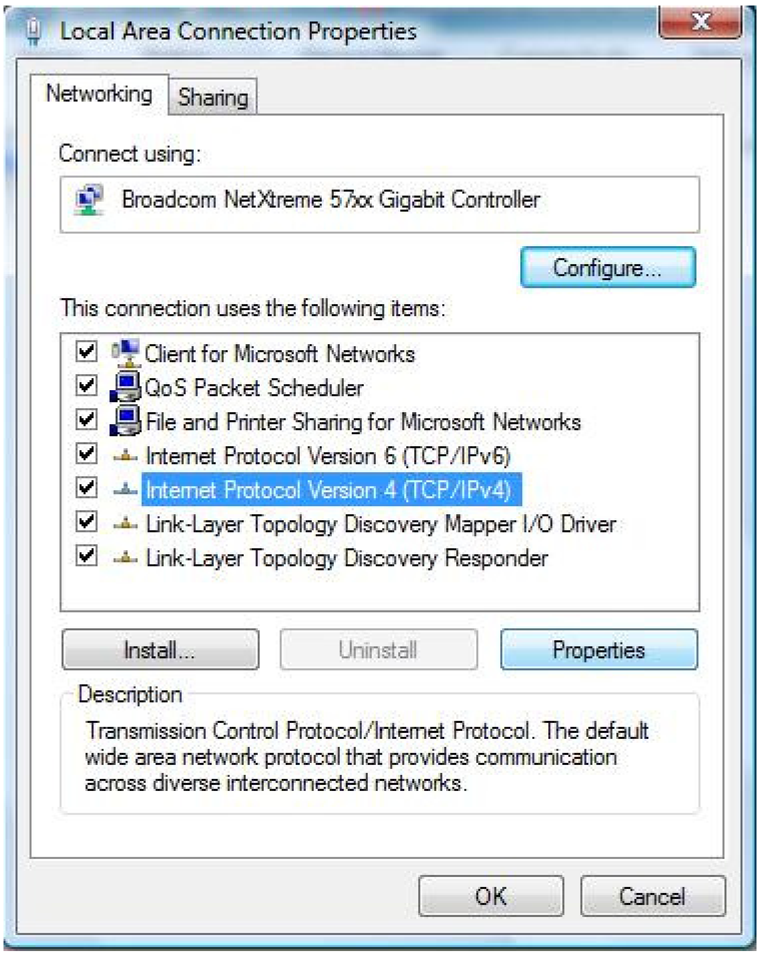
Please note that this has to be done on both the client and the remote system and they cannot have the same IP addresses.

3.3.1 Windows Vista

- Go to the control panel
- Go to Network and Sharing center
- Click on "Manage network connections"
- Select the network interface you want to use and right-click to get into properties



- Highlight "Internet Protocol Version 4" and press the Properties button



Local Area Connection Properties

Networking | Sharing

Connect using:

Broadcom NetXtreme 57xx Gigabit Controller

Configure...

This connection uses the following items:

- ✓ Client for Microsoft Networks
- ✓ QoS Packet Scheduler
- ✓ File and Printer Sharing for Microsoft Networks
- ✓ Internet Protocol Version 6 (TCP/IPv6)
- ✓ Internet Protocol Version 4 (TCP/IPv4)
- ✓ Link-Layer Topology Discovery Mapper I/O Driver
- ✓ Link-Layer Topology Discovery Responder

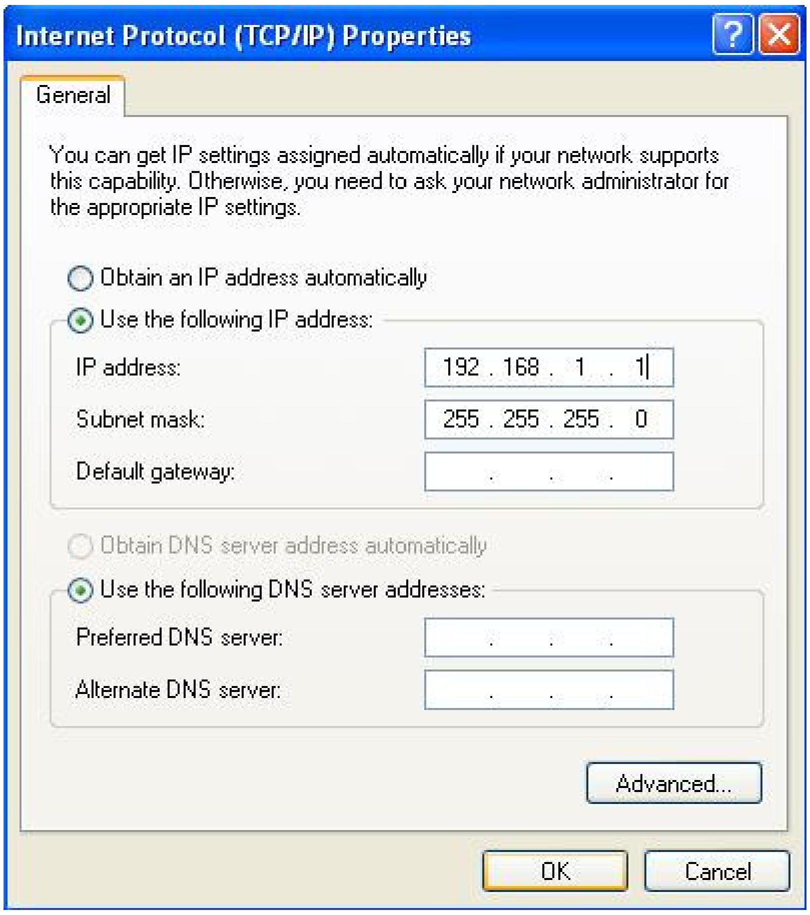
Install... | Uninstall | Properties

Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

OK | Cancel

- Select “Use the following IP address”
    - IP Address: 192.168.1.1
    - Subnet mask: 255.255.255.0
    - Skip gateway



Internet Protocol (TCP/IP) Properties

General

You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

Obtain an IP address automatically [✓ Use the following IP address:]

IP address: 192 . 168 . 1 . 1

Subnet mask: 255 . 255 . 255 . 0

Default gateway: . . .

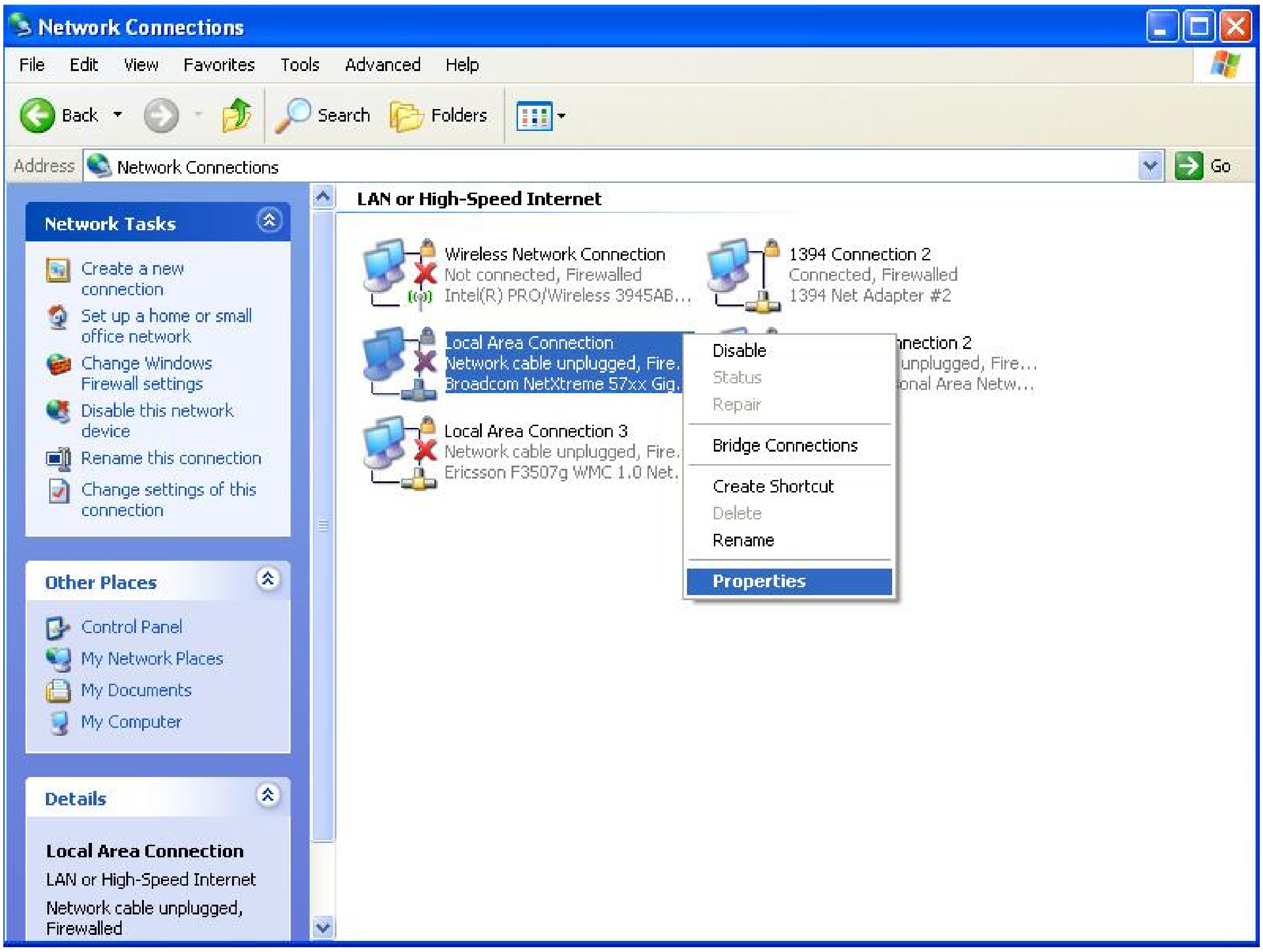
Obtain DNS server address automatically [✓ Use the following DNS server addresses:]

Preferred DNS server: . . .

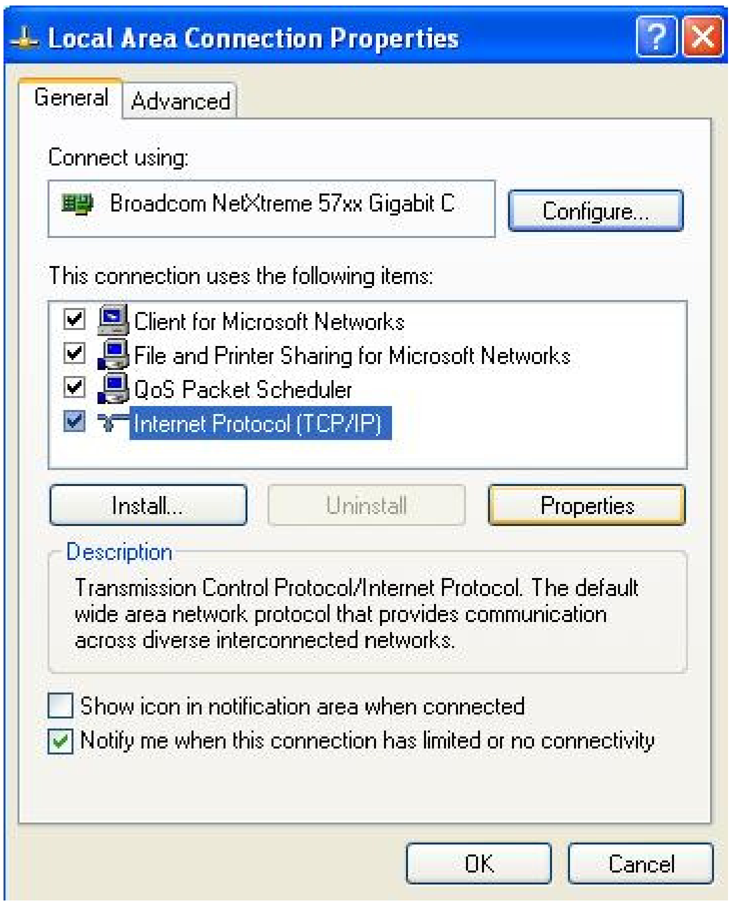
Alternate DNS server: . . .

3.3.2 Windows XP

- Go to the control panel
- Go to Network Connections
- Click on “Manage network connections”
- Select the network interface you want to use and right-click to get into Properties


Network Connections
File Edit View Favorites Tools Advanced Help
Back Search Folders
Address Network Connections
Go
Network Tasks
Create a new connection
Set up a home or small office network
Change Windows Firewall settings
Disable this network device
Rename this connection
Change settings of this connection
Other Places
Control Panel
My Network Places
My Documents
My Computer
Details
Local Area Connection
LAN or High-Speed Internet
Network cable unplugged, Firewalled
LAN or High-Speed Internet
Wireless Network Connection
Not connected, Firewalled
Intel(R) PRO/Wireless 3945AB...
1394 Connection 2
Connected, Firewalled
1394 Net Adapter #2
Local Area Connection
Network cable unplugged, Fire...
Broadcom NetXtreme 57xx Gig...
nection 2
unplugged, Fire...
onal Area Netw...
Local Area Connection 3
Network cable unplugged, Fire...
Ericsson F3507g WMC 1.0 Net...
Disable
Status
Repair
Bridge Connections
Create Shortcut
Delete
Rename
Properties

- Highlight “Internet Protocol (TCP/IP)” and press the Properties button



Local Area Connection Properties

General | Advanced

Connect using:

Broadcom NetXtreme 57xx Gigabit C

Configure...

This connection uses the following items:

- [✓] Client for Microsoft Networks
- [✓] File and Printer Sharing for Microsoft Networks
- [✓] QoS Packet Scheduler
- [✓] Internet Protocol (TCP/IP)

Install... | Uninstall | Properties

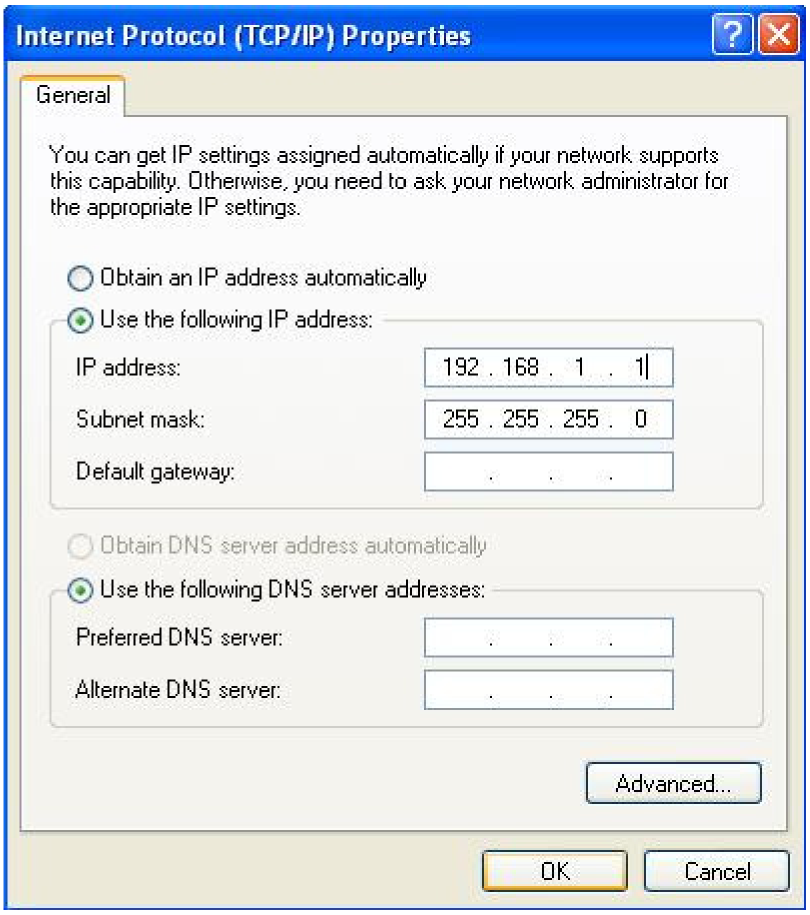
Description

Transmission Control Protocol/Internet Protocol. The default wide area network protocol that provides communication across diverse interconnected networks.

- [ ] Show icon in notification area when connected
- [✓] Notify me when this connection has limited or no connectivity

OK | Cancel

- Select “Use the following IP address”
  - IP Address: 192.168.1.1
  - Subnet mask: 255.255.255.0
  - Skip gateway



You can get IP settings assigned automatically if your network supports this capability. Otherwise, you need to ask your network administrator for the appropriate IP settings.

( ) Obtain an IP address automatically
(●) Use the following IP address:

IP address:	192 . 168 . 1 . 1
Subnet mask:	255 . 255 . 255 . 0
Default gateway:	. . .

( ) Obtain DNS server address automatically
(●) Use the following DNS server addresses:

Preferred DNS server:	. . .
Alternate DNS server:	. . .

3.3.3 On GNU/Linux XP

- Open a terminal window
- Type **ifconfig** and determine which network interface you should use(for example eth0)
- Run **sudo ifconfig eth0 192.168.1.1 up** to set the address.

3.3.4 Verify connection

Open a terminal (Windows: cmd) and try to ping the client from the host and vice versa. If this works, the systems are ready for remote testing.

Otherwise, make sure all firewalls are disabled and that the physical connection from client ←→ host is possible (i.e. check cables etc).

4 TEXAS Manager

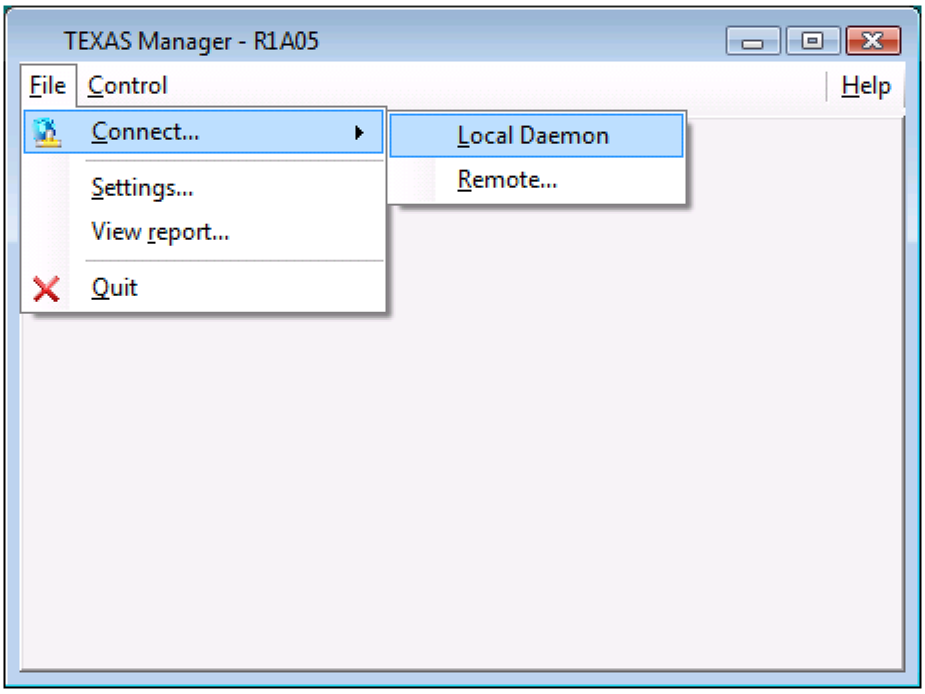
4.1 Connect to TEXAS Daemon

As mentioned earlier, there are two ways to execute tests in TEXAS. You can either start the test on a local running Daemon or a Daemon running in the network on a remote system. This section will describe how to connect to TEXAS Daemon from TEXAS Manager both remotely and locally. The last bullet will handle multiple connections. This means that TM can connect to several TEXAS Daemons, making it possible to control several tests on remote computers from one client.

4.1.1 Local Daemon

Start TEXAS Manager as described in section 4.2. When the GUI has started, press file and go to Connect → Local Daemon.

After pressing "Local Daemon", TM will initialize the manager view. See 5.1.3.



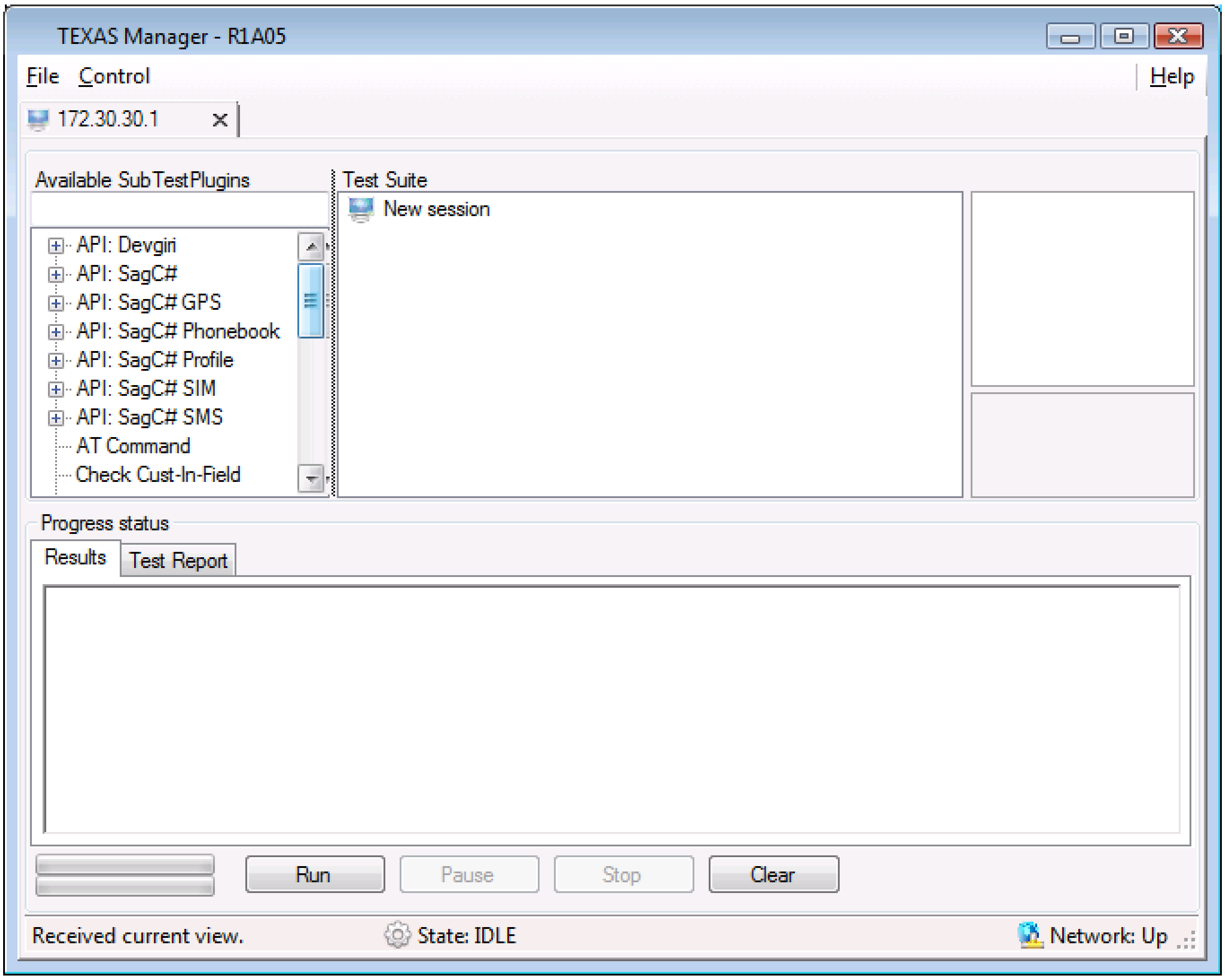
4.1.2 Remote Daemon

Start TEXAS Manager as described in section 4.2. When the GUI has started, press file and go to Connect → Remote….

A connection window will appear where you have to specify the IP address and port (Default port is 55001) to the remote TEXAS Daemon. TM will now initialize the manager view. See 5.1.3

4.1.3 TEXAS Manager View

When TM has connected to TEXAS Daemon, a new tab view will be created representing the connection to TD.



The list on the left is where the available sub tests are displayed. The plugins are displayed under certain group identifiers, to enhance the user experience. In the middle, there is a window called “Test Suite”. This is the work space of the current test, here you can build your test cases and suites from the sub tests in the plugin window. This will be described in section 5.2.

4.1.4 Multiple connections

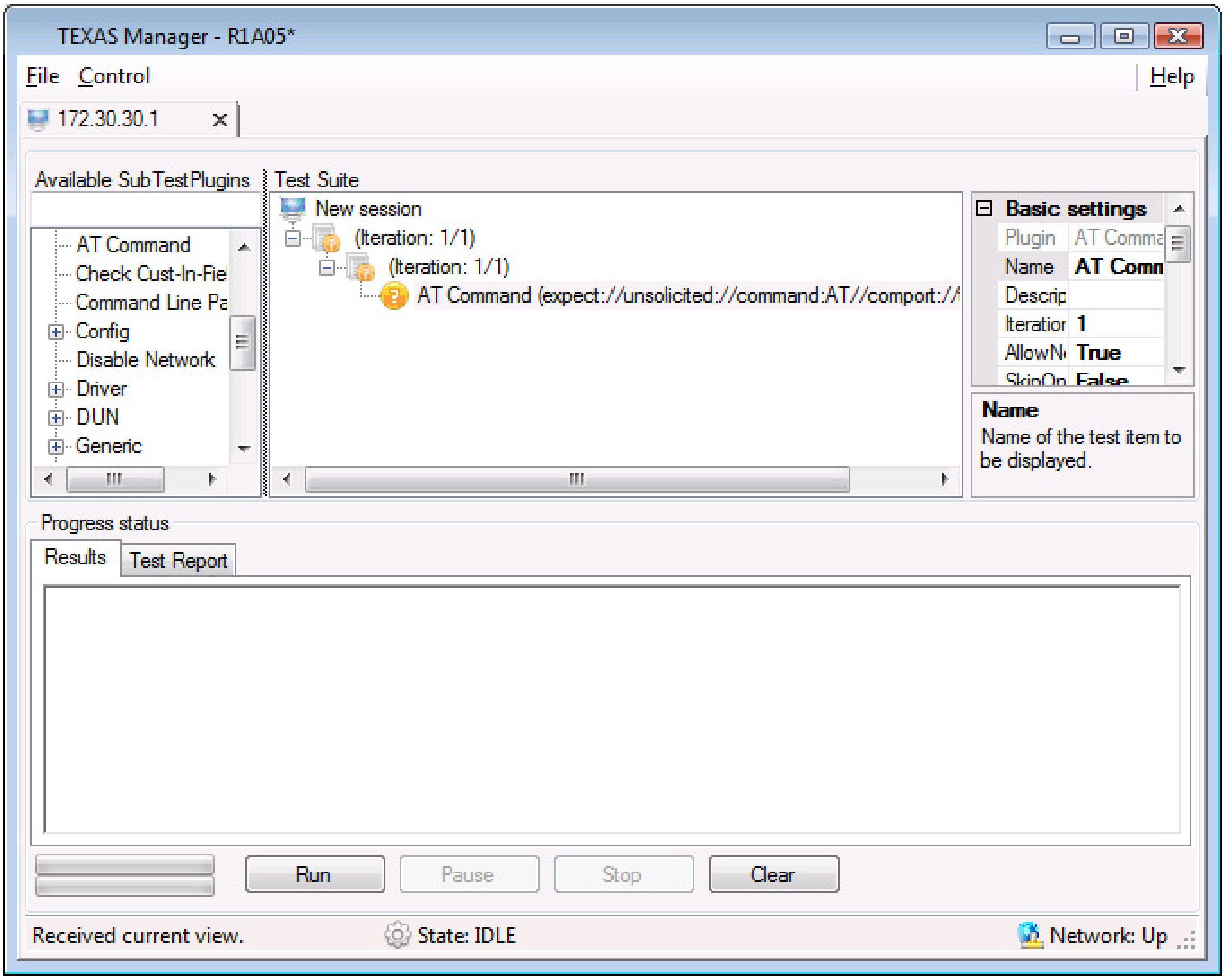
It is possible to connect to several TEXAS Daemons from TM. When a new connection is established, a new tab is initialized that displays the current status of that system. This enables remote testing on several computers with a single instance of TM.

4.2 Create your first test suite

4.2.1 Create your first test suite

Choose a plugin from the plugin list and either double-click or drag ‘n’ drop the plugin onto the workspace window (“Test Suite”). This will auto create a tree view with a Test Suite as top node, then a test case and then the plugin you picked. Some plugins (see section 7 about the plugins) have different input settings. The normal work flow is to choose a sub test, add it to the work space and then right-click->Sub Test->Settings or double-click on the sub test in the workspace to display the settings window.

The window to the right (when a sub test is highlighted in the work space), describes different options regarding the test execution. Please refer to section 4.7 “Sub test settings” for more information about them.



AT Command (expect://unsolicited://command:AT//comport://

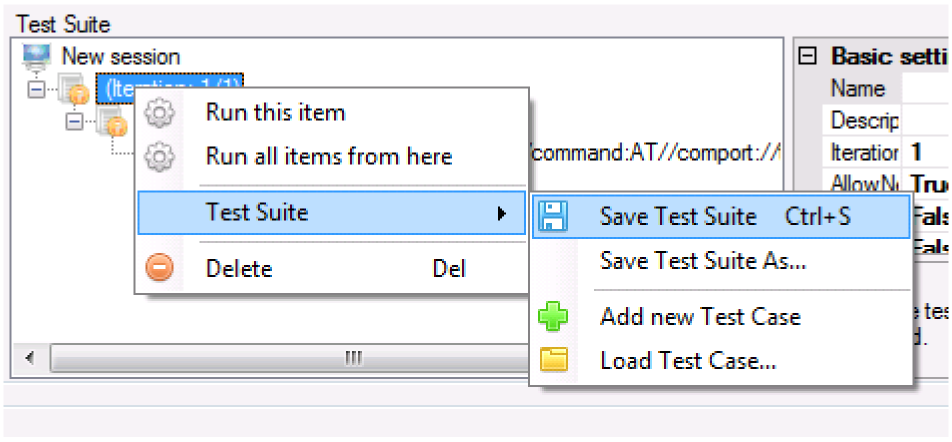
Plugin	AT Comma
Name	AT Comn
Descrip	
Iteratior	1
AllowN	True
SkipOn	False

Name
Name of the test item to be displayed.

Received current view.
State: IDLE
Network: Up

4.3 Save/Load test items

When you have created a new test suite and you want to save it for future encounters. Select the top node (under New session), right-click and go to “Test Suite”. A window describing the Save/Load options will now be present.



Press save test suite and a dialog window is present to letting the user choose where to put the file.

In the picture above, except saving a test suite, there are two options regarding test cases. These options enables loading of user created test cases. This option is useful when creating a test suite from a number of existing test cases.

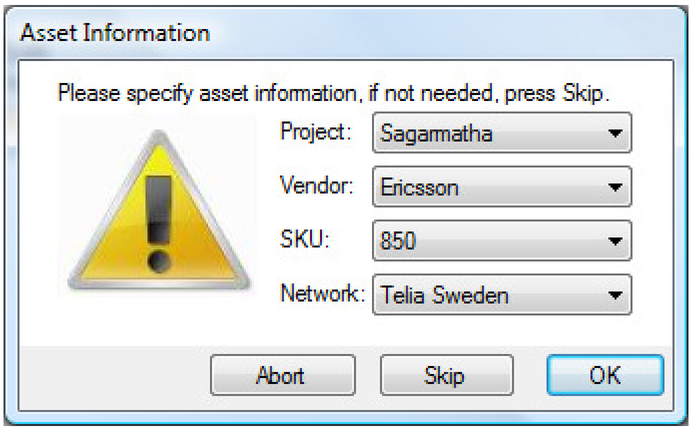
To save a test case, select the test case node of interest and right-click to display the option window.

4.4 Set up module information

There are different projects, different brands and different network operators. To ease the work for the Daemon, you as the user will be encouraged to provide this information upon the test initialization. There are two ways of specifying this information:

- Select “New session” in the workspace and look in the settings window to the right. There should be three fields named Vendor, Project, Network. Choose one name from the drop down box in each of these fields if you will interact with a module during the session.
- The other way, is to press Run and fill out the information in the pop up window that will be displayed if the information is mission. There will be three options to choose from in this window. Abort, Skip and Ok.

Please note that the pop up window only will appear when the information has been provided. After that, alternative one is the only way of changing the information.


Asset Information

Please specify asset information, if not needed, press Skip.

Project: Sagarmatha

Vendor: Ericsson

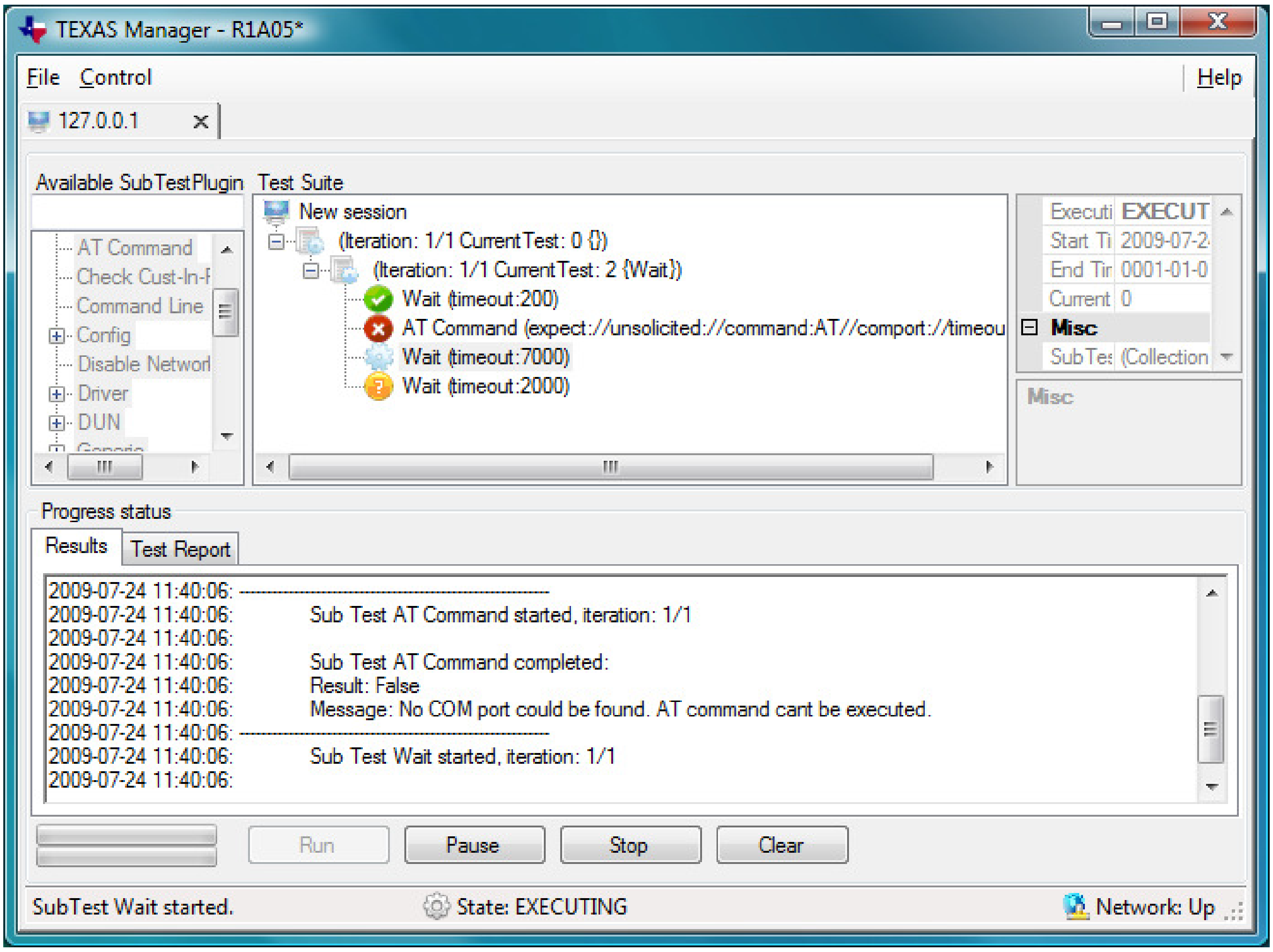
SKU: 850

Network: Telia Sweden

4.5 Run a test suite

When you are happy with your test suite and want the Daemon to execute it, just press the “Run” button and the execution will start. If you have not specified information about the module you are testing on the pop up described above will be present. The test suite execution will then start and the tree nodes in the workspace will change their state from a orange question mark to a spinning gear.

The status of the execution is updated throughout the test. When a sub test is finished, a green icon for pass or a red icon for fail is displayed, making it easy to follow the execution phase. A more detailed execution log is provided in the “Progress status” view, in the tab named “Results”.



```
2009-07-24 11:40:06: ------------------------------------------------------
2009-07-24 11:40:06:          Sub Test AT Command started, iteration: 1/1
2009-07-24 11:40:06:
2009-07-24 11:40:06:          Sub Test AT Command completed:
2009-07-24 11:40:06:          Result: False
2009-07-24 11:40:06:          Message: No COM port could be found. AT command cant be executed.
2009-07-24 11:40:06: ------------------------------------------------------
2009-07-24 11:40:06:          Sub Test Wait started, iteration: 1/1
2009-07-24 11:40:06:
```

When a test suite is finished and the execution has stopped. TEXAS Daemon sends a test report to the manager, containing useful information about the test run. See 4.7 for more information.

4.6 Control TEXAS Daemon from TEXAS Manager

There are tree different control calls from TEXAS Manager to TEXAS Daemon.

- Run

  Run starts a test.

- Stop

  Stop aborts an ongoing test

- Pause

  Pause, halts the ongoing test. When paused, the button changes name to “Resume”. If “Resume” is pressed the execution will start again.

4.7 Run TEXAS Manager as an observer

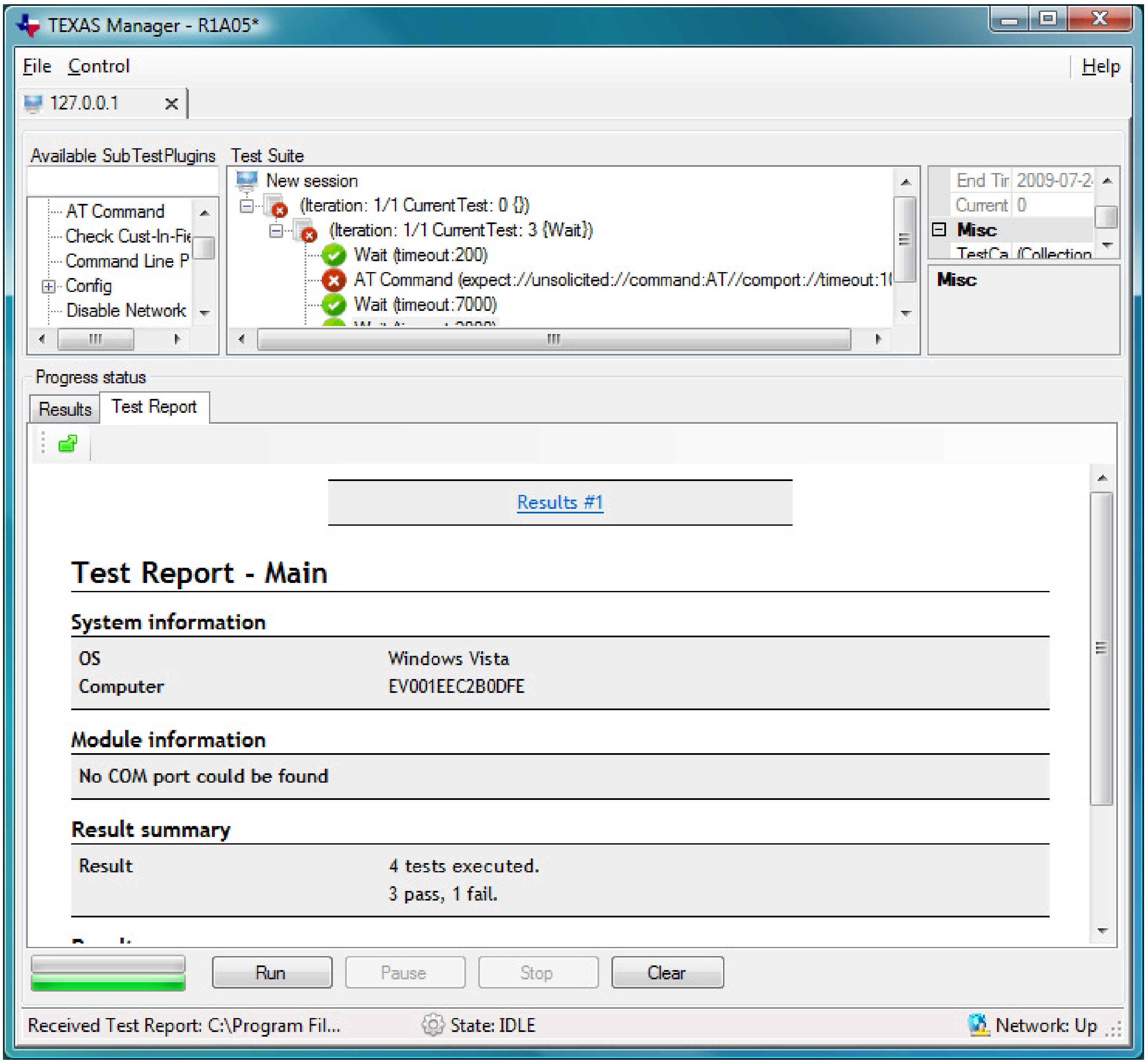
Texas Manager is allowed to connect and receive current Daemon state. This feature means it is possible to connect to a host, where a test suite is being executed, and follow the test results as an observer.

However, there are some limitations. The observer will not receive a test report after the execution is finished and all control calls from the observer will be rejected by the Daemon.

4.8 Test report generator

When a test suite has been executed, an XML log file of the run test will be sent to TEXAS Manager from the Daemon. A nicely formatted test report including detailed prints from each sub test that has been executed, is generated by the Manager and displayed in a HTML-viewer for easy viewing.

When TEXAS Manager has generated the report, it will automatically display it under the “Test Report” tab in the “Progress status” panel.



```
New session
(Iteration: 1/1 CurrentTest: 0 {})
(Iteration: 1/1 CurrentTest: 3 {Wait})
Wait (timeout:200)
AT Command (expect://unsolicited://command:AT//comport://timeout:1
Wait (timeout:7000)
```

End Tir 2009-07-2
Current 0
TestCa (Collection

Test Report - Main

System information

OS	Windows Vista
Computer	EV001EEC2B0DFE

Module information

No COM port could be found

Result summary

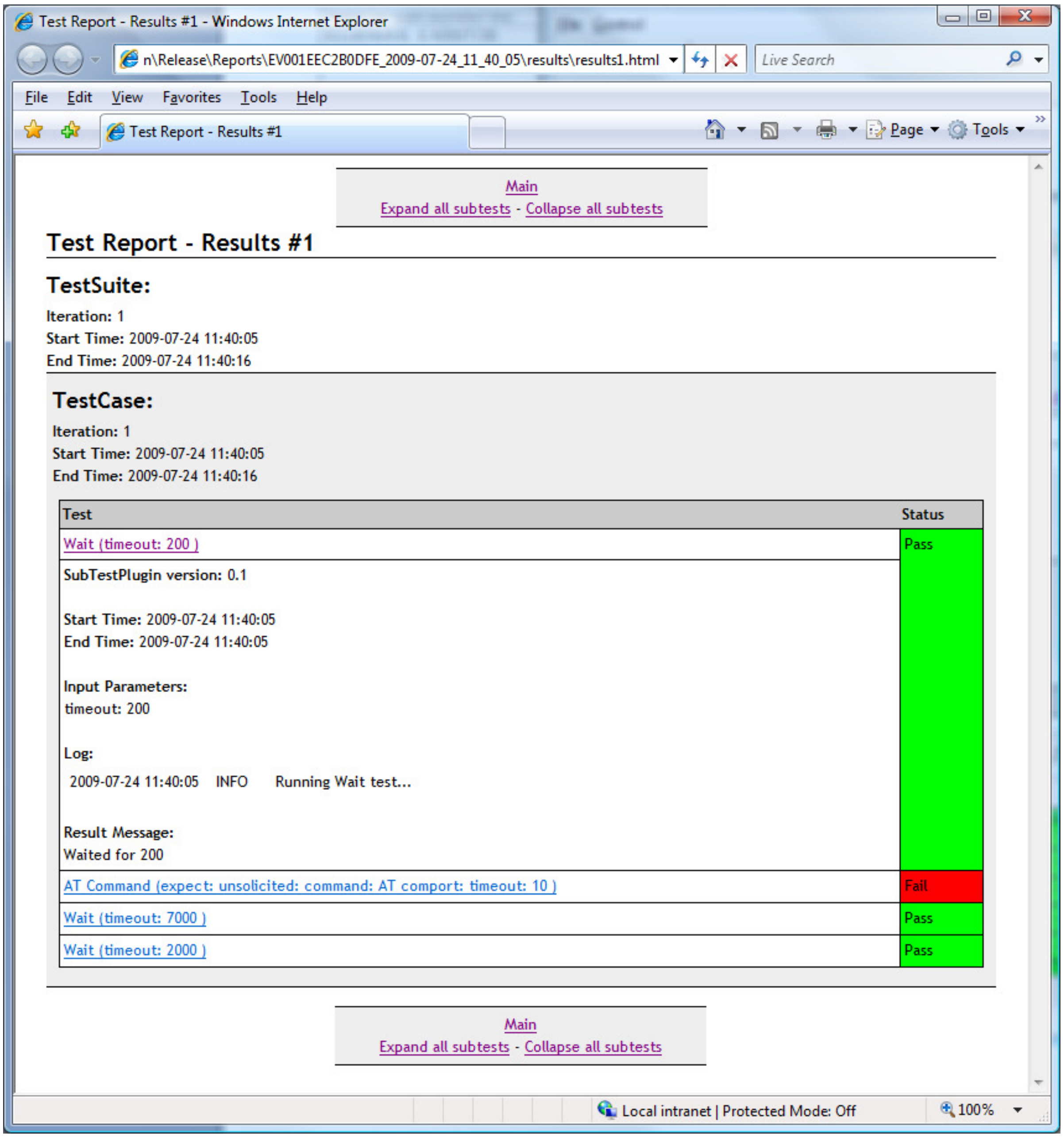
Result	4 tests executed. 3 pass, 1 fail.

Received Test Report: C:\Program Fil... State: IDLE Network: Up

As can be seen in the window above, there is a button with a green icon located to the top left of the test report view. By clicking this button the test report is displayed in a stand alone browser (Internet Explorer).

The reports are split up in one main page and one or more result pages. The main page presents system information, module information, a result summary and links to relevant result pages.

The screenshot below shows the result page of a report in a stand alone browser. Here, each sub test is underlined and when it's clicked, the information about the specific sub test will be expanded in the report. If the link is clicked when the information is visible, the sub test information will collapse and become hidden once again.


Test Report - Results #1 - Windows Internet Explorer
n\Release\Reports\EV001EEC2B0DFE_2009-07-24_11_40_05\results\results1.html
Live Search
File Edit View Favorites Tools Help
Test Report - Results #1
Page Tools
Local intranet | Protected Mode: Off
100%

Main
Expand all subtests - Collapse all subtests

Test Report - Results #1

TestSuite:

Iteration: 1
Start Time: 2009-07-24 11:40:05
End Time: 2009-07-24 11:40:16

TestCase:

Iteration: 1
Start Time: 2009-07-24 11:40:05
End Time: 2009-07-24 11:40:16

Test	Status
Wait (timeout: 200) SubTestPlugin version: 0.1 Start Time: 2009-07-24 11:40:05 End Time: 2009-07-24 11:40:05 Input Parameters: timeout: 200 Log: 2009-07-24 11:40:05 INFO Running Wait test... Result Message: Waited for 200	Pass
AT Command (expect: unsolicited: command: AT comport: timeout: 10)	Fail
Wait (timeout: 7000)	Pass
Wait (timeout: 2000)	Pass

Main
Expand all subtests - Collapse all subtests

It is possible to expand/collapse all subtests on a page through a single click by using the links in the menus available in the top and bottom of the page.

If you want to view a report that has been previously generated, you can use the menu choice View Report… accessed from the File menu, and locate the HTML report main file. You could also locate and open an XML log file from a run test created by a TEXAS Daemon with this menu choice. When doing that, a new HTML report is generated. Both when opening an already generated HTML report, and when generating a new one, the report will be shown in a standalone browser (Internet Explorer).

4.9 Sub test settings

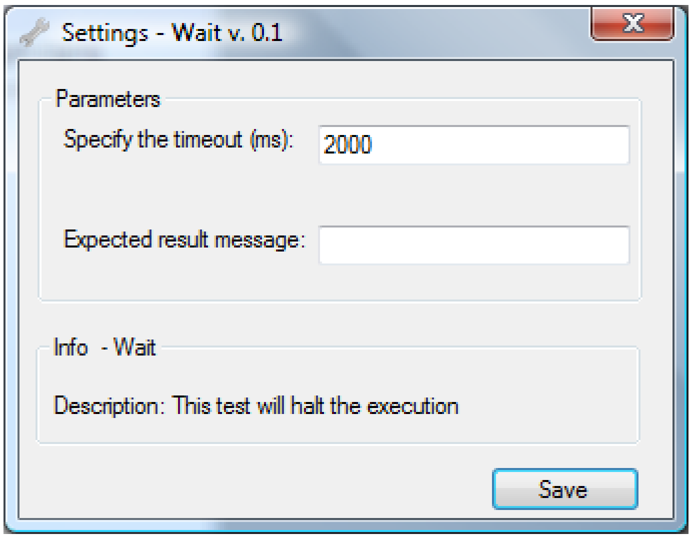
For each sub test there is a settings area in the rightmost window of TEXAS Manager. This section will describe each field and what the purpose they have and what impact it will bring to the test run.

There are three different setting types to consider in TEXAS Manager

- Sub Test Settings
- Basic Settings
- Global Parameters

4.9.1 Sub test settings

A lot of the sub tests have one or more input parameters. For example, the subtest "Wait". Wait halts the execution for a specified interval. That interval can be changed in the subtest settings. To change an input parameter, you can either highlight and double-click on the sub test or right-click and choose **Sub Test -> Settings.** When this is done, a window like the following will be displayed:


Settings - Wait v. 0.1

Parameters

Specify the timeout (ms): 2000

Expected result message:

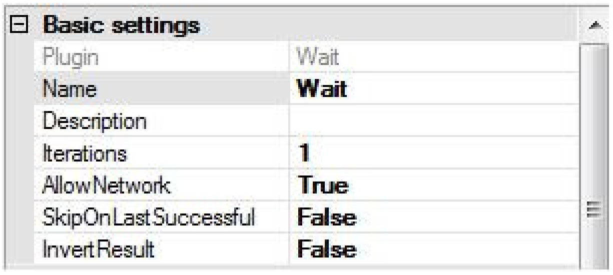
Info - Wait

Description: This test will halt the execution

The input box(es) inside the Parameters border is input parameters to the subtest. The second displays a brief description on how the test is intended to work. When the parameter values have been changed, press Save and the window will be closed and the values stored.

4.9.2 Basic settings

This settings option applies to every test item. It can be modified for the whole test suite, for different test cases and even for the sub tests. The basic settings window appears to the right when a test item node is selected and looks like this:



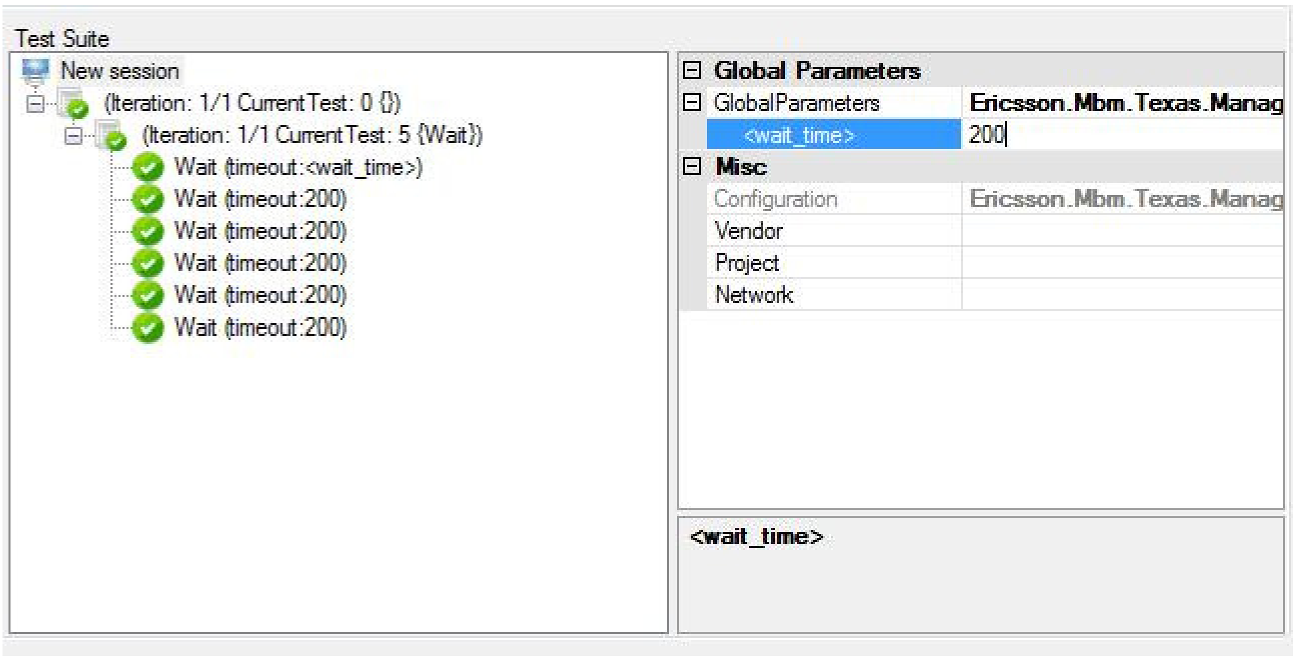
Basic settings	
Plugin	Wait
Name	Wait
Description	
Iterations	1
AllowNetwork	True
SkipOnLastSuccessful	False
InvertResult	False

There are six different settings that can be modified:

- **Name** – the displayed name of the test. This name can be changed.
- **Description** – If you would like to describe the test item more detailed then a description can be added in this field.
- **Iterations** – how many times will this test be executed.
- **AllowNetwork** – Sometimes you might want to disable the network interface to face a certain requirement or so. If the value is true, then the network adapter will be enabled, if false then it will be disabled. **Please note that this will disable all communication between TM and TD**
- **SkipOnLastSuccessful** – If you have several iterations on a test and you want to skip the iteration if the last result of this item was successful, then enable this option.
- **InvertResult** – If you expect an error from a test you can invert the test result.
- **AbortOnError** – If this option is set to true, the execution will abort if this test item fails.
- **Enabled** – If you have a large test suite and only want to run a few test cases or sub tests. The daemon will skip execution of every test item with this setting set to false.

4.9.3 Global parameters

With global parameters, a generic test suite can be built and used by several users. The only modification that has to be done is to make sure that the global parameters are set to a proper value. When setting a subtest setting, instead of typing a value you can type an identifier. The identifier is then used in a global settings window where you can assign a value to it. What will happen is that every sub test containing this identifier as an input value, will get the global value of the identifier as the input parameter for the specified setting.



An example: In the test suite above, there are six wait tests. One of them does not have a numeric value as input parameter. Instead it has been assigned the identifier <wait_time>. This tag is a global value identifier which can be modified from the “New session” node. As the picture above tells, the global parameter <wait_time> has been added to the GlobalParameters list in the rightmost window.

So, if there are several subtests in a test suite containing the same parameters, a global parameter might be a good choice.

4.10 Tips ‘n’ tricks

- Short keys

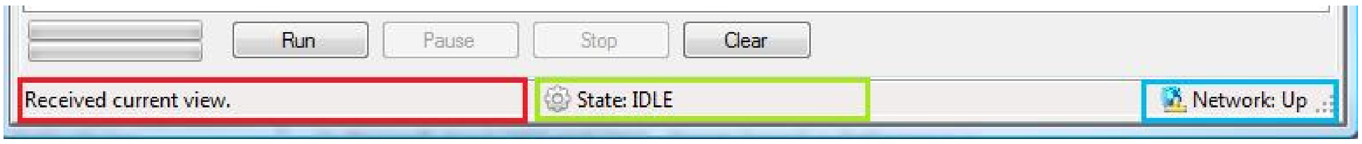
Action	Result	Command
Add sub test	A sub test is added to the work space	Double-click the sub test Drag ‘n’ drop the sub test with the mouse
Delete test item	The test item will be deleted from the work space	Highlight the test item, press Delete Right-click->Delete
Duplicate test item	The test item will be duplicated, inserted right after its sibling	Highlight the test item Ctrl+D Right-click → Duplicate
Move	Move a test item in the work space.	Highlight the node of the test item and drag ‘n’ drop the item up and down

- Basic settings and global parameters
  - Read about the different settings that can be used to do more accurate testing and set up generic test suites that can be used by several users.

4.11 TEXAS Manager Notification Fields

There are tree notification fields in TEXAS Manager.

- Execution status (The green area)
- Network status (The blue area)
- Status bar (The red area)



Received current view.

These three notification fields update the user with useful information about the current state. Network status displays if the network is up and running, meaning a valid connection to TEXAS Daemon.

The status bar shows a lot of different information, for example it can show:

Message	**Description**
Received current view	Plugins received and the window was initialized properly.
Setting up test	Initialize test, prepares for file transmission, generation of test data etc.
Sending file	Information about the current file while it gets transferred like speed and a byte counter.
Receiving test file	Like sending a file but now it is receiving instead.
Test was aborted	Displayed when the stop button has been pressed.
Test is paused	Displayed when the pause button has been pressed.
Critical failures	When the Daemon has encountered a serious fault, for example if it can’t start the test or a message could not be interpreted. A critical message is received.
Test item updates	Updates regarding the different test stages, executing, completed etc.

4.12 Settings

To view or edit the settings of TEXAS Manager, go to File -> Settings…. The settings dialog is based on tabs and currently, the only available setting is Report filter in the Reports tab (see 5.12.1). The Close button of the dialog exits the dialog and does not save any changed settings. The Save button saves changed settings and exits the dialog.

4.12.1 Report filter

The Report filter setting allows the user to specify the detail level of the generated HTML reports. The available choices together with what they mean are:

- Show all subtests
  All subtests of the run test session are reported. This is the default setting.
- Show only passed subtests
  Only the subtests of the run test session that passed are reported. This option could be useful when you are running many tests (or iterations of a test) where you expect a lot of fails, to filter out what is actually working as intended.
- Show only failed subtests
  Only the subtests of the run test session that failed are reported. This option could be useful when you are running many tests (or iterations of a test) where you expect a lot of passes, to filter out what is actually not working as intended.

4.13 Control

There is a Control menu available in TEXAS Manager. In this, you can control some parts of the test execution environment. Currently, there is only one submenu, namely Local C# wrapper (see 5.13.1).

4.13.1 Local C# wrapper

Some subtest plugins are Windows specific. This means that they can only be run on Windows. To enable this, a Windows service called “TEXAS C# Test Executor” runs in the background, executing all those subtest plugins. If you for some reason want to control the running state of that service, you can use this menu and through it either start, stop or restart the service.

4.14 Closing TEXAS Manager

Closing TEXAS Manager can be done in three different ways

1. Closing the tab (this actually only closes the connection to that Daemon)

2. Closing the complete window

3. Closing by navigating to **File → Quit**

However, if there is an ongoing test at the daemon when the program or tab is closed, please remember that the Daemon will expect you to re-connect and gather the test result.

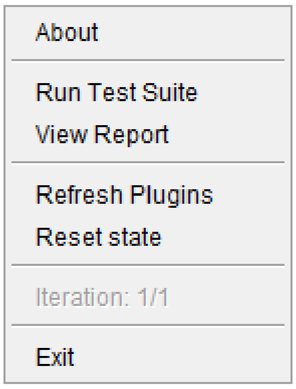
This means that the Daemon will be occupied and no one but you or a user with the same IP can collect the test data and making the Daemon available again.

5 TEXAS Daemon

5.1 User interaction with TEXAS Daemon

TEXAS Manager is the best way of interacting with TEXAS Daemon, but if this is not possible due to operating system or other reasons, the Daemon itself has a number of features that a user can use.

When TEXAS Daemon is up and running, there should be a TEXAS icon in the tray bar on both Windows and Linux. To enable the Daemon menu, right-click the tray icon and this menu will appear:



Existing menu items:

- About
  - A popup window is displayed, showing information about the Daemon. It will display:
    - Build – The version number
    - Port – The listening port of the Daemon
    - Status – Current execution status.
- Run Test Suite
  - This option prompts a window where the user can specify a test suite file. This option is useful on GNU/Linux systems where there exists no GUI (no TM). The test suite can be created from a Windows computer and then be loaded on a Linux system.
- View Report
  - The user can select a .log-file and a HTML report is generated and opened in the default web browser of the system.

- Refresh Plugins
  - If all plugins didn’t appear in the plugin list of TM, this option will do another scan and send whatever content it finds.
- Reset state
  - If it is impossible to connect to TD for some reason, it might be a good idea to reset the internal state to see if the issue is solved.
- Iteration
  - If a test is running, the current iteration of the test suite is displayed. Useful when running a test suite not using TEXAS Manager.
- Exit
  - Closes TEXAS Daemon.

6 Glossary

Name	**Description**
AT command	A command which the broadband module understands. AT commands are used internally to control and get the state of the module.
TD	TEXAS Daemon: Application that executes tests. A Daemon can be administered via its own tray menu or from a Manager.
TEXAS	Test EXecution Automation System
TM	TEXAS Manager: Application used to administer and control one or several Daemons. Through TM you control the execution of tests and also, you can create and edit test suites.
TeaTime	Test Execution Automation and Tracking Inventory Manager at Ericsson: consists of two parts; a test execution part that can be used to schedule tests on dedicated test computers, and a computer/module searching and booking websystem.
Test Item	All elements part of a test suite is considered to be a test item. This could either be a test suite, a test case or a subtest.
S3	An operating system power state. Also known as Sleep.
S4	An operating system power state. Also known as Hibernation.

8 TEXAS PLUG-IN DEVELOPMENT GUIDE

TEXAS Plug-in Development

Contents

1 Introduction

This document will describe how to extend functionality in TEXAS (Test Execution Automation System) used within the MBM department, by adding plug-ins. Please refer to xxxx for a detailed overview of the implementation and use of the system.

1.1 Abbreviations

TM	TEXAS Manager
JAR	Java ARchive
DLL	Dynamic-link Library
ANT	Another Neat Tool
CLI	Command Line Interface
DUT	Device Under Test

2 Plug-ins

The TEXAS environment features a plug-in based architecture for adding new functionality. The terminology for these plug-ins is “Sub Test Plug-ins”, as they provide functionality on a Sub Test level.

TEXAS comes with a set of pre-developed multi-purpose plug-ins. Before developing a new plug-in make sure there is no existing plug-in providing the desired functionality.

2.1 Overview

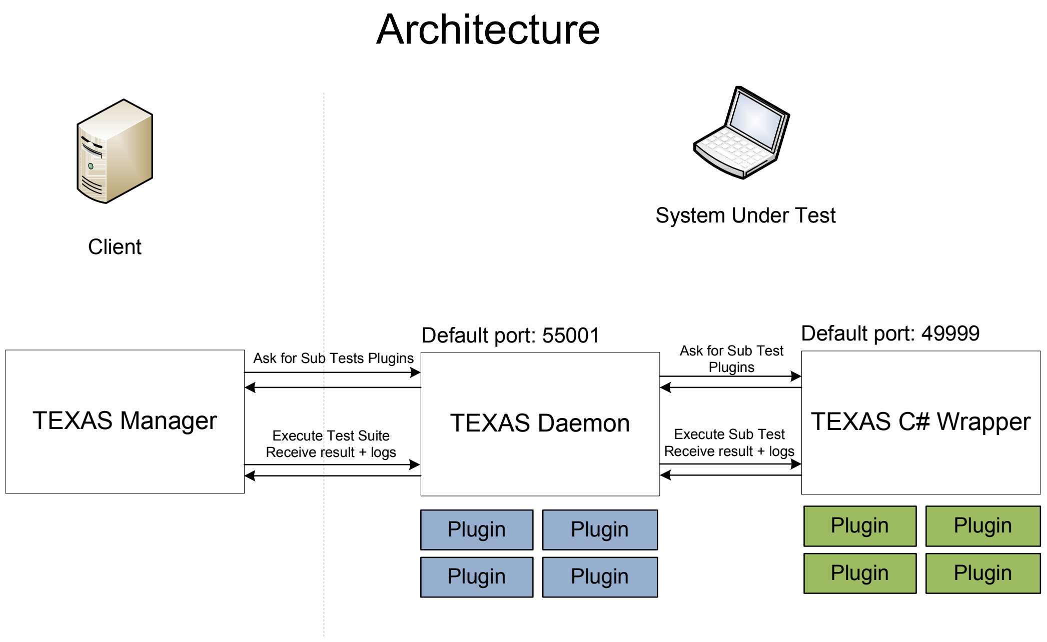


Figure 1: High-level architecture

TEXAS currently provides support for plug-ins written in Java or C# (.NET 2.0) deployed as JAR files and DLL files respectively.

As the core component, TEXAS Daemon, is written in Java, JAR files can be loaded directly into TEXAS Daemon in run-time. C# DLL files are loaded into a separate service process, TEXAS C# Wrapper, which communicates with TEXAS Daemon to coordinate test execution. The end user is exposed to a combined list of Sub Test Plug-ins but does not need to concern how they are implemented.

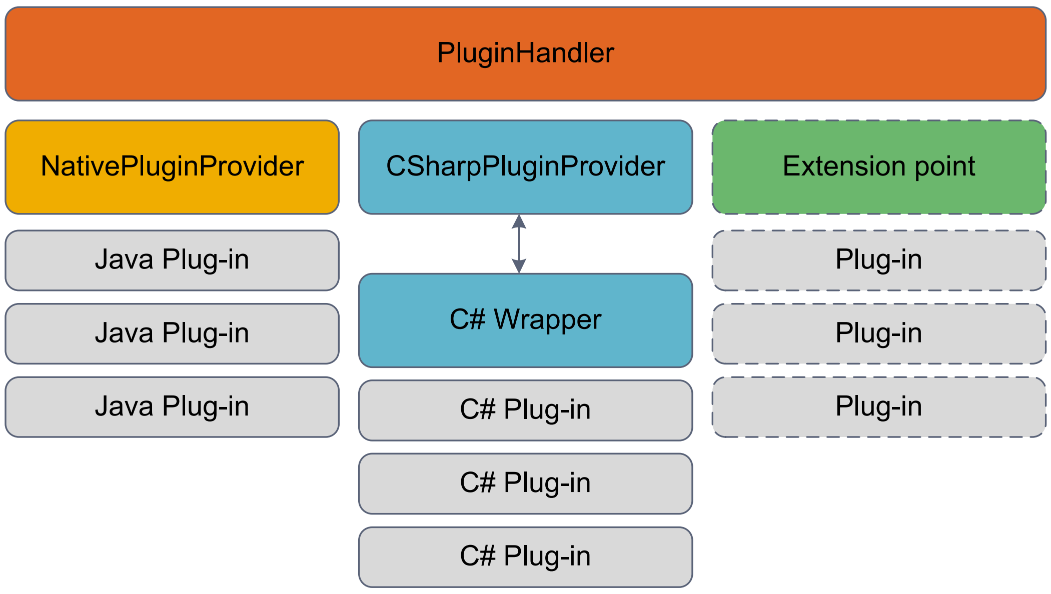


Figure 2: Low-level architecture

The internals of the plug-system is shown in Figure 2. The plug-ins are provided by PluginProvider objects. If in the future there is a demand for new types of plug-ins, a new PluginProvider can be added that interfaces with the new plug-in architecture.

2.2 General Plug-in interface

For a plug-in to be recognized, it must implement a plug-in interface, *ISubTestPlugin*, according to the high-level description below.

Attributes:

Name	Names of the plug-in. Must be unique!
Description	Describes the purpose of the plug-in.
Group	Categorizes the plug-in with other similar plug-ins.
Version	What versioning number is the plug-in. Maybe auto-added by ClearCase?
InputParameters	Specifies what input parameters can be passed to the plug-in and what the default parameter values are.

Functions:

Run	Execute the test code, and return a test result.

2.3 General guidelines

- Plug-ins are not loaded in any particular order, thus plug-ins should not have dependencies on each other
- The Name identifier must be unique. If two plug-ins have the same name, the one last loaded will be exposed to the user.

- Try to make the plug-in as generic as possible.
- If possible, implement in Java to eliminate unnecessary communication overhead.

2.4 Documentation

Update internal document with a complete description of:

- The purpose of the plug-in
- Usage
- Known limitations
- Parameter descriptions

3 Developing a Java plug-in

This section will describe hands on step-by-step how to get started with writing Java plug-ins. It assumes you have prior basic knowledge of Java and Eclipse.

3.1 Setting up the environment

It is recommended that Eclipse is used for Java developing.

When Eclipse is set up, create a new project and import TexasDaemon.jar available in CC to access the required interfaces and abstract class specifications. This can be done by right clicking on the *Project -> Properties*. In Build-path, choose *"Add External JARs"* and point to TexasDaemon.jar.

3.2 Implementation

3.2.1 Basics

Create a new class in the project, *"JavaPlugin"*, and put it in package *com.ericsson.mbm.texas.daemon.plugins*.

As mentioned, the class needs to implement the *ISubTestPlugin* interface. It is recommended to extend *AbstractSubTestPlugin* to access some helper functions. *AbstractSubTestPlugin* implements *ISubTestPlugin*.

Also import `com.ericsson.mbm.texas.daemon.testentities.*;` to access needed definitions.

Set the basic attribute settings in the constructor, such as name, description, group and version.

To fulfil the interface we also need to implement a `run()` method. This method will be called when the plug-in is executed. The semantics of this method will be covered further on.

```
package com.ericsson.mbm.texas.daemon.plugins;

import com.ericsson.mbm.texas.daemon.testentities.*;

public class MyFirstJavaPlugin extends AbstractSubTestPlugin {

        MyFirstJavaPlugin() {

                // Name the plug-in
                this.setName("My First Java Plugin");

                // Describe the purpose/usage
                this.setDescription("This test will do almost nothing.");

                // Set the group name
                this.setGroup("Dummy tests");

                // Set version
                this.setVersion("0.1");
        }

        public TestResult run() {

                // TODO Auto-generated method stub
                return new TestResult(true, "Test executed.");
        }

}
```

The above code is enough to get the plug-in running, even if it would be pretty useless.

3.2.2 Adding input parameters

It is possible to specify input parameters to the plug-in in order to control the execution and what data to process inside the run() method.

Input parameters should be specified in the constructor:

```
// Add input parameter with default value
this.addInputParameter("disp_text", "Display text", "Default value");

// Add input parameters with multiple choosable values
this.addInputParameter("disp_text_option", "Display text 2",
   new String[] {"Default value", "Option value #1", "Option value #2"});
```

The first line specifies an input parameter named “disp_text”. The descriptive name shown to the user is “Display text”. The default value of the parameter is “Default value”. If no value is specified by the user, this value will be used.

The second line takes a String array as value option. This means the user will presented with a list of choosable values. The first value in the list is the default one.

Please refer to JavaDoc for further details.

3.2.3 Retrieving input parameters

The input parameters can be retrieved inside the run() method.

```
// Retrieve parameters values
String parameter  = this.getInputParameter("disp_text");
String parameter2 = this.getInputParameter("disp_text_option");
```

other data types to the plug-in, do parse the string values after they have been retrieved, for instance by using `Integer.parseInt(stringval)`.

3.2.4 Run method and Test Result

When the input parameters have been retrieved implement your test code. Please comment the code and follow the Ericsson Java common guidelines. (?)

The run() method must return a TestResult data type. The TestResult specifies the outcome of the test, if the test was successful and also provides a custom message. The default constructor is:

`TestResult(boolean successful, String message)`

Example:

```
if (parameter.equals("a string value")) {
   return new TestResult(true, "Test executed successfully.");
}

return new TestResult(false, "Test failed duo to incorrect input param");
```

3.2.5 Logging

AbstractSubTestPlugin provides the object *logger* of type *TestLogger* which can be called to log events during the test execution. The log prints will be recorded to the test report.

The following levels may be used:

```
logger.trace(String message);
logger.debug(String message);
logger.info(String message);
logger.warn(String message);
logger.error(String message);
logger.fatal(String message);
```

3.2.6 Complete code listing

Now we have a complete runnable SubTestPlugin:

```java
package com.ericsson.mbm.texas.daemon.plugins;

import com.ericsson.mbm.texas.daemon.testentities.*;

public class JavaPlugin extends AbstractSubTestPlugin {

        JavaPlugin() {

                // Name the plug-in
                this.setName("My First Java Plugin");

                // Describe the purpose/usage
                this.setDescription("This test will do almost nothing.");

                // Set the group name
                this.setGroup("Dummy tests");

                // Add input parameter with default value
                this.addInputParameter("disp_text", "Display text",
                                                 "Default value");

                // Add input parameters with multiple choosable values
                this.addInputParameter("disp_text_option", "Display text 2",
                                new String[] {"Default value","Option value #1",
                                                 "Option value #2"});

        }

        public TestResult run() {

                // Retrieve parameters specified in constructor
                String parameter  = this.getInputParameter("disp_text");
                String parameter2 = this.getInputParameter("disp_text_option");

                logger.debug("Retrieved parameter1: " + parameter);
                logger.debug("Retrieved parameter2: " + parameter2);

                if (parameter.equals("a string value")) {
                        logger.error("The parameter was incorrect.");
                                return new TestResult(true,
                                                "Test executed successfully.");
                }

                return new TestResult(false, "Test failed.");
        }

}
```

3.3 Compiling & Packaging

The recommended way to build and package a Java plug-in for TEXAS is to use ANT, which is a build tool for Java to compile programs based on XML make files.

Install ANT from http://ant.apache.org/bindownload.cgi according to the instructions online.

In your project folder, create a folder called *buildscripts*

Create a buildfile, called *BuildJavaPlugin.xml* with the following contents:

```
<project name='Compile TEXAS Plugin' basedir='.' default='jar'>

 <target name='compile'>
        <javac srcdir='../src/com/ericsson/mbm/texas/daemon/plugins/'
               destdir='.'
               includes='MyFirstJavaPlugin.java
               classpath='../lib/TexasDaemon.jar'>
        </javac>
 </target>

 <target name='jar' depends='compile'>

        <property name='version.num' value='0.1'/>

        <jar includes='com/ericsson/mbm/texas/daemon/plugins/JavaPlugin.class'
             basedir='.'
             destfile='output/JavaPlugin.jar'>

        <manifest>
               <attribute name='Implementation-Version' value='${version.num}'/>
         </manifest>

         </jar>
  </target>

</project>
```

The script file has two specified *targets:*

- Compile the specified Java file
- Package the class file in a JAR-file.

Please refer to http://ant.apache.org/ for further documentation about the syntax of ant build files.

Execute ant with the buildscript as parameter.

```
C:\SubTests\buildscripts>ant -file BuildJavaPlugin.xml
 -lib .\\lib\\TexasDaemon.jar

Buildfile: BuildJavaPlugin.xml

compile:
    [javac] Compiling 1 source file to C:\SubTests\buildscripts

jar:
      [jar] Building jar:
C:\SubTests\buildscripts\output\MyFirstJavaPlugin.jar

BUILD SUCCESSFUL
Total time: 4 seconds
```

3.4 Deployment

To integrate your newly create plug-in in TEXAS place it in (usually)

C:\Program Files\Ericsson\TEXAS\Daemon\plugins\java

or in Linux

/opt/TEXAS/plugin/java

The file system watcher in TEXAS Daemon should automatically detect the new plugin and load it. A re-connection from TEXAS Manager might be necessary to view the new plugin, alternatively right click the TEXAS Daemon icon and click “Refresh plugins”.

4 Developing a C# Plug-in

This section will describe how to get started with writing C# plug-ins for TEXAS. It assumes you have prior basic knowledge of C# and Microsoft Visual Studio.

Most of the things discussed in previous sections are applicable, but with a slightly different syntax in C#.

4.1 Setting up the environment

Make sure Visual Studio is installed, create a new project and fetch the latest TEXASCSharpWrapper.dll and TEXASCSharpWrapper.xml from ClearCase. Add the DLL file as a project reference by right-clicking *References -> Add Reference…*

4.2 Implementation

4.2.1 Basics

Create a new class in the project, *"CSharpPlugin"*, and put it in namespace `Ericsson.Mbm.Texas.Daemon.SubTests`. Save the C# file in a folder called SubTests.

As mentioned, the class needs to implement the *ISubTestPlugin* interface. It is recommended to extend *SubTestPlugin* to access some helper functions. *SubTestPlugin* implements *ISubTestPlugin*.

Also import `Ericsson.Mbm.Texas.Daemon.CSharpWrapper.TestEntities;` to access needed definitions.

Set the basic attribute settings in the constructor, such as name, description, group and version.

To fulfil the interface we also need to implement a `Run()` method. This method will be called when the plug-in is executed. The semantics of this method will be covered further on.

```
using System;
using System.Collections.Generic;
using System.Text;
using System.Reflection;

// Must be included to access various interfaces
using Ericsson.Mbm.Texas.Daemon.CSharpWrapper.TestEntities;

namespace Ericsson.Mbm.Texas.Daemon.SubTests
{
    // All SubTests needs to extend SubTestPlugin
    public class CSharpPlugin : SubTestPlugin
    {

        public CSharpPlugin() {

            // Name the plug-in
            this.Name = "My First CSharp Plugin";

            // Description
            this.Description = "This test will do almost nothing.";

            // Set the group name
            this.Group = "Dummy tests";

        }

        // This method is executes test code
        public override TestResult Run() {

                return new TestResult(true, "No problems");
        }

```

The above code is enough to get the plug-in running, even if it would be pretty useless.

4.2.2 Adding input parameters

It is possible to specify input parameters to the plug-in in order to control the execution and what data to process inside the run() method.

Input parameters should be specified in the constructor:

```
// Add input parameter with default value
this.AddInputParameter("disp_text", "Display text", "Default value");

// Add input parameters with multiple choosable values
this.AddInputParameter("disp_text_option", "Display text 2",
                              new String[] { "Default value", "Option
                              value #1", "Option value #2" });
```

The first line specifies an input parameter named “disp_text”. The descriptive name shown to the user is “Display text”. The default value of the parameter is “Default value”. If no value is specified by the user, this value will be used.

The second line takes a String array as value option. This means the user will presented with a list of choosable values. The first value in the list is the default one.

Please refer to doxygen? for further details.

4.2.3 Retrieving input parameters

The input parameters can be retrieved inside the run() method.

```
// Retrieve parameters values
String parameter  = this.GetInputParameter("disp_text");
String parameter2 = this.GetInputParameter("disp_text_option");
```

Note that all parameter values are strings. If you want to pass Integers or other data types to the plug-in, do parse the string values after they have been retrieved, for instance by using `Int32.Parse(String stringval)`.

4.2.4 Run method and Test Result

When the input parameters have been retrieved implement your test code. Please comment the code and follow the Ericsson common coding guidelines. (?)

The Run() method must return a TestResult data type. The TestResult specifies the outcome of the test, if the test was successful and also provides a custom message. The default constructor is:

```
TestResult(bool successful, String message)
```

Example:

```
if (parameter.equals("a string value")) {
   return new TestResult(true, "Test executed successfully.");
}

return new TestResult(false, "Test failed duo to incorrect input param");
```

4.2.5 Logging

SubTestPlugin provides the object *logger* of type *TestLogger* which can be called to log events during the test execution. The log prints will be recorded to the test report.

The following levels may be used:

```
logger.Trace(String message);
logger.Debug(String message);
logger.Info(String message);
logger.Warn(String message);
logger.Error(String message);
logger.Fatal(String message);
```

4.2.6 Complete code listing

Now we have a complete runnable SubTestPlugin:

```
using System;
using System.Collections.Generic;
using System.Text;
using System.Reflection;

// Must be included to access various interfaces
using Ericsson.Mbm.Texas.Daemon.CSharpWrapper.TestEntities;

namespace Ericsson.Mbm.Texas.Daemon.SubTests
{
    // All SubTests needs to extend SubTestPlugin
    public class MyFirstCSharpPlugin : SubTestPlugin
    {

        public MyFirstCSharpPlugin() {

            // Name the plug-in
            this.Name = "My First CSharp Plugin";

            // Description
            this.Description = "This test will do almost nothing.";

            // Set the group name
            this.Group = "Dummy tests";

            // Add input parameter with default value
            this.AddInputParameter("disp_text", "Display text",
                                              "Default value");

            // Add input parameters with multiple choosable values
            this.AddInputParameter("disp_text_option", "Display text 2",
                    new String[] { "Default value", "Option value #1",
                                              "Option value #2" });

        }

        // This method is executes test code
        public override TestResult Run() {

            // Retrieve parameters specified in constructor
            String parameter  = this.GetInputParameter("disp_text");
            String parameter2 = this.GetInputParameter("disp_text_option");

            logger.Debug("Retrieved parameter1: " + parameter);
            logger.Debug("Retrieved parameter2: " + parameter2);


            if (parameter.equals("a string value")) {
                 logger.Error("Retrieved parameter2: " + parameter2);
                return new TestResult(true, "Test executed successfully.");
            }

            return new TestResult(false,
                       "Test failed duo to incorrect input param");

        }
    }
}
```

4.3 Compiling & Packaging

The recommended way to build and package a C# plug-in for TEXAS is to use NANT, which is a build tool for C# to compile programs based on XML make files. NANT is the C# equivalent to ANT (for Java).

Install NANT from http://nant.sourceforge.net/ according to the instructions online.

In your project folder, create a folder called *Buildscripts*

Create a buildfile, called *BuildCSharpPlugin.build* with the following contents:

```
<?xml version="1.0"?>
    <project name="" default="build" basedir=".">

        <property name="debug" value="true" overwrite="false" />

        <target name="clean" description="remove all generated files">
            <delete file="Output/CSharpPlugin.dll" failonerror="false" />
        </target>

        <target name="build" description="compiles the source code">
               <csc target="library" output="Output/CSharpPlugin.dll"
                                                                debug="${debug}">
                <sources>
                    <include name="SubTests/CSharpPlugin.cs" />
                </sources>
                <references>
                   <include name="../TEXASCSharpWrapper.dll" />
               </references>
            </csc>
        </target>
    </project>
```

The script file has two specified *targets:*

- Clean the output for any old builds
- Compile the specified C# file to a DLL file.

If you need to link to additional DLLs (such as APIs), include these in the <references> tag.

Please refer to http://nant.sourceforge.net/ for further documentation about the syntax of NANT build files.

Execute Nant with the buildscript as a parameter

```
C:\CSharp SubTests\Buildscripts>nant -buildfile:BuildCSharpPlugin.build
NAnt 0.86 (Build 0.86.2898.0; beta1; 2007-12-08)
Copyright (C) 2001-2007 Gerry Shaw
http://nant.sourceforge.net

Buildfile: file:///C:/CSharp SubTests/BuildCSharpPlugin.build
Target framework: Microsoft .NET Framework 2.0
Target(s) specified: build


build:


BUILD SUCCEEDED

Total time: 0.7 seconds.
```

Behold! Output/CSharpPlugin.dll is created.

4.4 Deployment

To integrate your newly create plug-in in TEXAS place it in (usually)

C:\Program Files\Ericsson\TEXAS\Daemon\plugins\csharp

Place referenced DLLs (such as API) in plugins\csharp\lib\ as these will always be loaded into runtime.

The file system watcher in TEXAS C# Wrapper should automatically detect the new plugin and load it. A re-connection from TEXAS Manager might be necessary to view the new plugin, alternatively right click the TEXAS Daemon icon and click “Refresh plugins”.

9 TEACUP PROTOCOL

Specification of protocol

Protocol for communication between Coordinator and Test Manager

General information

The protocol will be a simple socket protocol that can easily be implemented in any programming language with socket support.

The variable parts of the protocol will be encoded using JavaScript Object Notation (JSON)

JavaScript Object Notation (JSON)

JSON is a very widely used way of encoding simple data for transfer on a network.
It supports five different data types, each encoded differently:

Values:
A *value* can be a *string* in double quotes, or a *number*, or `true` or `false` or `null`, or an *object* or an *array*. These structures can be nested.

Strings:
A *string* is a collection of zero or more Unicode characters, wrapped in double quotes, using backslash escapes. A character is represented as a single character string.

Numbers:
A *number* is very much like a C or Java number, except that the octal and hexadecimal formats are not used.

Arrays:
An *array* is an ordered collection of values. An array begins with `[` (left bracket) and ends with `]` (right bracket). Values are separated by `,` (comma).

Objects:
An *object* is an unordered set of name/value pairs. An object begins with `{` (left brace) and ends with `}` (right brace). Each name is followed by `:` (colon) and the name/value pairs are separated by `,` (comma).

Protocol messages

General information

The protocol will have three message classes. Control messages (CONTROL), status messages (STATUS) and log messages (LOG).

Control

Usage:

The control messages are used when the Coordinator wants to tell the Test Manager what to do.

Message format:

A control message is sent as a JSON object, minimally with a “type” and an “id”. All values are in string format.
Example: `{“type”:”CONTROL”,“id”:”50”,“path_to_test”:”path\to\test.xml”}`

Control message types:

#	Action	Example
0	Query	`{“type”:”CONTROL”,“id”:”0”}`
1	Stop the test suite	`{“type”:”CONTROL”,“id”:”1”}`
2	Start the test suite	`{“type”:”CONTROL”,“id”:”2”}`
3	Pause test suite execution	`{“type”:”CONTROL”,“id”:”3”}`
4	Resume test suite execution	`{“type”:”CONTROL”,“id”:”4”}`
20	Connect	`{“type”:”CONTROL”,“id”:”20”}`
21	Ready to receive	`{“type”:”CONTROL”,“id”:”21”}`
22	Resume result transfer	`{“type”:”CONTROL”,“id”:”22”}`
50	Specify path to test file	`{“type”:”CONTROL”,“id”:”50”, “path_to_test”:”path\to\test.xml”}`
51	Specify path to package (Specify path to driver file and path to branding sheet file)	`{“type”:”CONTROL”,“id”:”51”, “path_to_package”:”path\to\package.xml”}`
52[1]	Specify asset configuration	`{“type”:”CONTROL”,“id”:”52”, “manufacturer”:”Dell”, “architecture”:”32”, “os”: “Ms_Windows_Vista”, “sp”:”1”}`

Additional Control messages: Daemon and the Test Manager.

5	Execute Test Suite	`{“type”:”CONTROL”,”id”:”5”,”file”:”XML-ENCODED-TEST-FILE”}`
6	Execute Test Case	`{“type”:”CONTROL”,”id”:”6”,”file”:”XML-ENCODED-TEST-FILE”}`
7	Execute Sub Test (On daemon or C# wrapper)	`{“type”:”CONTROL”,”id”:”7”,”file”:”XML-ENCODED-TEST-FILE”}`
10	Register listener (Register listener so the Daemon knows where the messages	`{“type”:”CONTROL”,”id”:”10”,”port”:”50000”`

[1] The configuration message includes all information about the asset that are currently stored in the Time database.

	should be sent.)	
11	Unregister listener (Stop listening to messages)	`{“type”:”CONTROL”,”id”:”11”}`
16	Binary File transfer (Tell daemon to get the specified file from the manager)	`{“type”:”CONTROL”,”id”:”15”,”file”:”name”,”size”:”value”}`

Additional Control messages: C# Wrapper and Daemon.

17	Remote Execution	`{“type”:”CONTROL”,”id”:”17”,”path”:”C:\\file.exe”,”args”:”/s /v\”/qn\””}`

Status

Usage:

The status messages are used when the Test Manager wants to tell the Coordinator what the status of a test execution is.

Message format:

A status message is sent as a JSON object, minimally with a “type” and an “id”. All values are in string format.

Example: `{“type”:”STATUS”,“id”:”75”,“reason”:”Deploying ghost image”}`

Status message types:

#	Action	Example
0	Query	`{“type”:”STATUS”,“id”:”0”}`
1	TM ready	`{“type”:”STATUS”,“id”:”1”}`
2	TM not ready	`{“type”:”STATUS”,“id”:”2”}`
3	TM setting up test suite	`{“type”:”STATUS”,“id”:”3”}`
4	Executing test	`{“type”:”STATUS”,“id”:”4”}`
5	Executing sub test	`{“type”:”STATUS”,“id”:”5”}`
6	DUT ready	`{“type”:”STATUS”,“id”:”6”}`
50	Test completed	`{“type”:”STATUS”,“id”:”50”,“name”:”Name”,”result”:”Pass”,”execution_time”:”Time”}`
51	Test suite completed	`{“type”:”STATUS”,“id”:”51”,“name”:”Name”,”result”:”Pass”,”execution_time”:”Time”}`
52	Test case completed	`{“type”:”STATUS”,“id”:”52”,“name”:”Name”,”result”:”Pass”,”execution_time”:”Time”}`
53	Sub test completed	`{“type”:”STATUS”,“id”:”53”,“name”:”Name”,”result”:”Pass”,”execution_time”:”Time”,”message”:”Message”}`
75	Planned outage (the DUT will be unreachable for a while)	`{“type”:”STATUS”,“id”:”75”,“reason”:”Deploying ghost image”}`
96	Critical failure	`{“type”:”STATUS”,“id”:”96”, “reason”:”Daemon is unreachable”}`

97	DUT busy (someone is already running a test on this DUT)	`{“type”:”STATUS”,“id”:”97”, “reason”:”The system is already executing a test, your test has been postponed”}`
98	Test aborted (by the user executing the test)	`{“type”:”STATUS”,“id”:”98”,“reason”:”Test aborted by user”}`
99	Test execution failed (the test execution was aborted because the DUT crashed (or similar)	`{“type”:”STATUS”,“id”:”99”,“reason”:”System has been unresponsive for 24 hrs, aborting test”}`

Additional Status messages: Daemon and the Test Manager.

40	Test Started	`{“type”:”STATUS”,”id”:”40”}`
41	Test Suite Started	`{“type”:”STATUS”,”id”:”41”}`
42	Test Case Started	`{“type”:”STATUS”,”id”:”42”}`
43	Sub Test Started	`{“type”:”STATUS”,”id”:”43”}`
150	Daemon queries the manager if it should continue the execution or if a control message has been sent to the manager.	`{“type”:”STATUS”,”id”:”150”}`

Info

Usage:

The info messages are used when a application wants to know a certain state.

Message format:

A info message is sent as a JSON object, minimally with a “type” and an “id”. All values are in string format.

Example: `{“type”:”INFO”,“id”:”1”,”state”:”RUNNING|IDLE|STOPPED”}`
`WE`

Info messages

0	Query Execution State	`{“type”:”INFO”,“id”:”0”}`
1	Execution State	`{“type”:”INFO”,“id”:”1”,”state”:”RUNNING|IDLE|STOPPED”}`
2	Query Plugins	`{“type”:”INFO”,“id”:”2”}`
3	Available Plugins	`{“type”:”INFO”,“id”:”3”,”pluginlist”:”XML-FILE-STRING”}`
4	Query Current Session	`{“type”:”INFO”,“id”:”4”}`
5	Current Session	`{“type”:”INFO”,“id”:”5”,”session”:”XMLS-FILE-STRING”}`

Log

Usage:

The log messages are used when the Test Manager wants to log the progress of a test to the Coordinator.

Message format:

A log message is sent as a JSON object, minimally with a “type” and an “id”. All values are in string format.
Example: `{“type”:”LOG”,“id”:”2,”message”:”Rebooting to deploy a ghost image”}`

Log severity levels:

#	Severity
0	Critical
1	Error
2	Warn
3	Info
4	Verbose
5	Debug